Portland Protected Bicycle Lane Planning and Design Guide

PBOT
PORTLAND BUREAU OF TRANSPORTATION

PORTLAND CITY COUNCIL

PROJECT TEAM

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Contents

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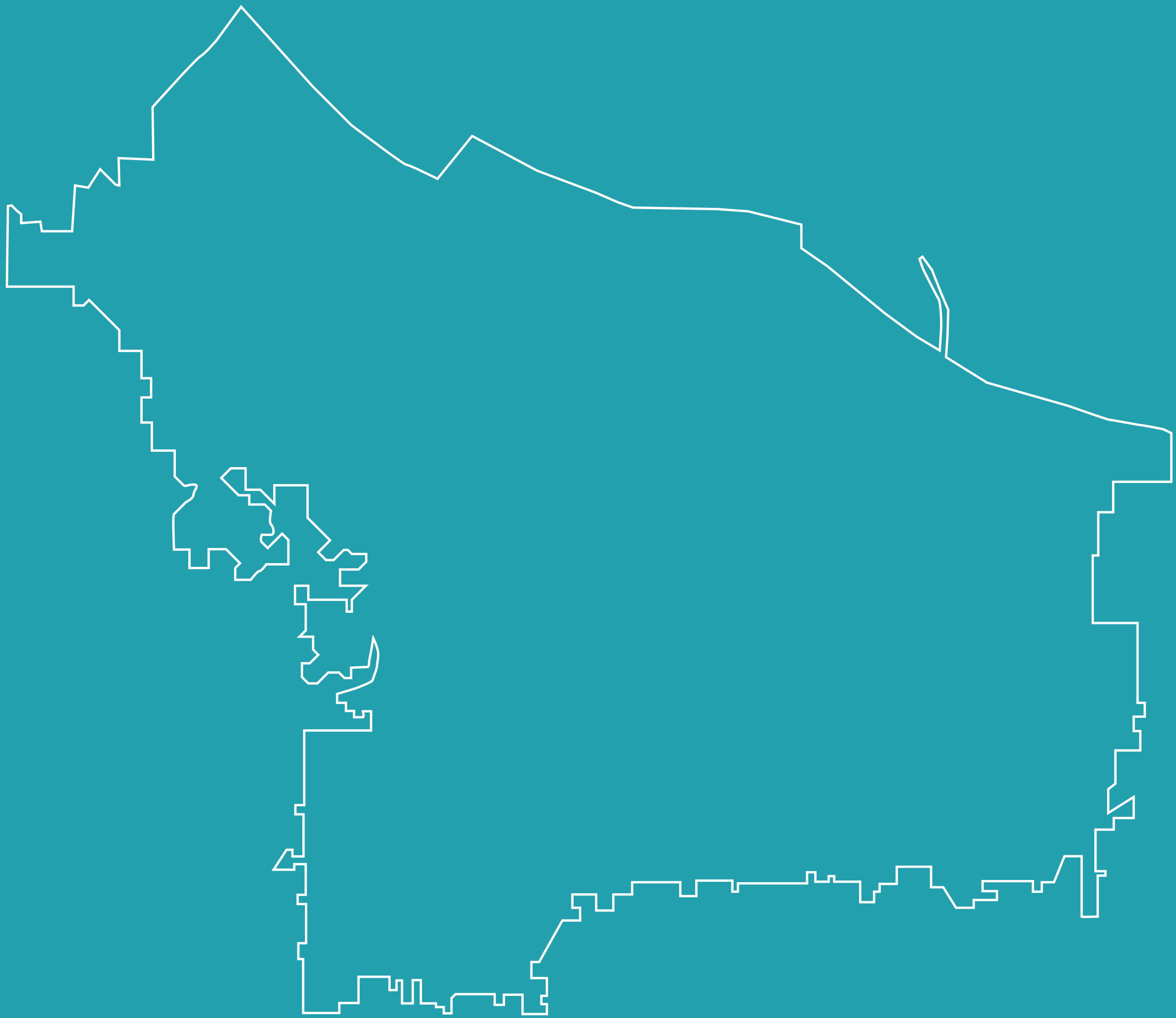


SECTION ONE

Introduction

This guide is developed to provide planners, engineers and project managers the tools necessary to implement a protected bikeway network in Portland. This is in support of Portland's goals, policies and objectives. Portland desires an automotive mode split of 30% by 2030 to meet County-wide climate change goals and to maintain Portland as a livable city. Retrofitting Portland's streets to provide safer and more comfortable conditions for bicycling is a key strategy in achieving both those goals and our Vision Zero goal for safety. Providing protected bicycle lanes aligns with the intent of City Policies 9.20 and 9.21, which call for making bicycling more attractive than driving for most short trips and to do so by creating a bicycle transportation system that is safe, comfortable and accessible to people of all ages and abilities.[1] It is also a key element of achieving Policy 9.6 (Transportation Strategy for People Movement), which directs the city to prioritize walking and bicycling—in that order—above all other means of personal transportation.

The intent of the designs in this guide is to quickly and emphatically reconfigure Portland's streets, not just so they operate in a safe manner, but also to communicate that bicycling is more attractive than driving and that bicycle transportation is accessible to people of all ages and abilities.

Portland's bicycle transportation network includes approximately 998 miles of roadways classified as either "City Bikeway" or "Major City Bikeway." *Portland's Bicycle Plan for 2030* and recent updates to Portland's Transportation System Plan identified 493 miles of bikeways as likely needing separation between motor vehicles and people bicycling.[2] *Portland's Transportation System Plan* includes the following guidance for how to improve such roadways:

> Major City Bikeways should be designed to accommodate large volumes of bicyclists, to maximize their comfort and to minimize delays by emphasizing the movement of bicycles. Build the highest quality bikeway facilities.[3]

Numerous studies from around the world, as well as our experience and the experience of cities with which we are allied through the *National Association of City Transportation Officials (NACTO),* have confirmed that providing protected bicycle lanes on busy streets is a key element to addressing the demand for better conditions for bicycle transportation. Such facilities are the highest quality bikeways and are appropriate on roadways that include higher motor vehicle speeds and volumes.

This guide is a culmination of an effort that began in October 2015 when then Portland Bureau of Transportation (PBOT) Director Leah Treat stated in an email to staff that, to achieve our policy goals protected bicycle lanes are to be Portland's preferred design where separation is appropriate. In her message, she stated: **"I am asking our engineers, project managers and planners to make protected bicycle lanes the preferred design on roadways where separation is called for. I am asking for this design standard for retrofits of existing roadways as well as to new construction. I want protected bikeways to be considered on every project where some type of separation is desired."**

PBOT has since made significant advances to provide protected bicycle lanes. Many miles of protected bicycle lanes have been either implemented or are funded. Design and project personnel from PBOT, BES, Fire Bureau, and BPS attended a week-long workshop to discuss and address barriers to protected bicycle lane implementation. The guidance in this document

[1] Policy 9.20, Bicycle transportation, states: Create conditions that make bicycling more attractive than driving for most trips of approximately three miles or less. Policy 9.21, Accessible bicycle system, states: Create a bicycle transportation system that is safe, comfortable, and accessible to people of all ages and abilities.

[2] The need for separation is determined by the operating conditions on the roadway. Figure 17, found at the beginning of Section 3 of this guide, identifies the conditions under which separation needs to be provided.

[3] Transportation System Plan Objective 9.5.a (Major City Bikeways) and Objective 9.5.b (City Bikeways) are comparable: "City Bikeways emphasize the movement of bicycles. Build the highest quality bikeways facilities."

builds off that previous progress toward making protected bicycle lanes the City's standard for retrofitting roadways where some type of separation is required.

This guide is also intended to provide more standardization when creating protected bicycle lanes. To date, designs for the existing protected bicycle lanes have been almost all unique. With few exceptions, no two segments are alike. By providing clear choices among a defined range of designs, this guide is intended to help address questions such as "how should it be built?" and "what materials should be used?"

Reconfiguring roadways for protected bicycle lanes generally means more space for bicycling and less space permanently dedicated to other functional needs of the right-of-way, such as the moving and/or parking of motor vehicles. This guide describes the designs that will fit within the street and highlights the trade-offs associated with implementation.

The dimensions presented for protected lanes in this guide have been vetted by Portland's City Traffic Engineer and other engineering staff. The dimensions were developed based on the safety and comfort for people bicycling and people driving on Portland streets. This guide addresses several key questions:

What types of protected bicycle lanes can we build?

This guide identifies seven categories of protected bicycle lanes: from the simplest delineator-separated bicycle lanes to sidewalk-level protected bicycle lanes. Six of these categories of protected bicycle lanes are the principal focus of this guide and are intended to be installed as part of retrofit projects of Portland roadways. The strategy is focused on retrofits for one principal reason: cost. Project funding is rarely available to reconstruct roadways with an integrated protected bicycle lane. Even when such funding is available, it is usually only in an amount that allows for the reconstruction of one corridor or segment at a time. Because the need to provide physically separated bicycle lanes is great, and because funding levels are generally low, for the foreseeable future most projects will address the retrofitting of Portland's roadways using paint, temporary features, and occasionally permanent features to create physically separated bicycle lanes.

This is not dissimilar to development projects, which also face constrained budgets and have scopes limited to short frontages. Nonetheless, this guide spells out the space requirements to be provided by development projects to build protected bicycle lanes for their frontages on streets requiring them. Each of these six categories displays up to five designs dimensioned to different widths. The intent is to show the full range of riding and buffer widths available within each category. In all, this guide displays twenty-eight different dimensioned drawings for protected bicycle lanes.

How will these designs fit on Portland roadways?

There are approximately 460 centerline miles[4] of Portland streets identified for "separated in-roadway" bicycle lanes.[5] **Figure 18** (page 37) and **Figure 19** (page 71) show the miles by width of both two- and one-way roadways identified for separated treatment. **Section Three** (page 35) of this guide shows a sample of designs recommended for the more common width roadways. Accompanying

[4] Much of the subsequent analysis of roadways in this guide is based on PBOT's pavement layer GIS shapefile. Because of gaps in that layer, it shows only 460 miles of the 493 miles identified elsewhere. Thus, from this point forward the analysis of roadways uses the 460-mile figure.

[5] The term "separated in-roadway" describes a bicycle network treatment ranging from standard bicycle lane, to buffered bicycle lane to raised lane to protected lane. The unifying concept is that traffic conditions are such that some level of separation within the right-of-way is required.

tables in **Appendix C** show precisely how each of the twenty-eight detailed designs can fit on one-way or two-way roadways of various widths. As such, this guide not only provides design guidance for planners and engineers for roadway projects, but also identifies the space requirements that shall be provided along the street frontage of all development projects where protected bicycle lanes are planned. Which streets require protected bicycle lanes is determined through Portland's bicycle transportation classifications and the contextual guidance provided in this guide, as well as through project development and public outreach as part of funded capital or corridor planning projects.[6]

What will it cost to retrofit Portland's roadways?

Appendix B provides planning-level estimates of the construction costs associated with retrofitting common width roadways to include any of the six types of protected bicycle lanes. All costs are in 2018 dollars. The cost is dependent on the following elements:

- Type of protected treatment and the cost of the barrier.
- Need to remove existing roadway striping before re-striping. This, in turn, is dependent on whether the design produces a symmetric roadway cross-section.
- Need to reconfigure traffic signals and automobile and bicycle detection with the retrofit.[7]

Estimated construction costs range from $73,000 per mile for providing parking-protected bicycle lanes on one-way roadways to $1.1 million per mile to implement a five-lane to three-lane roadway reconfiguration with concrete islands on a two-way street.[8]

Photo: Toole Design Group

[6] Portland streets classified as either City Bikeway or Major City Bikeway are where Portland by policy will focus its development of bikeways. Contextual Guidance is provided by the National Association of City Transportation Officials (NACTO) "Designing for All Ages & Abilities Contextual Guidance for High-Comfort Bicycle Facilities," The key table from that guide is reproduced here as Figure 17.

[7.] See Section 3 ("Representative Graphics") for additional narrative about potential impacts associated with changes to traffic signals.

[8.] Costs assume removing existing lane striping and re-striping as part of implementation. Costs are for the basic bikeway elements discussed in this guide. They do not include transit islands, green surface treatments, intersection treatments or any other element that may be included with a roadway project.


Photo: City of Portland

What are the implications of these designs for City and other operations in terms of:

- Maintenance: Work is ongoing to identify a maintenance vehicle that can sweep the narrowest widths (5 feet) identified in this guide. Other maintenance issues will include replacing and maintaining the elements of the protected bicycle lane barriers, which range from temporary (delineator posts) to permanent (poured concrete islands).
- Mail delivery
- Garbage, recycling and compost collection
- Service vehicle deliveries
- On-street parking

To address these questions fully, this guide is organized into the following five sections:

1) Introduction

2) Portland Protected Bicycle Lane Designs

Detailed information about the protected bicycle lane retrofit designs to be used on Portland streets.

3) Applying Protected Bicycle Lane Designs to Portland Streets

Demonstrating how designs could fit on Portland's most common width roadways. Shows all roadways of specific widths slated for protected bicycle lane designs.

4) Protected Bicycle Lane Design Elements and Considerations

Provides additional detail about considerations for design selection and additional design details.

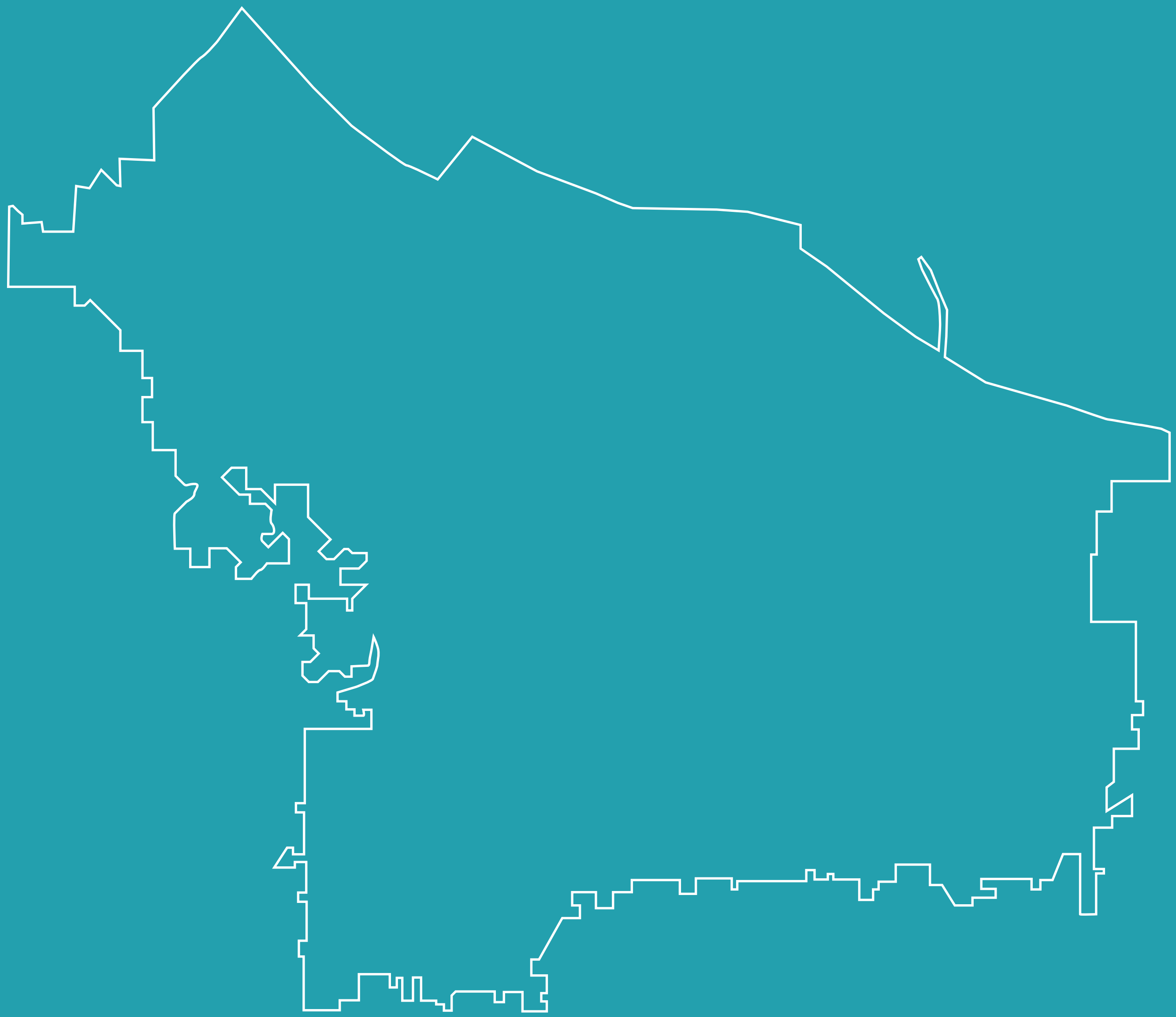
5) Appendices

Appendix A discusses the potential impact to on-street parking. **Appendix B** provides per mile construction and project cost estimates for implementing the different designs on Portland streets. **Appendix C** provides a series of tables showing which of the twenty-eight designs in this guide can fit on the common width roadways.

This guide does not address designs for intersections (including driveways), and only superficially addresses designs to accommodate transit, disabled parking, curbside loading and other considerations for curbside access. Nonetheless, these issues must be considered from the beginning of the planning and design process to inform the facility selection and elements of design. Designs for these specific elements are continuing to evolve, with current best practice design captured in guidance provided by *NACTO: Urban Bikeway Design Guide and Transit Street Design Guide, the FHWA: Separated Bicycle Lane Planning and Design Guide*, and individual state guidance (notably the *MassDOT Separated Bike Lane Planning & Design Guide*). Portland's own experience with these designs, as well as continuing national research into best practice, will continue to inform Portland's efforts.

November 2018

Photo: Toole Design Group



SECTION TWO

Portland Protected Bicycle Lane Designs Principles and Considerations

The Federal Highway Administration (FHWA) defines a protected bicycle lane as "an exclusive facility for bicyclists that is located within or directly adjacent to the roadway and that is physically separated from motor vehicle traffic with a vertical element".

This guide notably borrows from the *FHWA Separated Bicycle Lane Planning and Design Guide,* as well as from the *NACTO Urban Bikeway Design Guide,* from the *MassDOT Separated Bike Lane Planning & Design Guide,* as well as from local experience implementing protected bicycle lanes on Portland streets. Portland's bikeway designers and engineers are still expected to refer to these and other guides, as well as to their own experience to address the many details that contribute to a successful bikeway design.

Protected bicycle lane retrofit designs will fall into six categories on Portland roadways:[9]

- Parking-protected
- Parking-protected with delineators
- Delineator-protected
- Traffic separator-protected
- Planter-protected, and
- Concrete island-protected

The focus is on retrofit designs because the opportunities for significant roadway reconstruction that can produce permanent, hardscaped or landscaped protected bicycle lanes are limited. Where permanent protected bicycle lanes are provided, a sidewalk-level protected bicycle lane is Portland's preferred design for capital projects for new construction or reconstruction. The design, shown in **Figure 1**, offers significant flexibility for incorporating surface and subsurface stormwater treatments, providing for transit stops and service vehicles, including trees, and incorporating

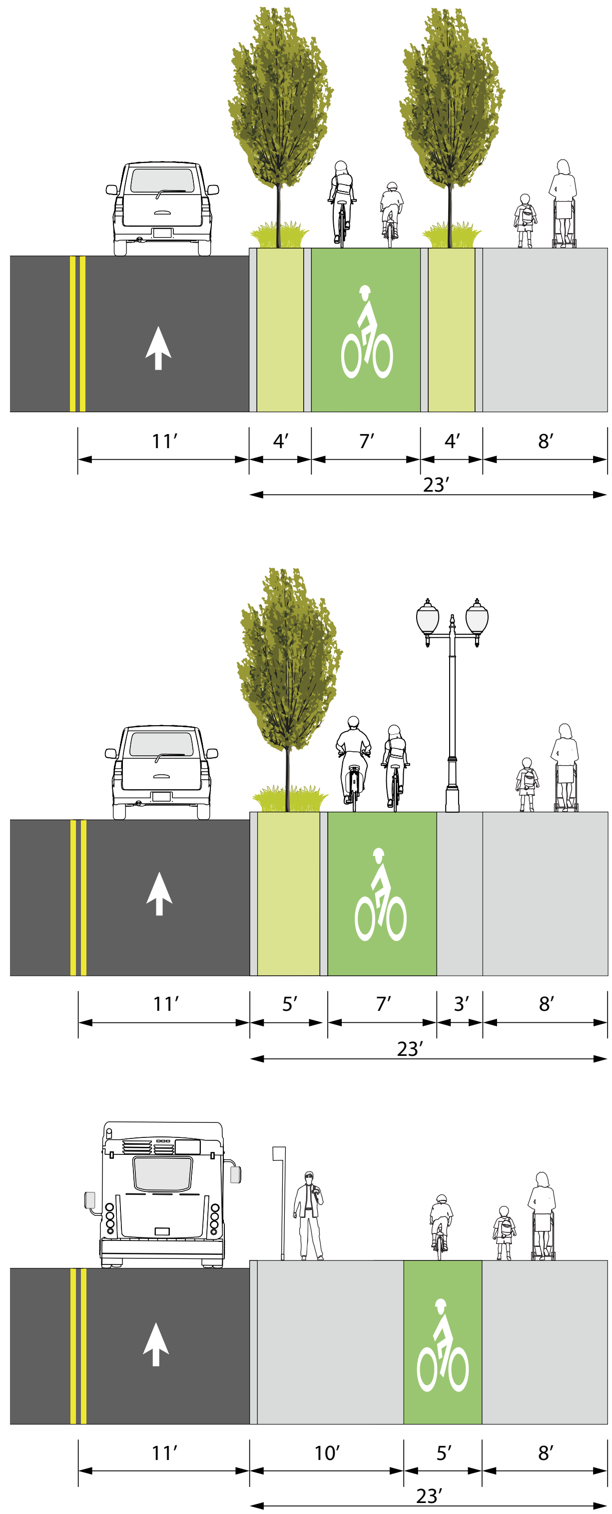


Figure 1. PBOT's preferred design for a sidewalk-level protected bicycle lane. This figure demonstrates the flexibility of this design. This design requires 18-23 feet behind the curb. Specific dimension of each zone can vary based on the context of the location and available width.

9 The twenty-eight designs show a range of dimensions using different types of barriers. Designs can be slightly modified within the continuum of widths shown for each class of protected bicycle lane.

driveways all while creating high-quality protected bicycle lanes and walkways for people bicycling and walking.[10]

The twenty-eight designs on the following pages display three critical dimensions: travel lane, width required outside of the travel lane (sum of the widths of the bicycling zone and buffer zone) and sweeping access width (distance from the curb to the vertical barrier). The designs all assume 10-foot -wide travel lanes; where necessary the designs incorporate one foot of shy distance between the travel lane and the vertical buffer element.[11] Design elements can of course be modified; thus, there are more than twenty-eight possible designs.

The bicycle lane designs and calculation of available widths—especially for sweeping—are based on the diagram shown in **Figure 2**. This diagram identifies the component parts of a retrofit protected bicycle lane design, including the critical dimension for sweeping.

This guide discusses one-way directional bicycle lanes only (i.e., bicycle lanes on each side of a two-way roadway proceeding in the direction of traffic and one-way bicycle lanes on one-way streets), as they are the preferred design. Portland has, and will continue to implement, two-way bicycle lanes on one side of a roadway where conditions are appropriate. Because there are many fewer opportunities and appropriate context for two-way bicycle lanes than for one-way directional bicycle lanes, and because each two-way bicycle lane requires careful consideration of the often-unique circumstances found on the design roadway, designers should use the tools found in this guide to assist in the design of two-way bicycle lanes after first ensuring the design is appropriate for the location.

The following designs are intended to be relatively interchangeable. When comparing designs across different bicycle lane types, it is useful to look at the dimension labeled "Width required outside of travel lane." When those widths are the same across designs, then the barrier used can be easily interchanged.

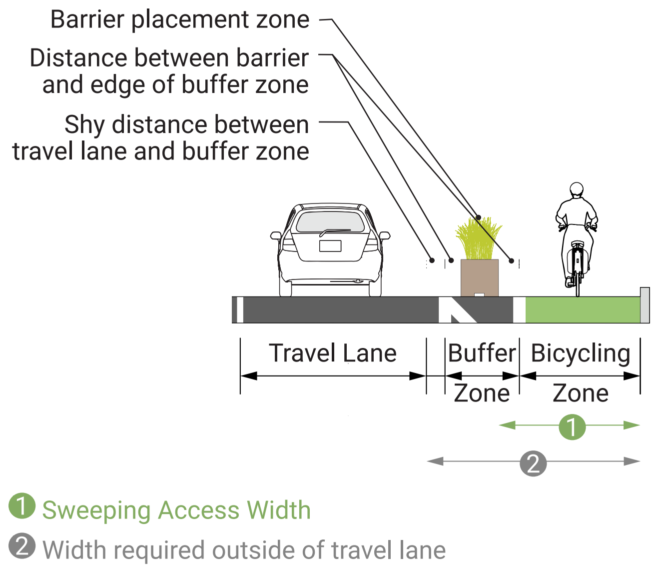


Figure 2. Diagram showing the component parts of the retrofit protected bicycle lane designs.

10 As of October 2017, the city has several projects that are building sidewalk-level protected bikeways. They are: NE 47th Avenue (LID), NW 20th Avenue (LID), SW Bond Avenue (development requirement), SW Capitol Hwy (regionally funded). All told, these four projects will produce approximately two miles of this facility type. Another six miles are funded and will be constructed using the retrofit designs developed for this guide.

11 The 10-foot travel lane width is based on several factors. Principal among them is the December 7, 2015 memo from Portland's City Engineer regarding Motor Vehicle Lane Widths. That memo defines 10 feet to be "the new preferred lane width" for Portland roadways with lane markings. This memo is based on a body of research indicating that 10- foot travel lanes operate safely (notably Potts, Ingrid, Harwood, Douglas and Richard, Karen, "Relationship of Lane Width to Safety for Urban and Suburban Arterials, TRB 2007 Annual Meeting). This research was codified in NCHRP Report 783: "***Evaluation of the 13 Controlling Criteria for Geometric Design***", published by the Transportation Research Board in 2014. That report noted "no documented relationships that indicate an effect of lane width on crash frequency for urban and suburban arterials…" and noted that "***The Green Book*** provides substantial flexibility in choosing among 10-, 11-, and 12-foot lanes for urban and suburban arterials." It goes on to say that "Using narrower lanes on urban and suburban arterials can provide space for incorporation of other features that are positive for operations and safety including medians, turn lanes, bicycle lanes,…" This is the approach taken in this guide—to start with 10-foot travel lanes to provide bicycle facilities consistent with the City's policies.

Finally, the NCHRP report continues to say that "This is not intended to imply that lane widths are not an important consideration in the design of urban and suburban arterials, or that any lane width can be used at any location, but rather that lane widths should be selected on a location-by-location basis to complement the other selected features of the roadway cross section within the available cross-section width." Most designs in this guide allow for the creation of greater than 10-foot travel lanes where justified.

Parking Protected Lanes

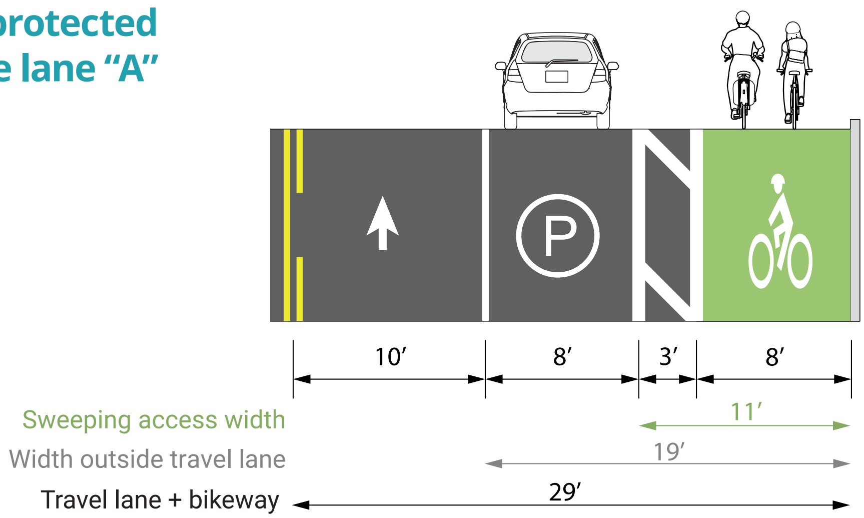
Using parked cars as the physical barrier between people bicycling and general-purpose travel lanes will allow for the retention of as much on-street parking as feasible. Portland's guidance is to remove on-street parking sixty-feet (60') in advance of intersections and major commercial driveways and twenty-feet (20') in advance of residential and other minor driveways.

The standard width for the buffer is three feet. The buffer may go to a minimum 2.5' wide.

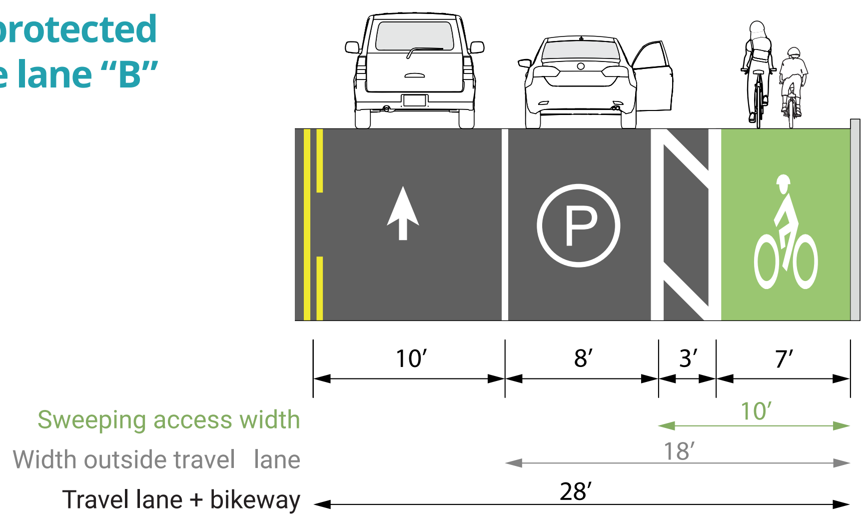
Consideration should be given to maintaining sufficient width in the bicycling zone to allow side-by-side riding and passing. This is especially important in areas with expected high volumes of bicycle use. To be avoided is creating a design in which side-by-side riding or passing necessarily occurs within the buffer zone as this is the area into which car doors will open. A narrow bicycling zone, as shown in option "E", below, is permissible under conditions where peak hour bicycling volumes are not expected to be high or for short stretches when addressing narrow points in a roadway.

Design "B" is the original protected bicycle lane design as employed in 2009 on SW Broadway adjacent to Portland State University campus. Option E is the design employed on SW Halsey and Weidler in the Halsey-Weidler commercial district.

Parking protected bicycle lane "A"

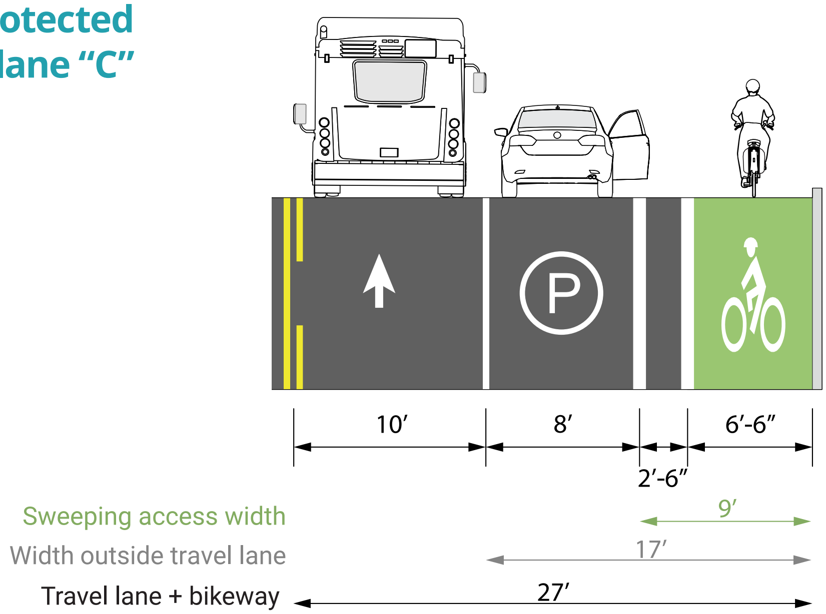


Parking protected bicycle lane "B"

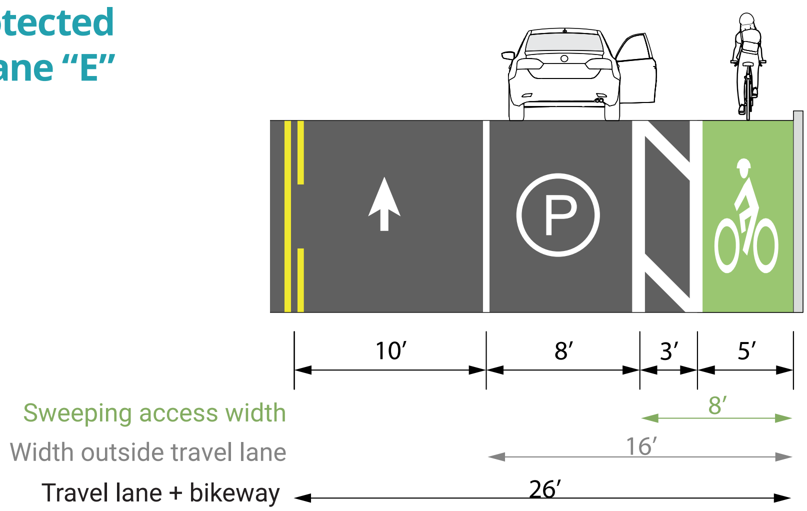


Parking Protected Lanes

Parking protected bicycle lane "C"



Parking protected bicycle lane "E"



Parking Protected Lanes With Delineator Posts

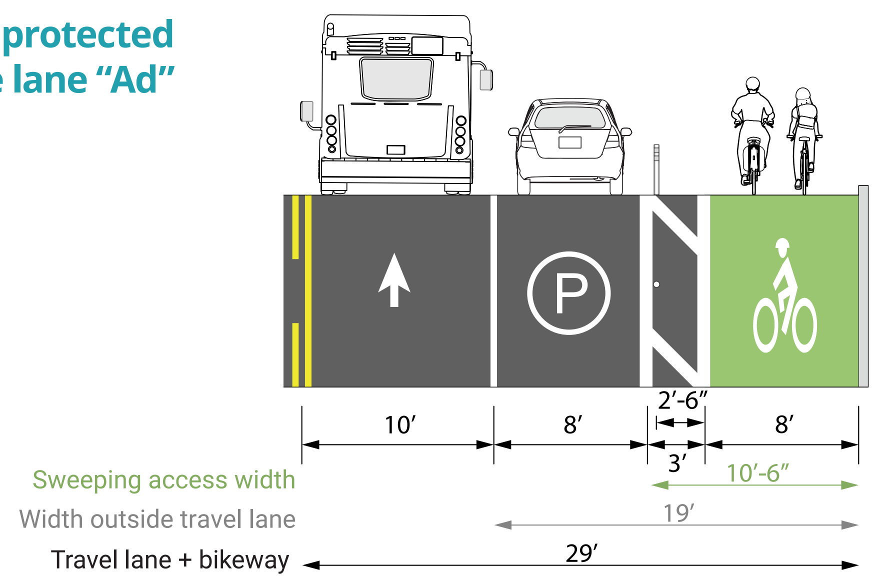
It is useful to implement delineator posts when parking utilization is sufficiently low that long stretches of the “protected” lane operationally function as a buffered bicycle lane and/or when people regularly park cars in a manner that intrudes into the buffer zone. When used with on-street parking, delineator posts should be spaced approximately every twenty feet and should be centered one-half foot (six inches) from the stripe defining the outside edge of the parking space.

Parking-protected bicycle lanes provide protection only when parking utilization is relatively high. If parking use is not sufficiently high at all times then, adding delineator posts in the buffer zone maintains a consistent vertical barrier. “At all times” includes during the daytime in residential areas and late at night in commercial areas.

Also at issue is the accuracy with which people park their automobiles. On some parking protected lanes those parking are able to do so with high accuracy and remain outside the buffer area. In other locations, people park in a manner that intrudes into the buffer area. If intrusion in to the buffer is a problem then, use delineator posts to enforce good positioning of the parked cars.

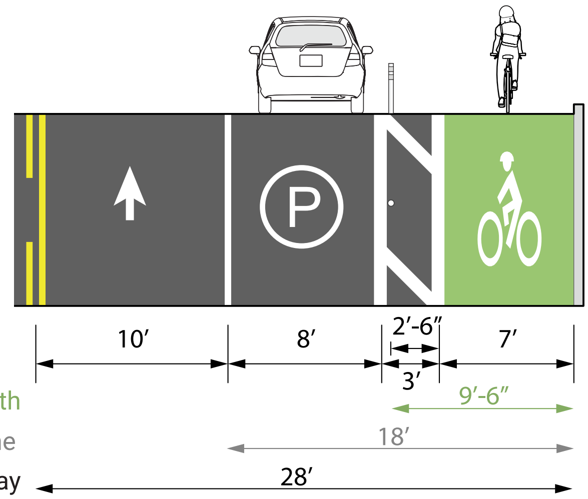
Delineator posts can also be used to place parking-related signs. When intended for that purpose posts should be sixty inches (60”) tall. Otherwise, the posts used as a barrier, only are thirty-six inches (36”) tall.

Parking protected bicycle lane “Ad”

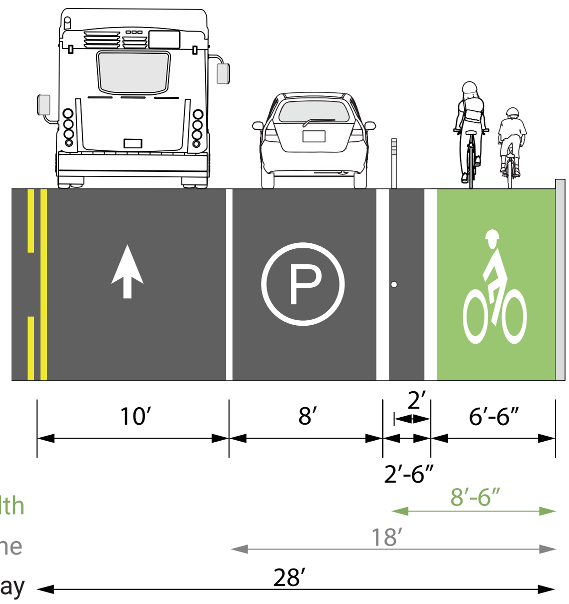


Parking Protected Lanes With Delineator Posts

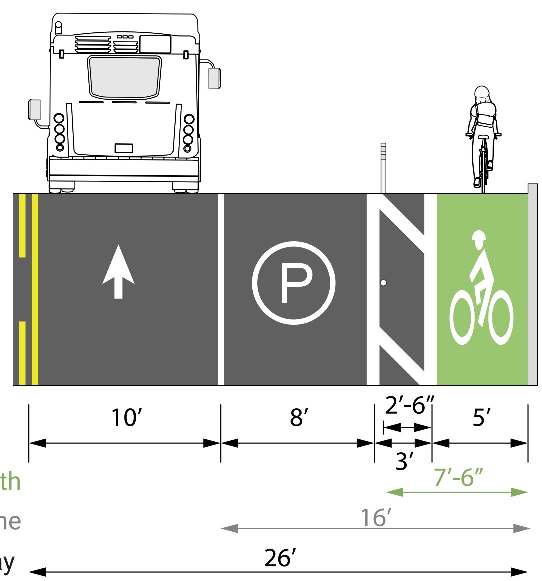
Parking protected bicycle lane "Bd"



Parking protected bicycle lane "Cd"



Parking protected bicycle lane "Ed"



Delineator Post Protected Lanes

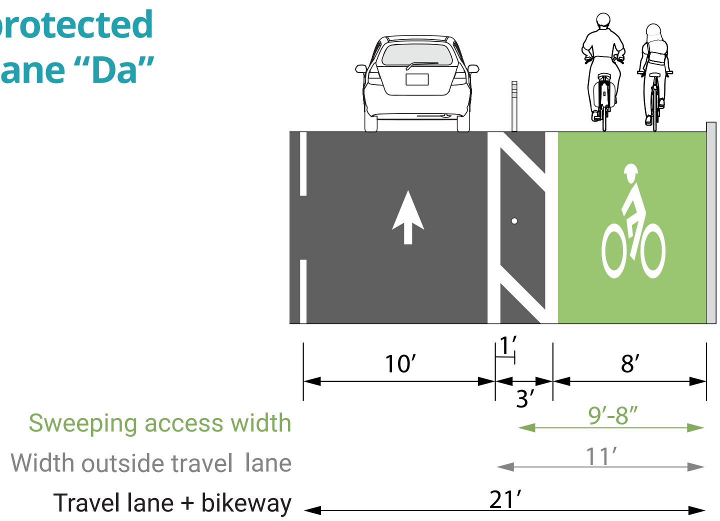
As with parking protected lanes, delineator post protected lanes are a relatively inexpensive means to create protected bicycling space. Delineator posts should be centered one-foot from the outside of the desired width travel lane. This creates the desired one-foot shy distance between the travel lane and the vertical barrier.

With no concern about opening car doors as with the parking protected lanes the buffer zone can go to a minimum width of one-and-a-half feet (1.5'). That width still allows the placement of a barrier outside of the riding zone and one-feet from the travel lane.

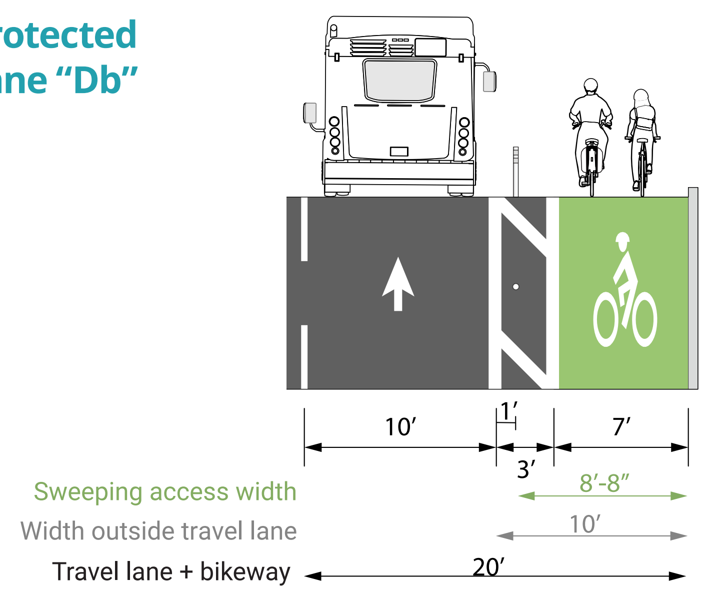
A common spacing for delineator posts is twenty-feet (20') on center. Closer spacing, going to as narrow as ten feet increases cost but, also creates a stronger visual barrier.

One issue with delineator posts is the need for frequent maintenance. Some installations seemingly require little maintenance while other locations appear to need weekly repair to address posts that have been knocked down.

Delineator post protected bicycle lane "Da"

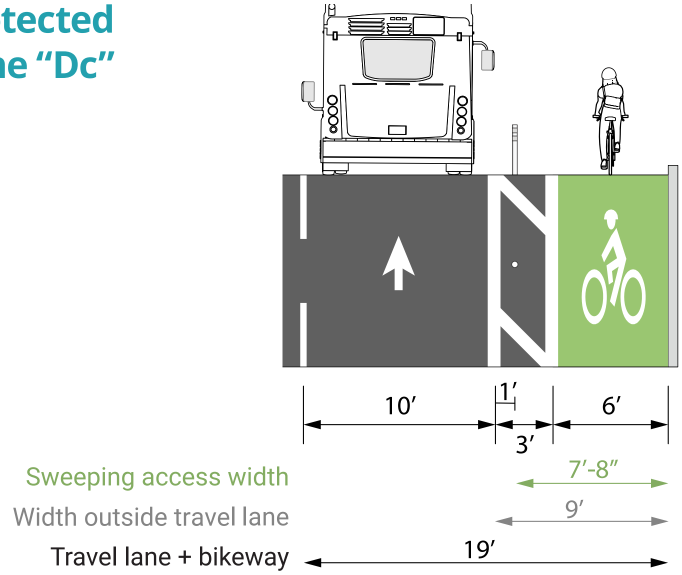


Delineator post protected bicycle lane "Db"

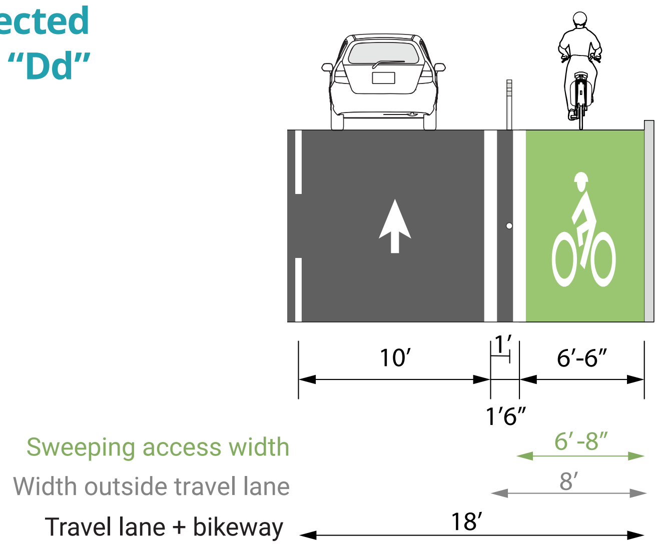


Delineator Post Protected Lanes

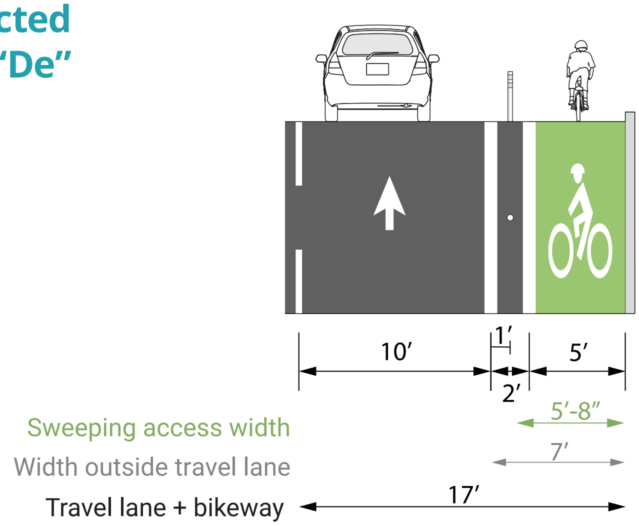
Delineator post protected bicycle lane "Dc"



Delineator post protected bicycle lane "Dd"



Delineator post protected bicycle lane "De"



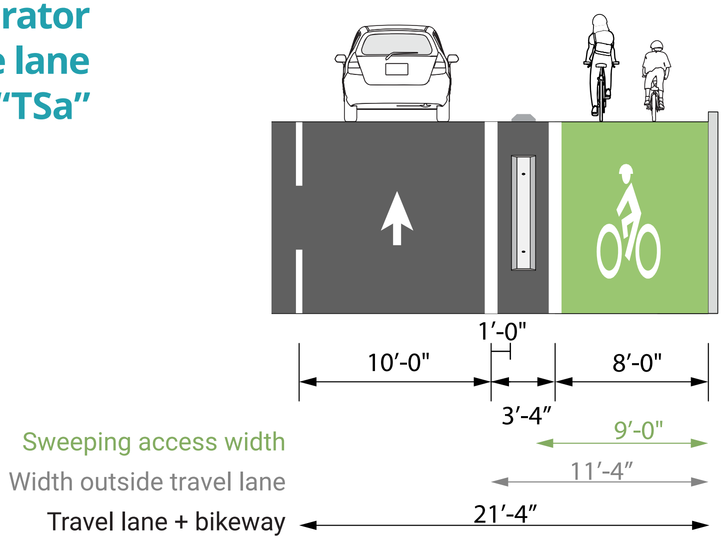
Traffic Separator Protected Lanes

Standard traffic separators are four inches (4”) tall, can be either sixteen or twenty-four inches wide (16” or 24”) and are generally cast-in-place in lengths of twenty-four feet (24’). They are a significant cost step up from delineator posts, incurring between three to four times more construction costs. However, because they require less maintenance they may offer a better life-cycle cost compared to delineator posts.

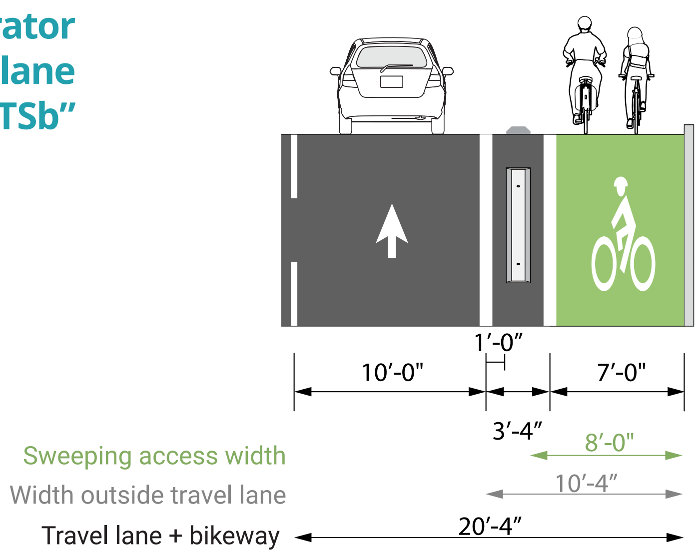
Because of their solidity and permanence, traffic separators may be seen as providing a higher level of comfort than delineator posts. They are also considered more visually appealing. The attractiveness of a facility is always a consideration, especially in residential and commercial areas.

As with other vertical elements, it is necessary to maintain a one-foot (1’) shy distance between the edge of the separator and travel lane.

Traffic separator protected bicycle lane “TSa”

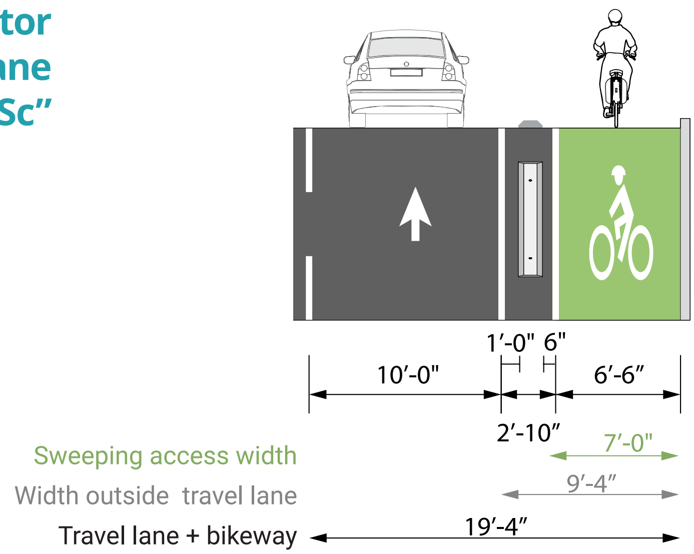


Traffic separator protected bicycle lane “TSb”

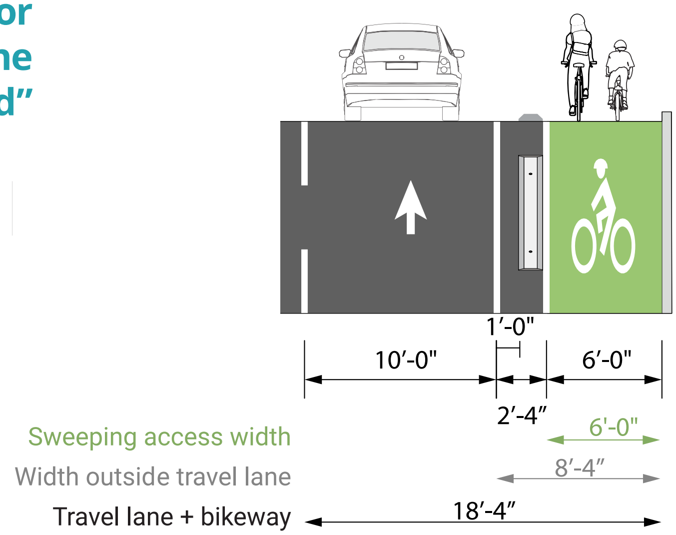


Traffic Separator Protected Lanes

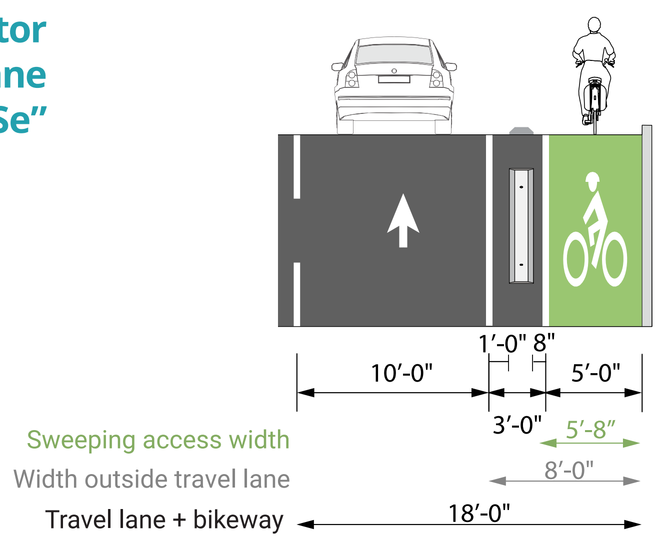
Traffic separator protected bicycle lane "TSc"



Traffic separator protected bicycle lane "TSd"



Traffic separator protected bicycle lane "TSe"



Concrete Island Protected Lanes

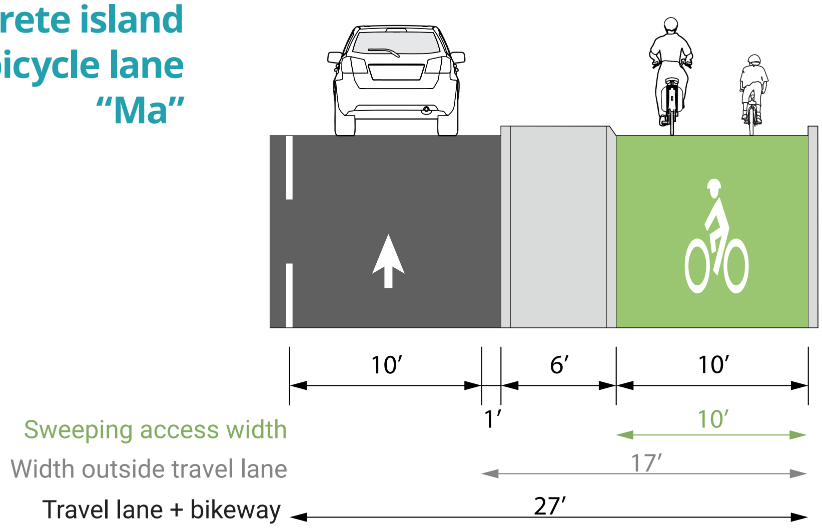
Concrete island protected lanes are the most expensive retrofit designs in this guide. They are the most permanent of protective elements, especially if formed below the roadway surface as opposed to being doweled in. These can be employed along an entire corridor or at intersection approaches. With wide buffer areas they can run seamlessly into features that create a protected intersection.

If the pavement quality of the area to be designated for the bicycling zone is low (PCI< 70) then, the pavement in that area should be improved before installing the barrier.

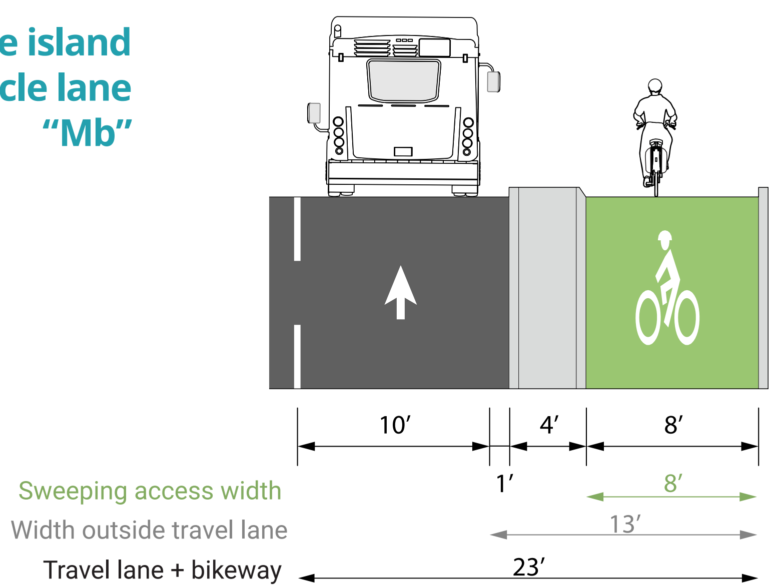
Concrete islands should be considered when there is consistent demand for service access to a curb, as with rural mail delivery or residential garbage collection. A wide concrete median can facilitate both.

As with all vertical elements, it is necessary to maintain a one-foot (1’) shy distance between the edge of the separator and travel lane.

Concrete island protected bicycle lane “Ma”

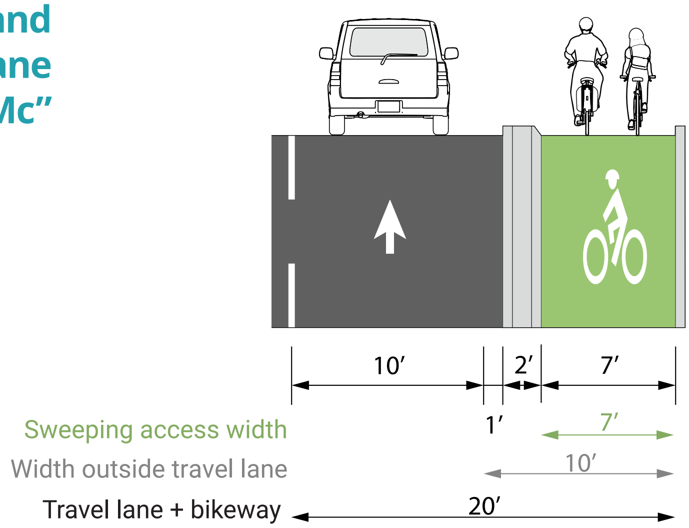


Concrete island protected bicycle lane “Mb”

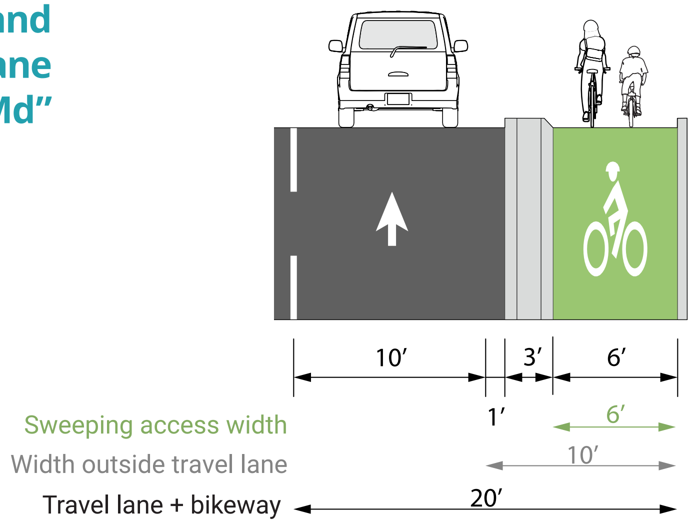


Concrete Island Protected Lanes

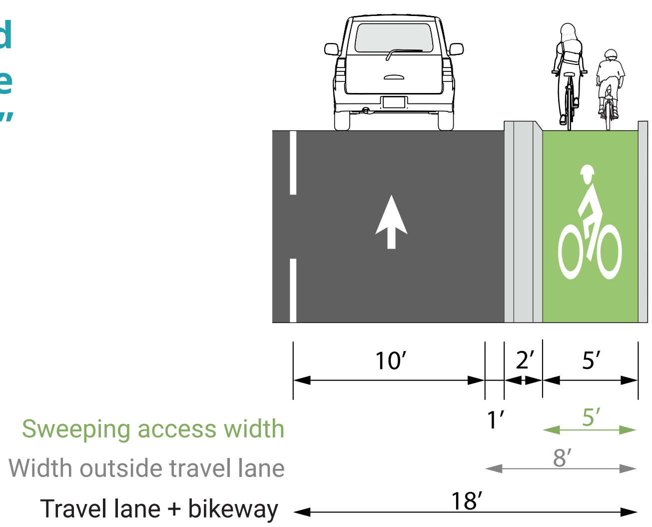
Concrete island protected bicycle lane "Mc"



Concrete island protected bicycle lane "Md"



Concrete island protected bicycle lane "Me"



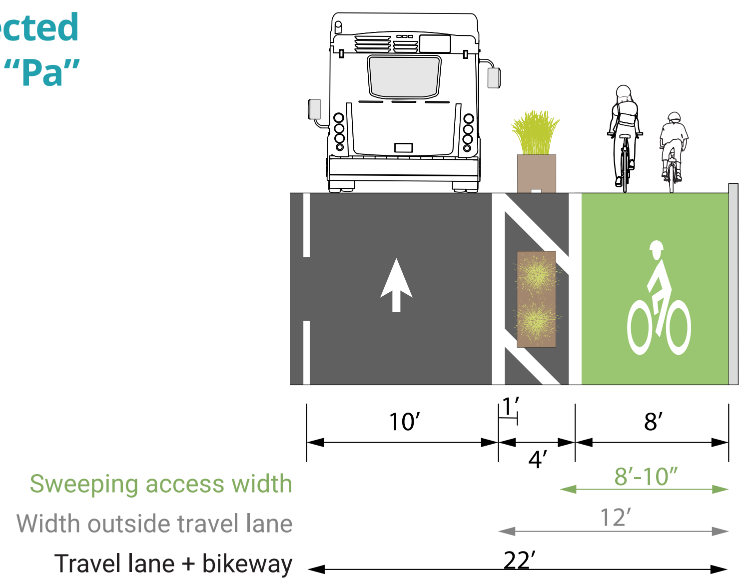
Planter Protected Lanes

The planters displayed here are modeled on commercially-available planters with approximate dimensions of 26-inches -wide by 20-inches-tall and 53-inches-long. All dimensions rounded to the nearest inch. The protected design includes a one-foot-shy distance from the edge of the planter to the adjacent travel lane.

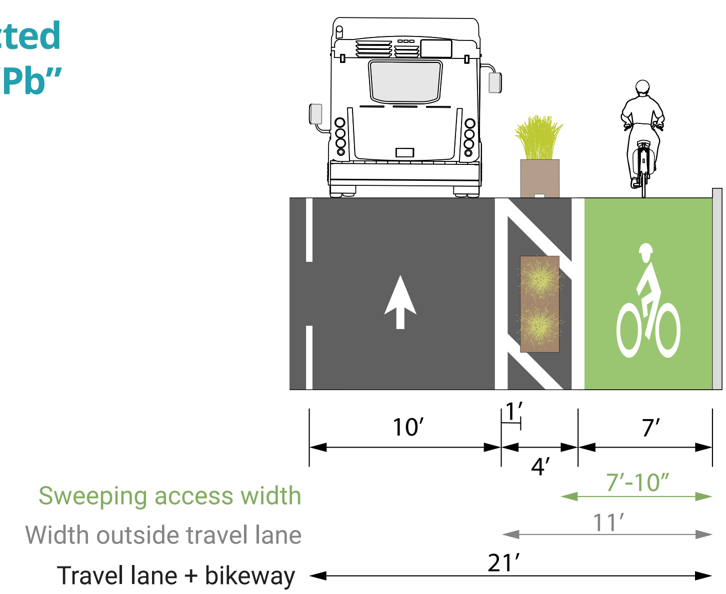
Planters as barriers are a good option when there is a premium on creating an attractive environment, as in a commercial corridor or, even in residential neighborhoods. Planters require a long-term maintenance agreement. Even though they are "self-watering" the internal reservoir still needs to be filled several times during the summer and during other low-rain periods. Maintaining their attractiveness may also require periodic maintenance of the flora growing in them. They are typically used in low-speed roadways.

Because of their width and height, a minimum shy distance is required both between the travel lane and planter and between the bicycling zone and the planter. This necessitates a wide buffer area, shown as four feet (4') in these diagrams.

Planter protected bicycle lane "Pa"

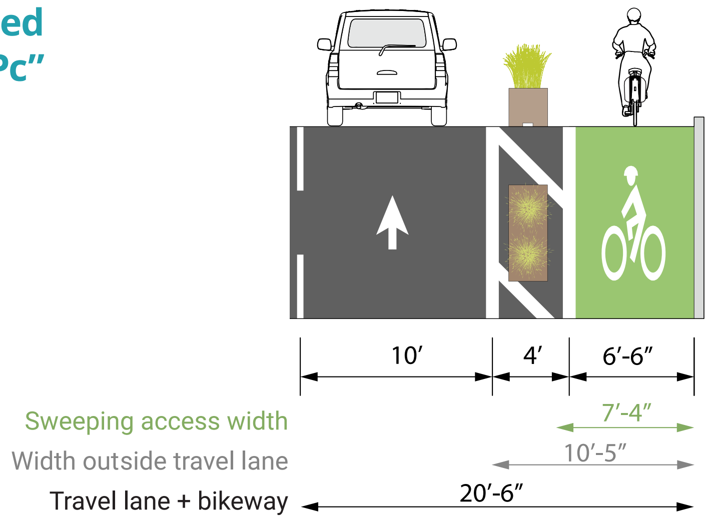


Planter protected bicycle lane "Pb"

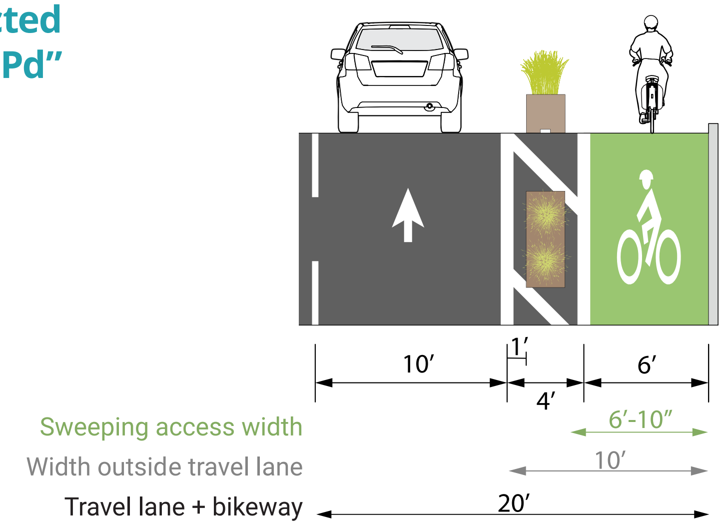


Planter Protected Lanes

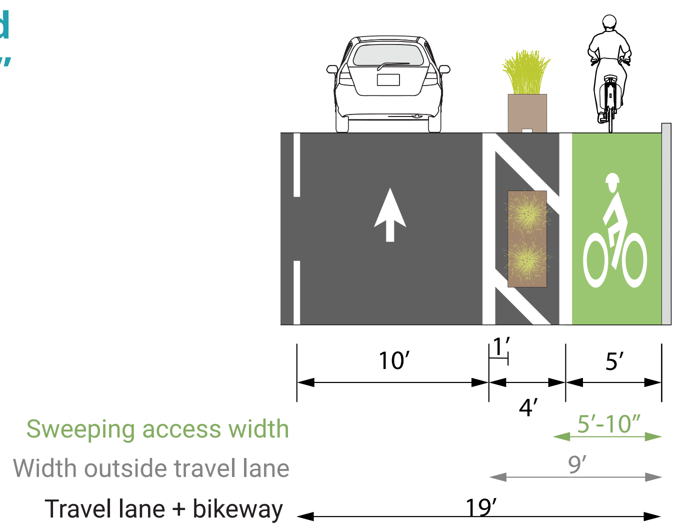
Planter protected bicycle lane "Pc"



Planter protected bicycle lane "Pd"



Planter protected bicycle lane "Pe"



Design Considerations

While this guide identifies the desirability of a raised, sidewalk-level, protected bicycle lane, it focuses principally on tools that would allow for the timely retrofit of Portland's streets to create a network of street-level protected lanes. Because of this, the guide focuses on two principal types of facilities: barrier-protected and parking-protected bicycle lanes. For the barrier-protected type, design barriers include delineator posts, traffic separators, planters, and concrete islands.

This section describes the elements that contribute to each bikeway design type and discusses considerations on when to use each design. When considering the width of the bicycling zone refer to **Figure 3**, Portland's recommended width for directional bikeways. One of the first considerations for which design to use should be the width of the bicycling area. Higher volumes of people bicycling necessitates more opportunities for passing and thus this guide calls for a preferred width of 6.5-feet clear in the bicycling zone under most conditions.[12] Greater width is needed where higher volumes of bicyclists are either present or anticipated to provide opportunities for faster bicyclists to pass slower cyclists, to accommodate side by side bicycling, and to ensure efficient and comfortable operation for the protected facility. Getting the width of the bicycling zone right is especially important with parking-protected bicycle lanes. With those facilities, if the bicycling zone is too narrow, then passing activity could occur in the buffer zone, which is also the zone into which car doors open.

Though this guide doesn't specifically address the design of two-way bicycle lanes, **Figure 4**, Portland's recommended widths for bidirectional bikeways, provides width guidance for those facilities based on expected volumes of people bicycling.

Retrofit protected bicycle lanes necessitate operational changes for right-of-way functions requiring curbside access. Providing curbside access is important for transit, disabled parking, loading zones, mail delivery, and for garbage, recycling, and compost collection.[13]

With a parking-protected bicycle lane implemented with paint and temporary vertical elements, it is possible to provide sidewalk curb access by:

Peak Hour Directional Bicyclist Volume	Bike Lane Width (ft.)	
	Preferable	Minimum*
<150	6.5	5
150-750	8	6.5
>750	10	8

* Constrained width may be as low as 4 feet for short distances.

Figure 3. Portland's recommended widths for directional bikeways

Peak Hour Bidirectional Bicyclist Volume	Bike Lane Width (ft.)	
	Preferable	Minimum*
<150	11	10
150-350	12	11
>350	16	14

* Constrained width may be as low as 8 feet for short distances.

Figure 4. Portland's recommended widths for bidirectional bikeways

[12] Carefully consider the environment in which the 6.5-foot bicycling zone is placed. If between two vertical elements (including curbs) there will be a shy distance to consider that might require additional width to provide 6.5 feet of functional width. This can be partially mitigated by using curbs angled back from the bicycling zone and having a shy distance from other vertical elements. It can also be mitigated by providing 7-foot-between vertical elements.

[13] More detailed design guidance for curb access can be found in other guide books, including the FHWA Separated Bicycle Lane Planning and Design Guide and the series of guide books published by the National Association of City Transportation Officials (NACTO).

- Deflecting the bicycle lane around the location of curb access. As shown in **Figure 16**, this was done on SW Broadway to allow paratransit vehicles access to the curb. It requires a minimum width of 13 feet (8 feet for transit vehicle, 5 feet for minimal bicycle lane). Parking protected bicycle lanes, as identified in this guide, have available 16 to 20 feet.

- Providing a sidewalk-level island aligned with the parking lane and providing accessible pedestrian crossings of the bicycle lane.

- Providing a street level painted island accessible from a curb ramp at the sidewalk

Street-side collection of household waste already requires sanitation workers to maneuver around on-street parking. A parking protected bicycle lane design simply positions the existing condition further out into the roadway.

Barrier protected retrofit bicycle lanes generally necessitate opening the barrier to allow curbside access or creating a short-stretch of sidewalk-level bikeway by raising the bicycle lane to sidewalk level in areas where curbside access is desired.

Barrier protected bicycle lane design elements

Barrier protected bicycle lanes have two zones:

- **The Buffer Zone**, where the vertical element is placed, and

- **The Bicycling Zone** where the bicyclists ride.

Protected bicycle lanes are defined by the horizontal separation from automobile lanes created by the buffer zone and the vertical element placed within that buffer.

Figure 5. Bikeway protected with plastic delineators in Chicago.

Advantages of Barrier-Protected Bikeways

A barrier-protected bicycle lane is a good retrofit design that: does not affect stormwater; can be a relatively low-cost treatment; and provides flexibility in the type of barrier that can be used.

Disadvantages of Barrier-Protected Bikeways

Depending on the barrier used, the design can have a temporary aesthetic and may not be welcome in all districts. On streets with many driveways and/or transit stops, these retrofit protected bicycle lanes will have gaps in protection. The amount of protection ultimately possible on such streets will be a function of the frequency of driveways and transit stops.

The Buffer Zone

This zone provides a clear space between people bicycling and motor vehicles. It is where vertical elements are placed. Depending on the buffer width, it may accommodate waste containers, mail boxes, bicycle parking, or other street appurtenances.

The minimum width of the buffer zone is determined by considering: the width of the vertical element, the desired shy distance between the vertical element and the travel lane and bicycle lane, and other desired uses for the buffer zone. Another important consideration is the minimum width required for sweeping the bicycling zone, defined as the width from the curb to the edge of the vertical element in the buffer zone. Some jurisdictions, including Portland, have used buffer zones where the vertical elements constitute the entire width of the buffer (see **Figure 7**). In other cases, the buffer zone is quite wide (see **Figure 5**). The wider the buffer zone, the more separation from moving traffic and therefore more comfortable for people bicycling. PBOT's proposed designs include buffers ranging from 1-foot-4 inches to 6-feet-wide. The

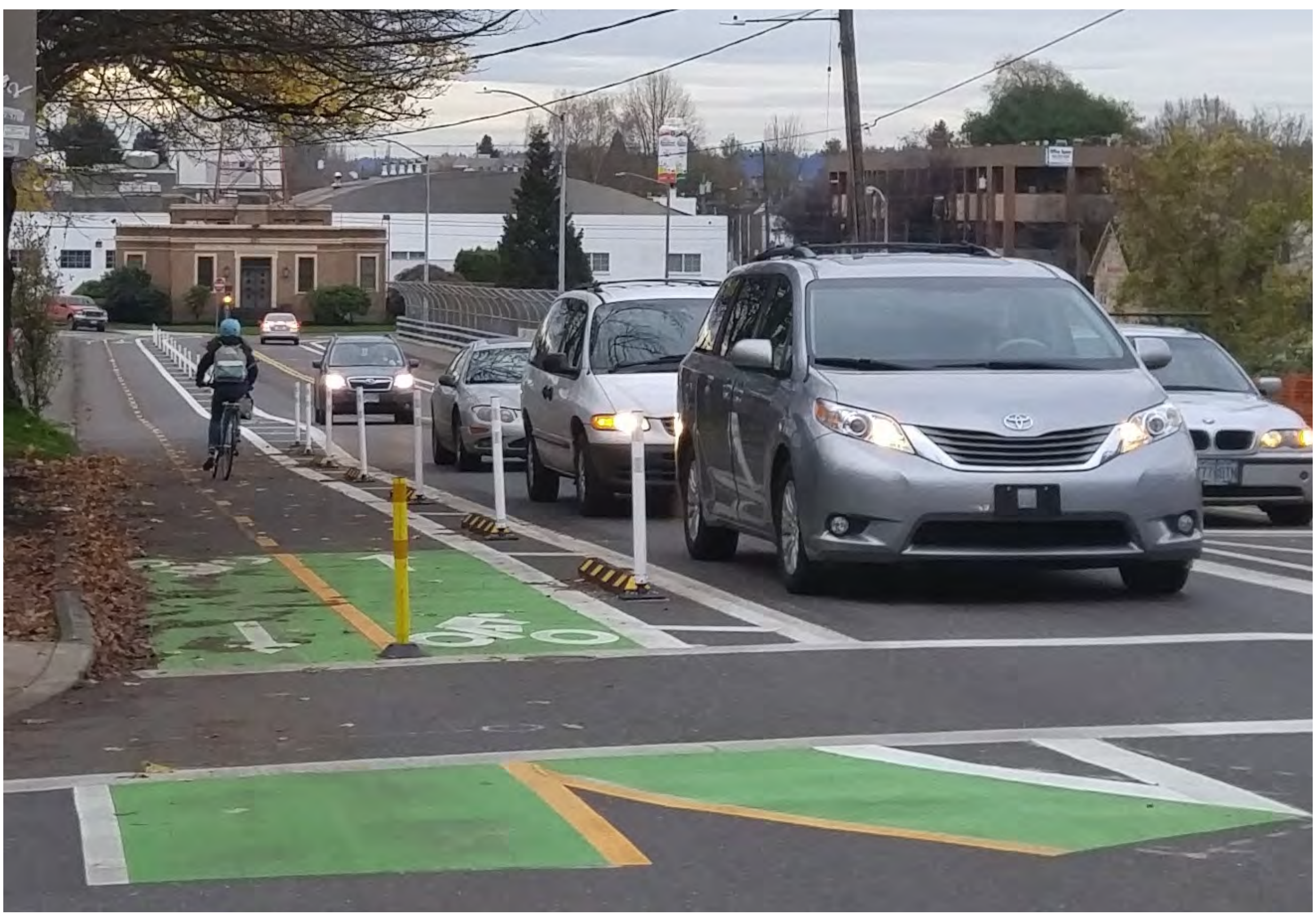


Figure 6. Parking stops and delineator post barrier on two-way bikeway on NE 21st Avenue in Portland.

Figure 7. "Better Naito" showing spacing of 12 feet between delineator posts. The posts are mounted directly on the lane line, adjacent to an 11' travel lane; an effective 10' travel lane with a 1' shy distance. (Photo: bikeportland.org/J. Maus)

Figure 8. Concrete island doweled in to roadway to create a protected bicycle lane in Austin, TX.

more common widths for the buffer are between 2 to 4 feet. Twenty-four of the twenty-eight barrier-protected bicycle lane designs in this guide have buffers of 2 to 4 feet.

Barrier Types

PBOT has decided to use the following temporary vertical objects to provide physical separation: plastic delineator posts (aka "tubular markers"), planters, and traffic separators, all of which may be used alone or in combination with other temporary elements.[14]

Delineator posts

Delineator posts are the least expensive tool to create a barrier-protected bicycle lane. Standard delineator posts have an 8-inch base. Other posts have a sub-surface base and are thus no wider than the post diameter. To provide a suitable shy distance from the travel lane, delineator posts should be mounted 1-foot-on-center from the edge of the travel lane. The report *"Lessons from the Green Lanes"*.[15] identified barrier protected bicycle lanes using plastic delineators as the second most comfortable protected bicycle lane design.

Jurisdictions across North America that rushed to install protected bicycle lanes with delineator posts are replacing them with more permanent materials. Delineator posts may require frequent maintenance if they are hit often. For example, some of Portland's existing delineator protected bicycle lanes require replacement of approximately 10% of installed posts every six months.

Traffic separators

Traffic separators are standard, but relatively infrequently used, roadway elements. Typical uses are to separate turn lanes from general purpose lanes and to create barriers to prohibit left turns or turns across railroad crossings. They are concrete elements that can be either precast and placed into the roadway or, more typically cast-in-place with dowels. Type A separators have a standard height of 4 inches and a minimum width of 16 inches.[16] Their use can be supplemented with delineator posts, as shown in **Figure 6**. When used they should be placed to provide a 1-foot-shy distance between the edge of the traffic separator and the 10-foot travel lane.

[14] Private sector vendors are beginning to develop standardized products that bear similarities to traffic separators. PBOT will continue to explore new tools as they become available.

[15] Lessons from the Green Lanes: Evaluating Protected Bike Lane in the U.S., Monsere, Chris, Dill, Jennifer, McNeil Nathan, Clifton, Kelly, NITC-RR-583, June 2014

[16] A 12-inch wide traffic separator is also available and can be used.

It is important to pay attention to pavement quality when using traffic separators as it can be difficult to maintain the bicycling zone once traffic separators are in place. If the pavement quality is approaching or at a Pavement Condition Index (PCI) of 70 or below consider grinding out and replacing the existing pavement from the existing curb to the limits of the traffic separators This will ensure a smooth riding surface for bicycling and a long service life for the pavement in the bicycling zone.

Planters

The planters shown in this guide are based on a self-watering 54-inch-long, 20-inch-high, 26-inch-wide rectangular planter. Planters are best used in commercial locations or along commercial corridors where favorable aesthetics are a priority. Planters require a maintenance agreement for watering. They are typically used on low-speed roadways.

As with other vertical elements, planters require a 1-foot-shy distance from the 10-foot travel lane and, ideally, a 1-foot-shy distance from the bicycling zone. All buffer zones for planters are shown in this guide as being 4-feet-wide, allowing the shy distance to occur within the buffer zone.

Concrete islands

Of the recommended retrofit barriers, concrete islands offer the most permanence and lowest maintenance. Concrete islands consist of curbs up to 6-inches-high and can vary in width. They require a 1-foot-shy distance to the travel lane, shown as occurring outside the striped buffer zone. Concrete islands will generally be no narrower than 2 feet.

The barrier should have a 3-inch-radius on the travel lane side of the barrier. On the bicycling zone side, efforts should be taken to minimize the threat of pedal strikes. This can be done with a beveled curb on the bicycle lane side or a treatment in which the barrier slopes down to a 2-inch curb height on the bicycle lane side. As a point of reference, the average bicyclist's pedal has a 4-inch clearance from the ground.

The approach end of the island (and both island ends adjacent to driveways) shall be tapered at 1:10 from the 6-inch curb height to a 2-inch curb height.[17] Concrete islands should include a minimum 12-inch break every 25 feet to accommodate drainage.[18] The 1:10 taper is not required at the drainage gaps. Do not install concrete islands between driveways or intersections where the island length would be

Figure 9. Traffic separator protected lane on N Burgard Rd, Portland. Source: Matt Ferris-Smith, PBOT

Figure 10. Linear array of planters on Seattle's 2nd Avenue (two-way) bikeway

[17] See ODOT Standard Drawing RD707B.

[18] See ODOT detail 706. Work with civil designers to ensure that a 12-inch gap every 25 feet is sufficient for the flow and drainage on a specific corridor. Consider slope and cross-slope of roadway.

Figure 11. Parking protected bicycle lane on Kinzie Street in Chicago. Design used both parked cars and delineator posts for separation.

less than 20 feet. Instead, install delineator posts at these locations with a minimum 10-foot-spacing.

It may be beneficial to install white delineator posts[19] on the approach ends of the concrete islands at public street intersections and approximately every 100 feet after.

Concrete islands less than four-feet wide need to be embedded into the roadway. Islands four-feet and wider can be doweled into the pavement.

It is important to pay attention to pavement quality when using concrete islands as it can be difficult to maintain the bicycling zone once a concrete island is in place. If the pavement quality is approaching or at a Pavement Condition Index (PCI) of 70 or below consider grinding out and replacing the existing pavement from the existing curb to the limits of the concrete island. This will ensure a smooth riding surface for bicycling, a long service life for the pavement in the bicycling zone and a means to embed the concrete island.

Other barrier elements

There are other barriers that have been employed in Portland and other cities across North America to create protected bicycle lanes. This guide suggests limiting barrier types to those discussed above to provide consistent expectations about the network of facilities and to streamline the maintenance of barrier types.

Spacing of vertical elements

A question that arises with these designs is how significant or substantial does the vertical element

[19] Contraflow bicycle facilities would require yellow delineators if used on the stripe separating directions of travel.

need to be to provide people using the facility the necessary sense of comfort?

The intent of the vertical element between the bicycling zone and the travel lane is to both bring attention to the barrier between the modes and to create the appearance of a nearly continuous barrier between people bicycling and driving. Previous practice in North American jurisdictions has been to space delineator posts so that they are passed by motorists at a rate of one per second. This results in a spacing of 37 feet at 25 mph, 44 feet at 30 mph, 51 feet at 35 mph and 59 feet at 40 mph. This motorist-based approach perversely results in fewer vertical elements as traffic speeds increase.

This guide suggests that the placement of vertical elements should center on the perceptions of those bicycling in the facility—a bicycle-based approach. Sticking to the idea of one delineator post per second, at the average cyclist speed of 10 mph this would result in placing posts every 15 feet. Portland's experience with "Seasonal Better Naito," with posts spaced every 12 feet, indicates that closer spacing produces a design that is seen by people bicycling as a more comfortable and more protected environment. Twenty-foot spacing for delineator posts should be the maximum distance when they are the sole barrier.

Traffic separators and concrete islands should be installed in a manner that creates a near-continuous barrier. Regular gaps—every 25 feet—should be provided to allow for stormwater to drain to the edge of the roadway. Traffic separators can be augmented with the installation of delineator posts. In this instance delineator posts can be spaced at 40-foot intervals. Planters, because of their size, can be placed with more generous spacing between them, but should still create the sense of a nearly-continuous barrier.

Issues

Mounting delineator posts or traffic separators typically requires bolting them into the asphalt. This may not be possible on bridges and other structures where water in the superstructure can cause rusting of steel elements and freezing that can cause concrete to spall. When knocked over, delineators can also temporarily present a hazard to automotive or bicycle travel. The same is true for a traffic separator that is hit and moved out of position.

The Bicycling Zone

This is the area where people will ride their bicycles. The width of this zone should be based on: overall available width, expected volume of bicycle use, and the design user's bicycle type, including a consideration for bicycle trailers.

The recommended minimum width for the bicycling zone is 6.5 feet. This is the clear width and should not include shy distance. This recommended minimum allows for passing behavior by people bicycling. See **Figures 3 and 4** for a guide to appropriate bicycling zone widths based on expected use.

A narrow buffer zone (i.e. 1.5 feet) will result in minimal shy distance from the edge of vertical elements to the bicycle lane. That may reduce the ability for cyclists to pass one another even in a 6.5-foot bicycling zone due to cyclist shy distance from vertical elements on both sides.

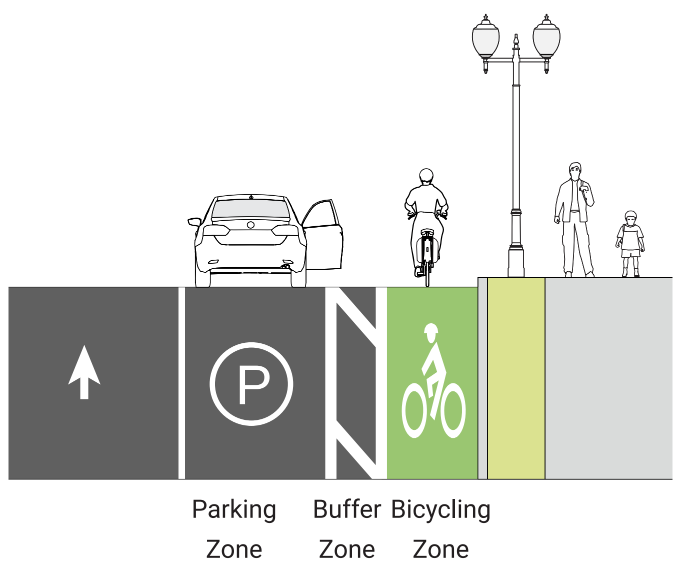


Figure 12. Parking protected bikeway zones.

Figure 13. Parking stall on NE Cully Boulevard, Portland, OR.

Street-level parking protected bicycle lanes design elements

Advantages of Parking-Protected Bikeways

This design works well when there is strong demand for on-street parking. It does not affect stormwater and is typically accomplished through striping eradication, re-striping and minimal civil changes, if any. As such, it is a relatively low-cost treatment to provide protected bicycle lanes. Implementation is often accomplished through repurposing one or more travel lanes.

The space of the parking lane, together with the buffer zone, creates the width needed to provide a well-designed protected intersection and circulation / queueing areas to accommodate bicycle turning movements. The width of the parking and buffer zones can also be used to create transit islands so that transit vehicles do not have to access the existing curb.

Disadvantages of Parking-Protected Bikeways

In areas with low or intermittent parking demand the protection will be absent and people driving may confuse the parking area for a travel lane. People loading and unloading from their automobile need to cross the bicycle lane and ADA accessible parking spaces may require additional construction. Compared to existing conditions, some parking will be lost to accommodate sight distance at all intersections and driveways (see below under "The Parking Zone").

In addition to the buffer and bicycling zones, parking protected bicycle lanes also must consider the parking zone.

The Buffer Zone

For a parking protected bikeway, the buffer zone provides sufficient space so that an open car door need not intrude into the bicycling zone. It also is the space for people loading and unloading from their cars, and for Parking Enforcement Deputies to be outside of the bicycling zone.

A standard width of 3 feet for this zone is identified in the *NACTO Urban Bikeway Design Guide* as well as in the *FHWA Separated Bicycle Lane Planning and Design Guide*. It is also the width Portland has used for existing parking-protected facilities. Under certain circumstances it will be appropriate to go to a minimum width of 2.5 feet. This is especially true in the case where the narrowing of the buffer width will allow for the provision of a minimum 6.5-foot bicycling zone. Analysis of the width at which car doors open and how people open them indicate that most doors will not intrude excessively into a buffer as narrow as 2.5-feet.

Figure 14. Colored buffer zone with delineators on NE Multnomah, Portland, OR. Current guidance would place delineators closer to the parking zone.

Figure 15. Parking zone, buffer zone with pedestrian marking and bicycling zone on SW Broadway, Portland, OR. (Photo: Toole Design Group)

The buffer zone is defined by striping. The zone can be further clarified by adding markings, including hatching, pedestrian legends, and/or a distinguishing color.

When parking occupancy is consistently high, then delineators may not be required. However, when parking use is light—either always or at certain times of day (i.e. early morning or late at night in a commercial district; middle of the day in a residential area)—then a parking-protected bicycle lane functions more like a wide buffered bicycle lane. Consider using delineator posts, spaced every 20 feet (length of standard parking stall), in conjunction with on-street parking.

Another consideration for using delineator posts is to enforce good parking space compliance. At some installations, people park their cars into and past the buffer zone, narrowing the bicycling zone and creating potential door zone hazards. At other installations people park their cars appropriately with no further guidance than the buffer zone striping. To ensure that parked automobiles stay out of the buffer zone install delineator posts close to the edge of the zone closest to the parking zone. Consider making delineator posts a standard element for street level parking-protected bicycle lanes to account for both periods of low-parking demand and desired alignment of parked vehicles.

When used, delineators should be placed six inches into the buffer zone, as measured from the center of the post. When the posts are also used as parking sign posts, they can be placed further into the buffer zone so that the 12 inch signs (placed at a 45-degree angle) will be further away from parked cars. Posts should be placed every 20 feet with consideration to not interfere with car doors opening. Delineator posts used for signs should be sixty inches (60") tall.

The Parking Zone

The area where automobiles park. Its width is that of a standard parking stall. In Portland, this is typically 8-feet-wide, though it can be as narrow as 7 feet in residential areas. Consider narrowing the parking zone if doing so results in either a wider bicycling zone or a 2.5-foot-minimum buffer zone. In some circumstances parking zones narrower than 8 feet may require design approval. As 8 feet is the width required for loading, going to less than 8 feet will likely not work in areas with high demand for loading. However, narrower parking lanes can be widened to 8 feet to accommodate specific loading zones, and then narrowed following the loading zone. This can be a good strategy when the demand for and number of loading zones is minimal. To achieve an 8-foot loading zone in an area where parking is narrower, consider narrowing the buffer to 2.5 feet or the bicycle lane width just in the area where loading is desired. This will allow for the width necessary for loading without a corridor-wide impact to the width of the bicycling zone

To identify the parking stall and avoid confusion with the travel lane, Portland has used the capital letter "P" inside an oval as a pavement marking. This can be done as a temporary application for newly implemented configurations or as a permanent application, depending on the context. Parking "T's" can also be used to identify the extent of each stall. The intent of these design elements is to clearly communicate that the space is for parking and not a travel lane, despite it being more than 10 feet from the curb.

PBOT guidance calls for removing on-street parking for a parking-protected bicycle lane a minimum of sixty-feet (60') approaching an intersecting roadway or major driveway (for sight distance) and eight-feet (8') after the driveway for turning movements. The corresponding minimum distances for residential or lower-use driveways are twenty-feet (20') approaching and six-feet (6') following.

The Bicycling Zone

With parking-protected bicycle lanes, a bicycling zone that is too narrow for conditions could result in people bicycling in the buffer zone into which car doors open. Consider narrowing other roadway elements to maintain a minimum 6.5-foot bicycling zone.[20] On bicycle lanes where use is expected to be lower, it may be appropriate to go to as narrow as a 5-foot bicycling zone. This narrow bicycling zone should not be used when a narrower buffer zone is also used. Four-foot-wide zones—with a 3-foot buffer—can be considered for short, width-constrained segments (as on a curve or in an uphill direction).

Because people walking tend to see parking-protected bicycling zones as safe places to stand, or as a way to access the de facto refuge offered by parked cars, consider prominent visual cues that this space is for bicycling (i.e. colored pavement, pavement markings). This is especially necessary at intersections where crossing activity is focused.

Figure 16. Curb access with a painted parking-protected bicycle lane (SW Broadway, Portland). Elsewhere, the areas shown hatched is for car parking. To allow LIFT vehicles to the curb the bicycle lane deflects around the LIFT access area (marked in blue). When a vehicle is servicing the stop a buffered bicycle lane remains. When no vehicle is there people bicycling can maintain a straight course. This was implemented where dimensions were: 8 foot – 3 foot – 7 foot (parking, buffer, bicycle zone respectively).

[20] As noted previously, 6.5-feet-between vertical elements may still be too constrained because of shy distance. Consider designing the bicycling zone to 7-feet-between vertical elements.

Other Considerations

Retrofitting roadways for protected bicycle lanes will often place the bicycling zone in an area of the roadway not previously used for bicycling—notably in the curb zone. Because it is typically used for on-street parking, any deficiencies in the curb zone may not be obvious until the protected bicycle lane is implemented. To ensure that operating conditions in the new bicycling zone will be safe and comfortable for bicycling, assess the following three elements in advance.

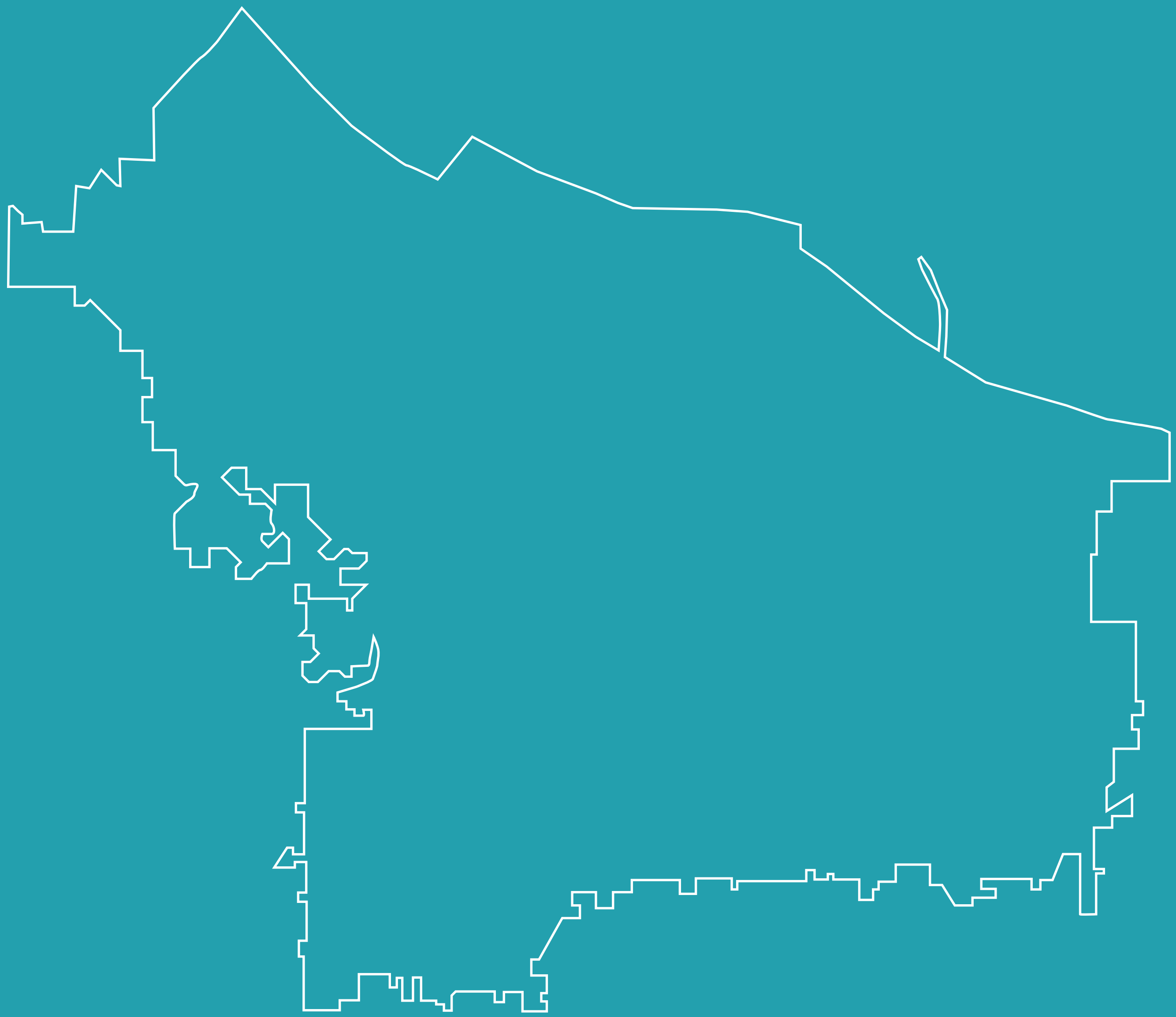
- the condition of any stormwater inlets, manhole and valve covers
- the quality of the pavement, and
- the presence of any overhanging foliage.

All inlet grates should be bicycle-friendly and flush with the roadway. Portland's guidance for inlets in the bicycling zone is that they not be depressed. This is accomplished by building them or retrofitting them to match both the cross-slope and longitudinal slope of the street. Ensure that any other manhole or access inlets are flush with the roadway and embedded in good quality asphalt.

Poor pavement quality in the curb zone is often unnoticed and ignored, especially when under parked automobiles. Assess the curb zone for damaged, uneven and otherwise rough pavement and correct as needed.

As with the above two elements, overhanging foliage, especially tree branches, is not an operational issue when the curb zone is used for parking. However, once it becomes a bicycling zone low hanging branches and other intruding foliage present a hazard to people bicycling. Portland Bureau of Transportation requires tree branches to be trimmed to a minimum of eleven feet above the roadway.

Photo: Toole Design Group



SECTION THREE

Applying protected bicycle lane designs to Portland streets

Protected bicycle lanes are appropriate on most streets where separated facilities for bicycling are called for. However, not all such roadways will require protected facilities, nor will it always be possible to provide them. *Portland's 1996 Bicycle Master Plan* included guidance that called for the provision of bicycle lanes when daily motor vehicle volumes on a roadway exceeded 3,000. That guidance was silent on speed.

Recognizing the need for more sophisticated guidance on the conditions that would benefit from protected bicycle lanes, NACTO developed *"Designing for All Ages & Abilities, Contextual Guidance for Selecting High-Comfort Bicycle Facilities"*. This NACTO guide provides thresholds for automotive speeds and volumes and other factors that would indicate the need for a protected bicycle lane, as shown in **Figure 17**. The main guidance is that a protected bicycle lane is needed to create comfortable cycling conditions when daily motor vehicle volumes exceed 6,000. Between 3,000 and 6,000 motor vehicles per day either a buffered or protected lane will suffice. Finally, at speeds greater than 25 mph a protected bicycle lane is appropriate regardless of motor vehicle volumes.

NACTO's Contextual Guidance for Selecting All Ages & Abilities Bikeways				
Roadway Context				
Target Motor Vehicle Speed*	Target Max. Motor Vehicle Volume (ADT)	Motor Vehicle Lanes	Key Operational Considerations	**All Ages & Abilities Bicycle Facility**
Any		*Any*	*Any of the following:* high curbside activity, frequent buses, motor vehicle congestion, or turning conflicts ‡	**Protected Bicycle Lane**
< 10 mph	Less relevant	No centerline or single lane one-way	Pedestrians share the roadway	**Shared Street**
≤ 20 mph	≤ 1,000 – 2,000		< 50 motor vehicles per hour in the peak direction at peak hour	**Bicycle Boulevard**
≤ 25 mph	≤ 500 – 1,500			
	≤ 1,500 – 3,000	Single lane each direction, or single lane one-way	Low curbside activity, or low congestion pressure	**Conventional or Buffered Bicycle Lane, or Protected Bicycle Lane**
	≤ 3,000-6,000			**Buffered or Protected Bicycle Lane**
	Greater than 6,000			**Protected Bicycle Lane**
	Any	Multiple lanes per direction		
Greater than 26 mph †	≤ 6,000	Single lane each direction	Low curbside activity, or low congestion pressure	**Protected Bicycle Lane, or Reduce Speed**
		Multiple lanes per direction		**Protected Bicycle Lane, or Reduce to Single Lane & Reduce Speed**
	Greater than 6,000	Any	Any	**Protected Bicycle Lane, or Bicycle Path**
High-speed limited access roadways, natural corridors, or geographic edge conditions with limited conflicts		Any	High pedestrian volume	**Bike Path with Separate Walkway or Protected Bicycle Lane**
			Low pedestrian volume	**Shared-Use Path or Protected Bicycle Lane**

* While posted or 85th percentile motor vehicle speed are commonly used design speed targets, 95th percentile speed captures high-end speeding, which causes greater stress to bicyclists and more frequent passing events. Setting target speed based on this threshold results in a higher level of bicycling comfort for the full range of riders.
† Setting 25 mph as a motor vehicle speed threshold for providing protected bikeways is consistent with many cities' traffic safety and Vision Zero policies. However, some cities use a 30 mph posted speed as a threshold for protected bikeways, consistent with providing Level of Traffic Stress level 2 (LTS 2) that can effectively reduce stress and accommodate more types of riders.18
‡ Operational factors that lead to bikeway conflicts are reasons to provide protected bike lanes regardless of motor vehicle speed and volume.

Figure 17. Contextual guidance chart from the NACTO guide, "Designing for All Ages & Abilities."

The remainder of this section addresses the following two issues:

- **Representative graphics** showing means of retrofitting the typical width roadways found in Portland—both two-way and one-way—with protected bicycle lanes, and
- **Roadway descriptions and maps**, showing the extent of roadways of different widths.

Following is a more in-depth description of this section's elements.

configurations for bicycle operations. As might be expected, the wider the roadway the more options that are available.

In some of these examples the entire width of the roadway is not fully taken up by the standard design elements (which always include 10-foot travel lanes). When available, this extra width is shown with green dimensional call outs at the outside of the roadway cross-sections. This width can be assigned to create wider automotive lanes in areas with high volumes of larger vehicles or can be put to other uses.

Representative Graphics

These graphics show examples of how different protected bicycle lane designs—or often, combinations of protected bicycle lane designs—can be used to create different roadway cross-sections on Portland's typical width streets. There are many possible options for most roadway widths. The following graphics generally show the best

Descriptions and maps

This section maps out those roadways of specified widths and provides a brief description of what could be provided at each width.

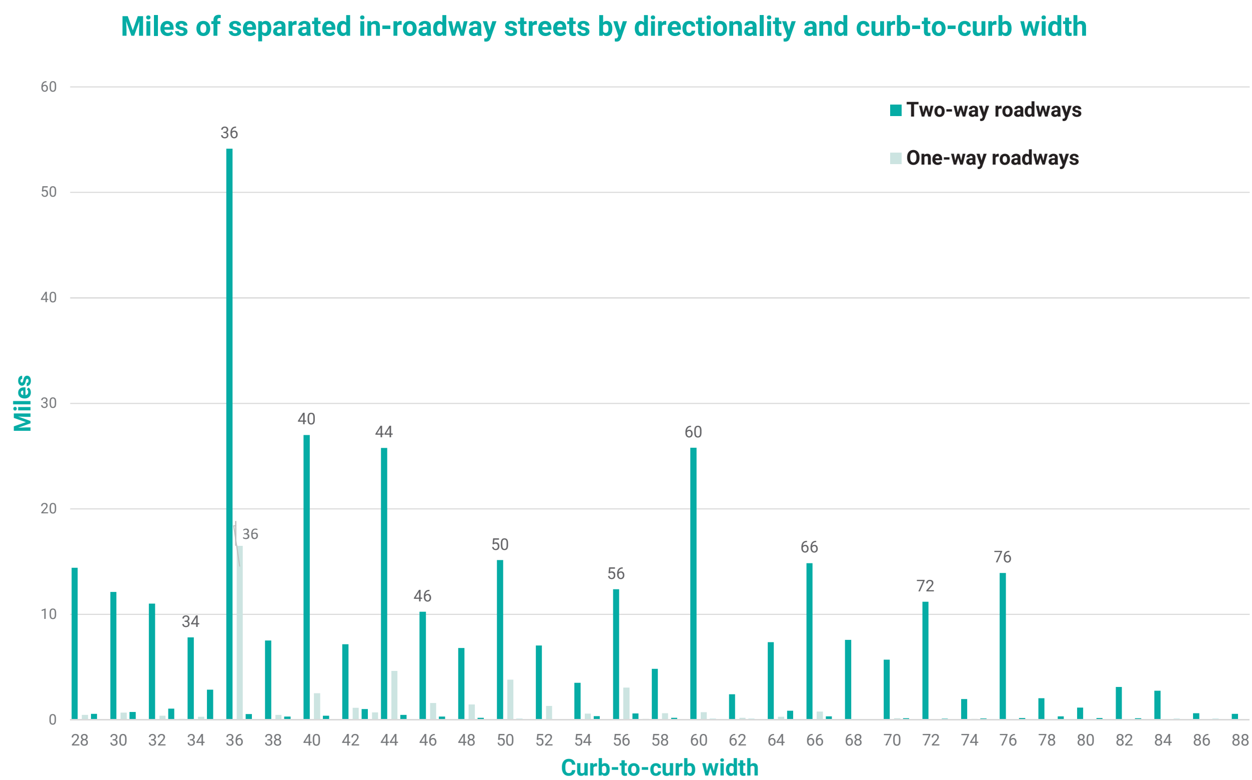


Figure 18. This figure shows the miles by curb-to-curb width of Portland roadways identified in city plans as requiring separated in-roadway ("SIR") treatment in the bikeway network. The green columns are two-way roadways and the light green are one-way roadways. The numbers atop the columns represent roadway curb-to-curb width.

Representative Graphics

The graphics on the following pages demonstrate several of the many ways in which protected bicycle lane designs can be employed on typical Portland streets. The figures depict reasonable options that create desired conditions for bicycling on Portland's most common width roadways. For most of the existing roadway widths there are often many more options available (See **Appendix C**). The options presented here tend to show the best—or better—conditions for the bicycling environment with different roadway configurations. Generally, this means that the bicycling zone is maximized to increase comfort and bicycle capacity.

Important decisions to be made when selecting protected bicycle lane designs include identifying the long-term need for on-street parking and the acceptable level of service for automobile traffic. Most of the protected bicycle lane designs shown in this guide will require the removal of either on-street parking (one or both sides) or travel lane(s). The process and guidance to determine which is removed will need to be firmly established for each project.

All designs depict 10-foot travel lanes. Lane widths wider than 10 feet may be desired for a number of reasons, including: accommodation for freight and transit vehicles and geometric roadway features, including intersection alignment, concrete islands, curb extensions, traffic calming devices, and other physical devices in or near the roadway. The vertical elements shown are generally interchangeable for most roadway widths.

All diagrams are to scale and show dimensions. Any dimensions shown in green indicate unassigned width that can be added to the travel lanes, buffer zones or bicycling zone as deemed appropriate. For presentation purposes they are shown on the extreme outside edges of the following graphics. Representative roadways listed in **bold font** are classified as Major City Bikeways in Portland's functional bicycle classification.

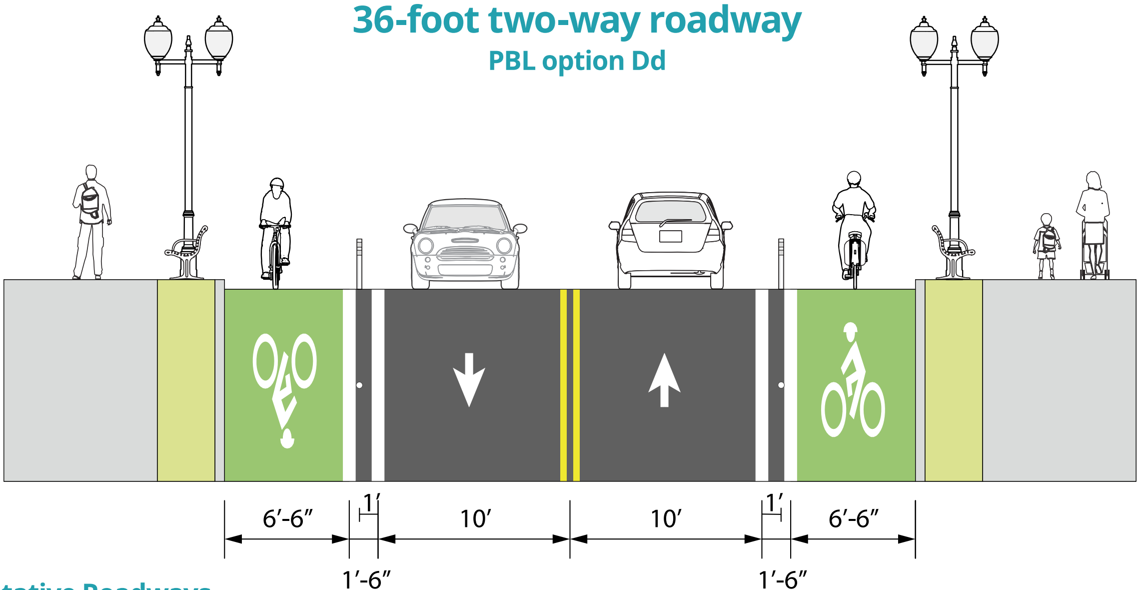
The designs on the following pages show cross-sections that are either balanced or unbalanced. Balanced designs typically have the same protected bicycle lane design on both sides of a two-way roadway. Unbalanced designs typically have a parking protected design on one side of the street and a barrier protected design on the other side. When considering the design layout, recognize that an unbalanced cross section is likely to result in higher costs because every existing lane marking on the roadway will typically need to be replaced. Higher costs could also result from the need to re-position or install new signal hardware.

Another trigger for significant changes in signal operations and thus higher costs include two-way protected bicycle lanes, which will require separate signal phases for people bicycling on the opposite side of the street from the "normal" direction of travel. The provision of protected bicycle through movements at intersections with high turning movements will also result in changes in signal operations and hardware.

Two-Way Roadways

36-foot two-way roadway

PBL option Dd

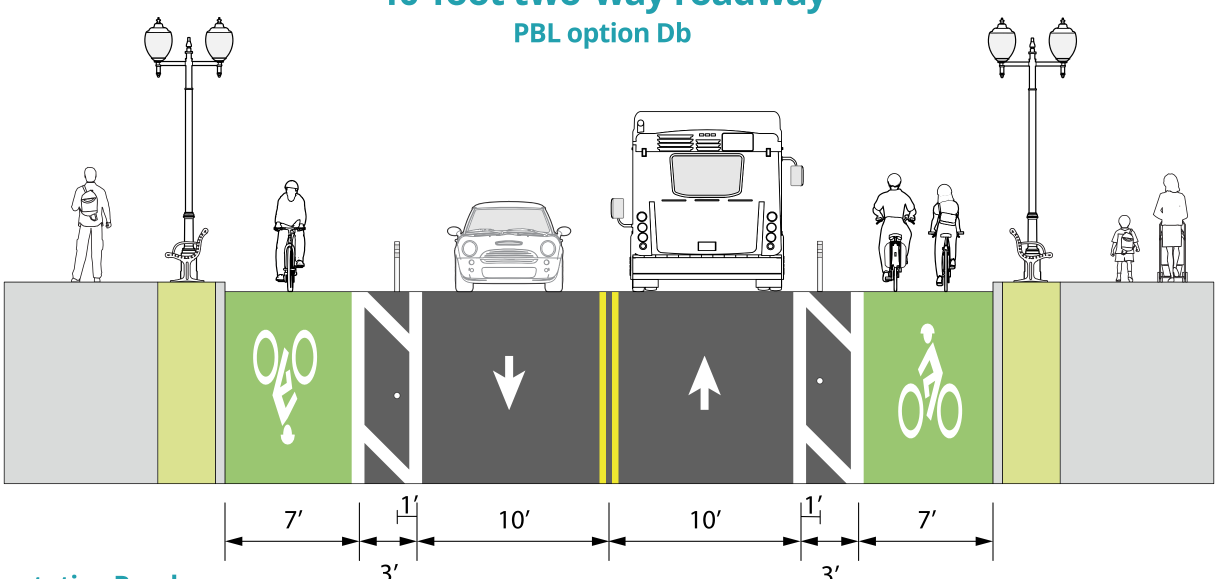


Representative Roadways

NW 9th Ave
NE 15th Ave
NW Thurman Street
NE Knott Street
N Ida Ave
N Willamette (east of Ida)
N Lagoon
SE Belmont
SE Holgate
NE Halsey
NE Fremont
SW Multnomah (w of 56th)

40-foot two-way roadway

PBL option Db

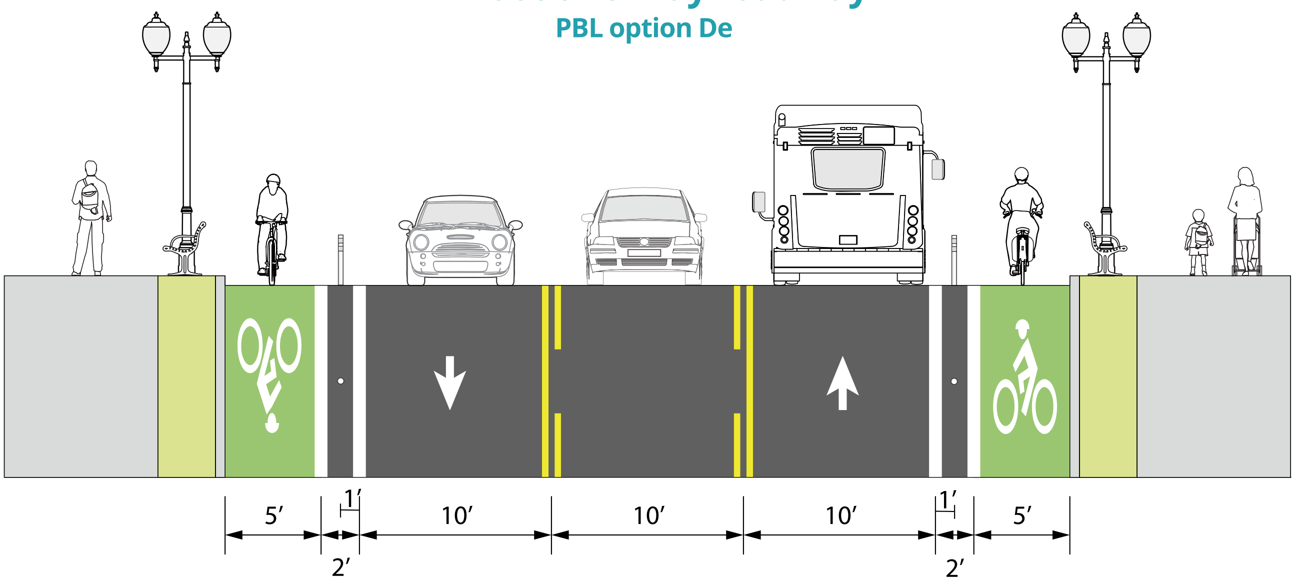


Representative Roadways

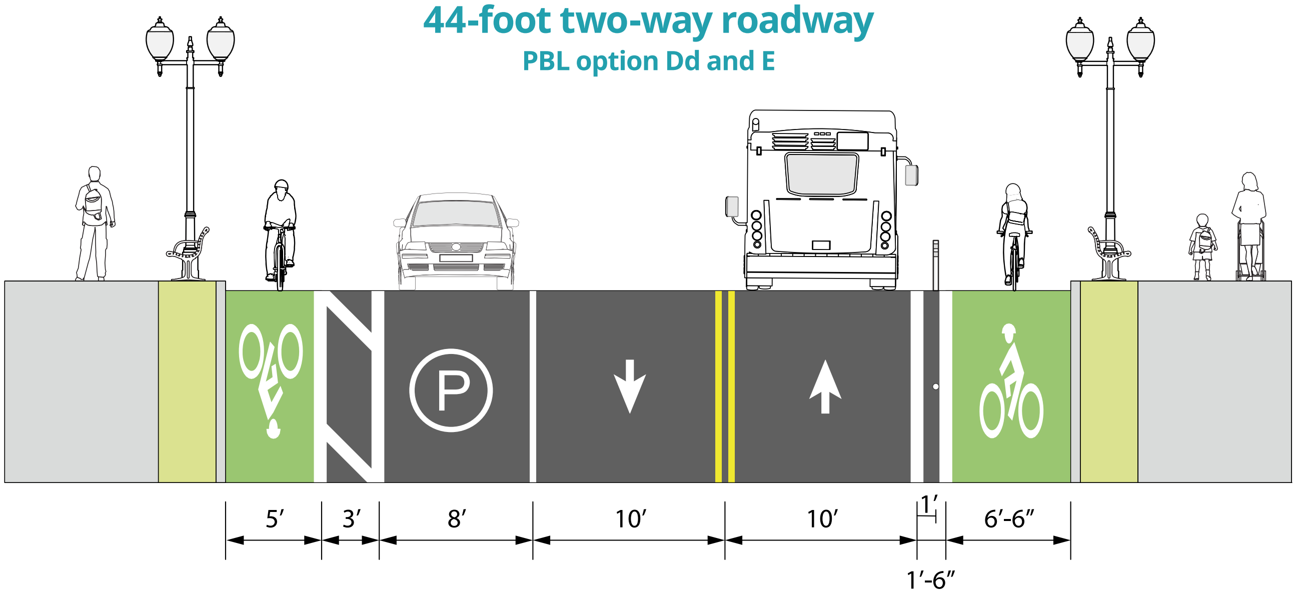
SE 41st/42nd
SE 52nd Ave
SE 72nd Ave
SE 92nd Ave
NE Fremont (EPDX)
NE Tillamook (62nd - 82nd)
N Willamette (along the bluff and west)
SE Market
SE Millmain
SE Steele
N Mississippi
N Ainsworth

Two-Way Roadways

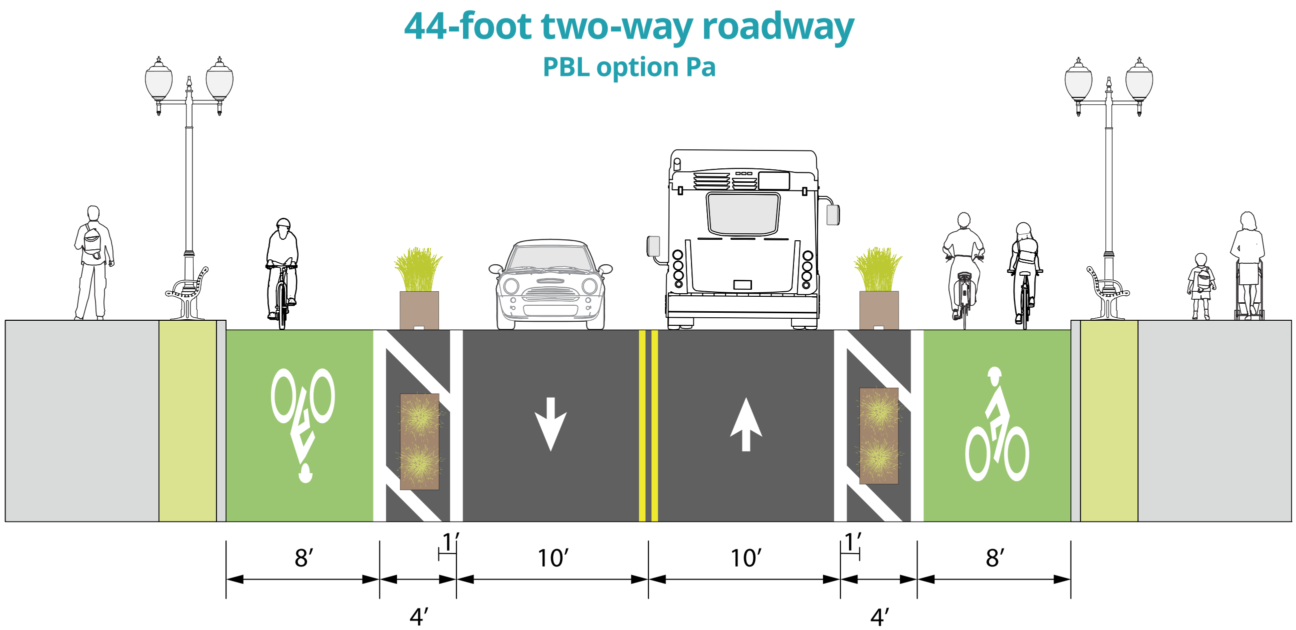
44-foot two-way roadway
PBL option De



44-foot two-way roadway
PBL option Dd and E



Two-Way Roadways

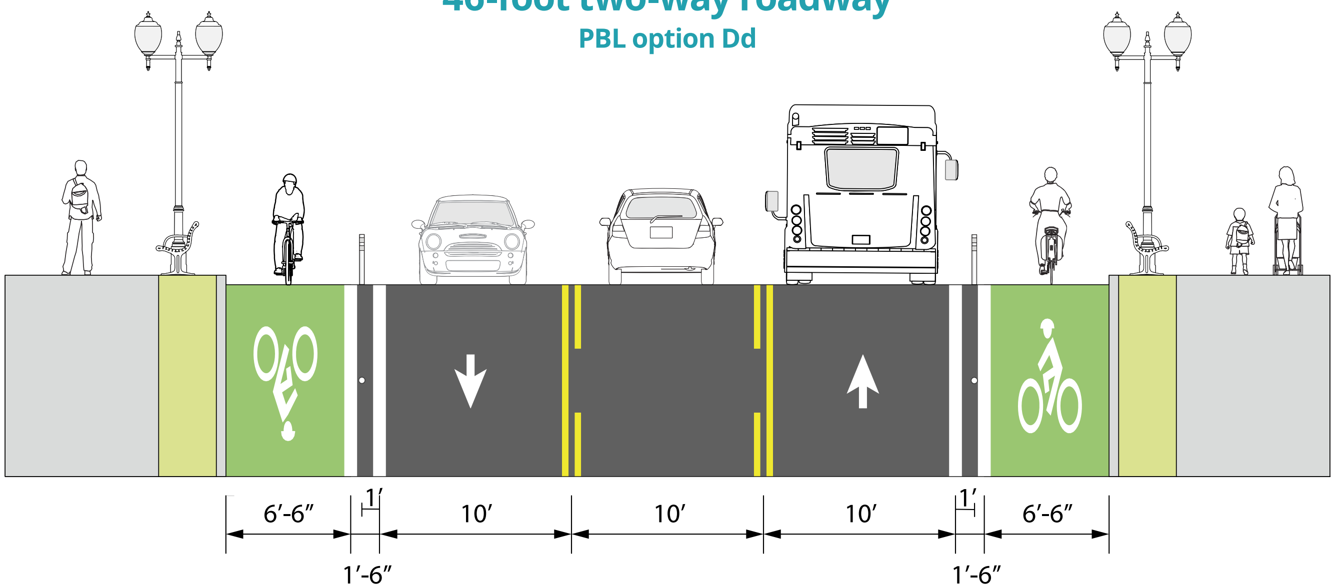


Representative Roadways

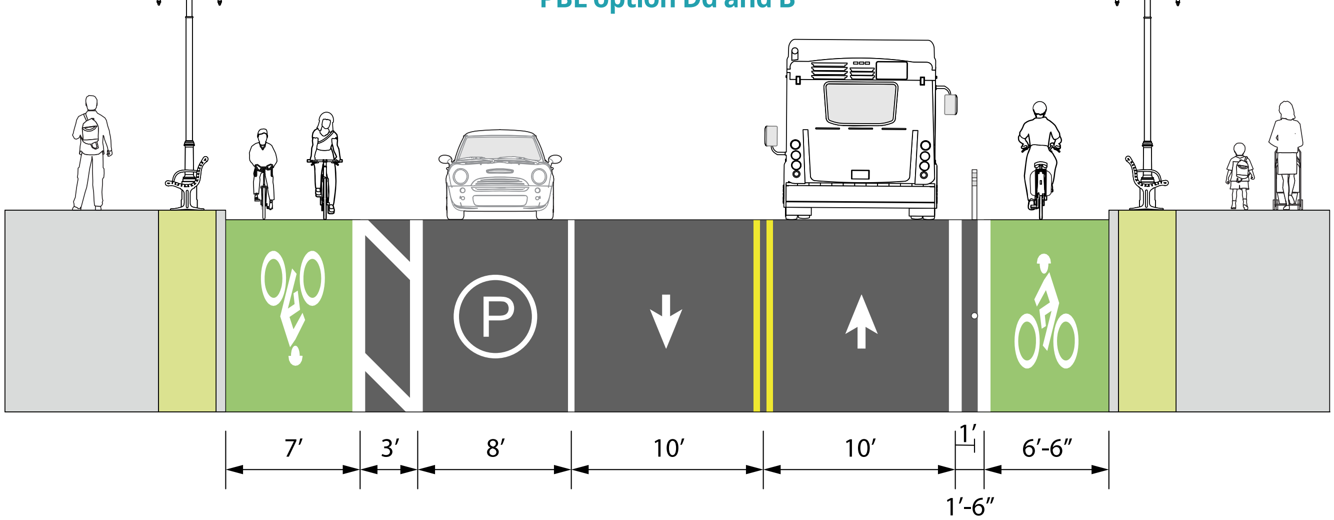
N Basin
SE Cherry Blossom/112th
NE Prescott (81st - I-205)
SW Capitol/Vermont (30th - Bertha)
SE Flavel
SE Duke
SE Woodstock (w of 72nd)
SE 45th
SE Steele
SE Division (60th to 79th)
E Burnside (e of 78th)
SE 92nd

Two-Way Roadways

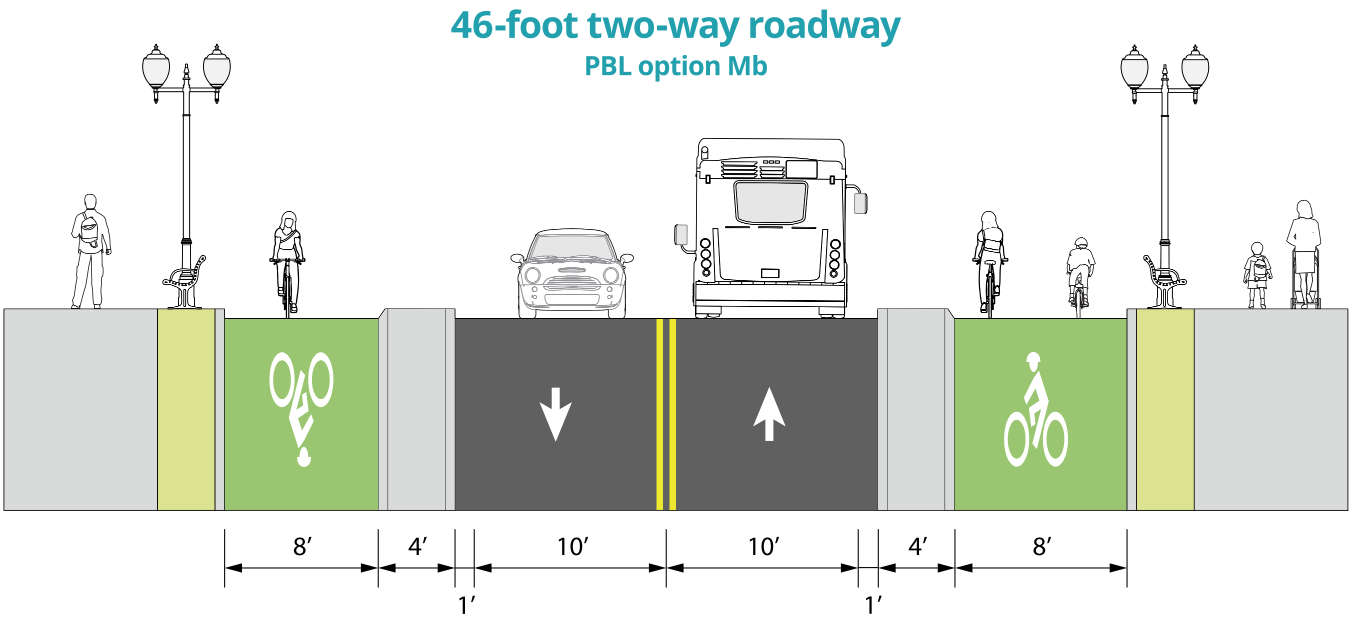
46-foot two-way roadway
PBL option Dd



46-foot two-way roadway
PBL option Dd and B



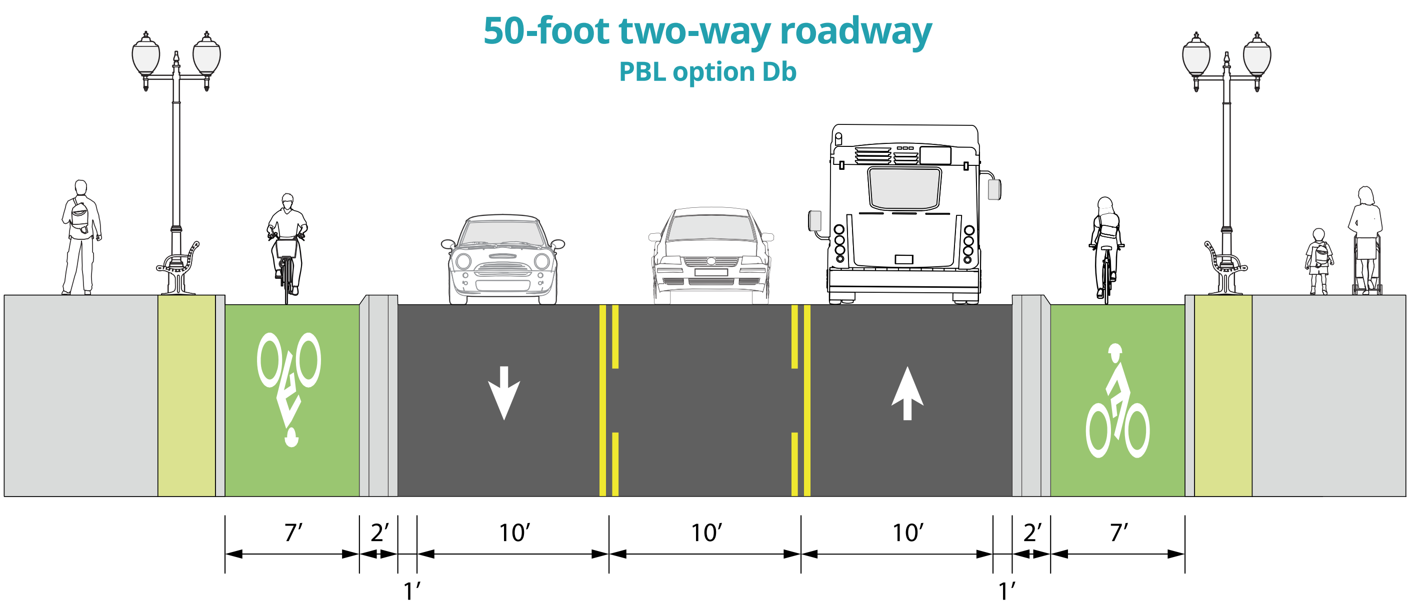
Two-Way Roadways

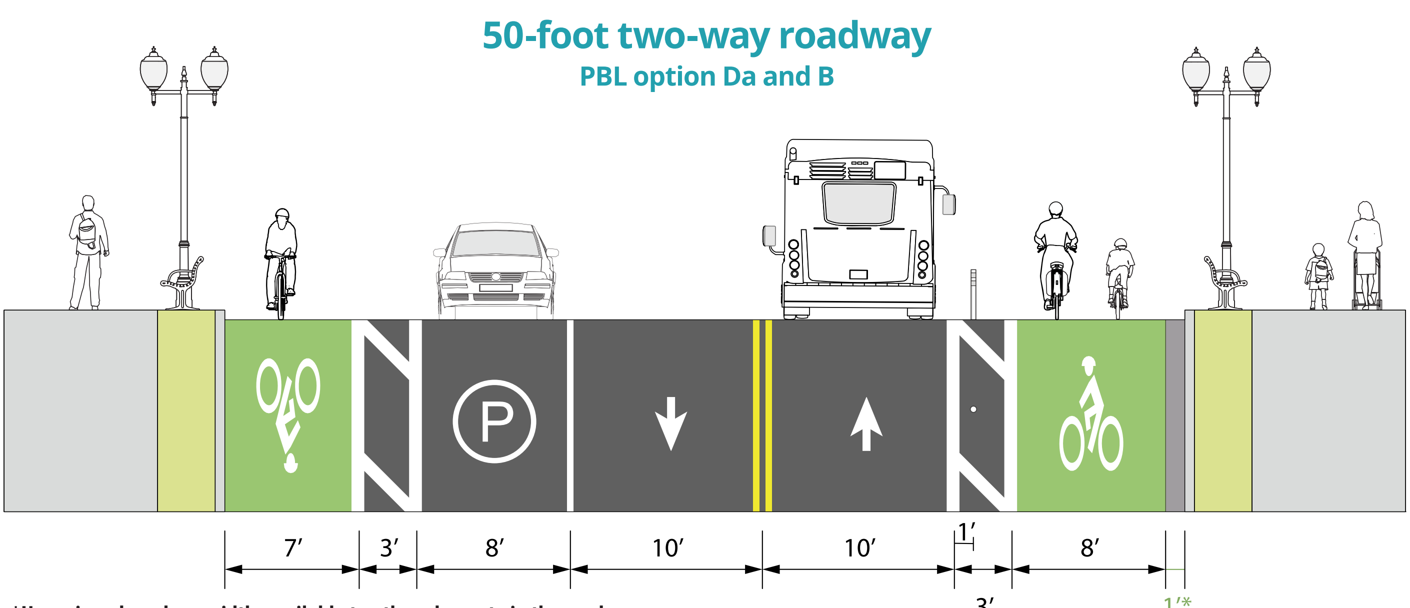


Representative Roadways

N Lombard (at the cut)
NW Front Ave
N Albina
NE 7th Ave
SE Holgate
SW Bertha
NE Cully
SE Harold

Two-Way Roadways



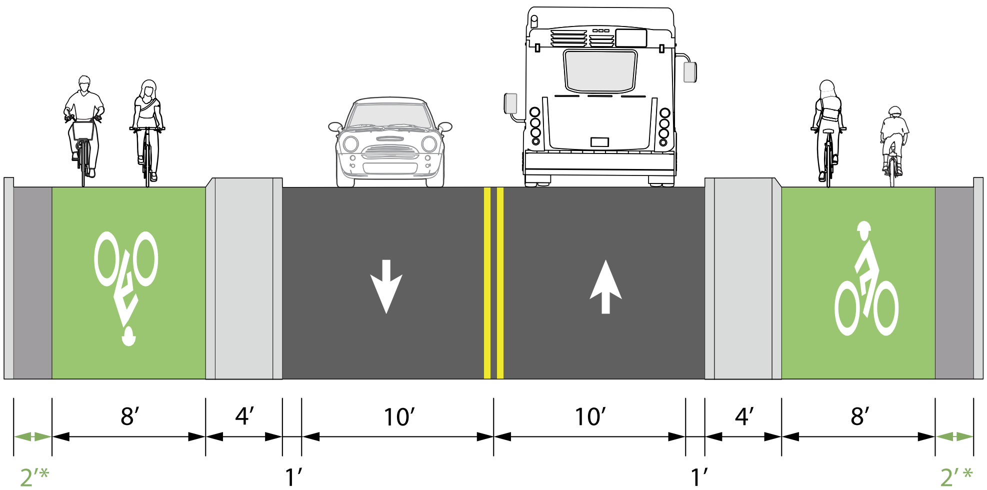


***Unassigned roadway width; available to other elements in the roadway.**

Two-Way Roadways

50-foot two-way roadway

PBL option Mb



***Unassigned roadway width; available to other elements in the roadway.**

Representative Roadways

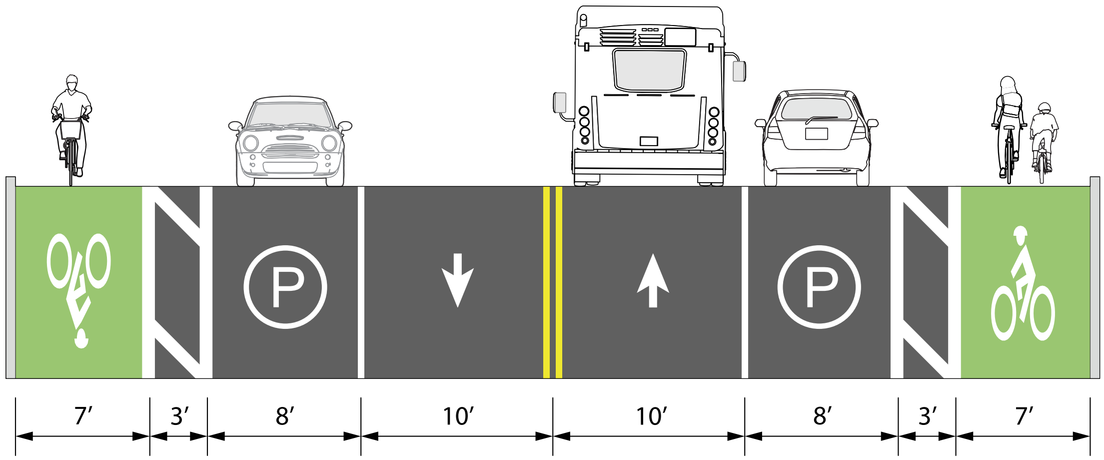
NW Broadway (Hoyt - Burnside)
N Portsmouth
N Lombard
N Fessenden
SW 26th (Marigold - Dolph)

N Denver
E Burnside (32nd - 52nd)
NE Glisan (47th to 82nd)
SE Gladstone
SE Foster (west of 75th)

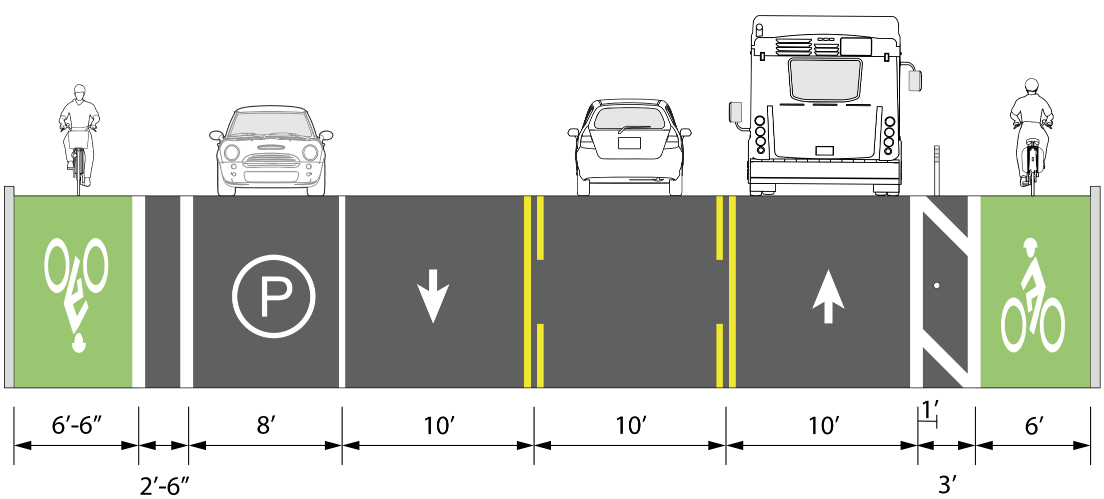
SE Woodstock (41st - 70th)
SE 41st
SE 52nd Ave (s of Duke)
SE Hawthorne (12th - 53rd)

Two-Way Roadways

56-foot two-way roadway
PBL option E

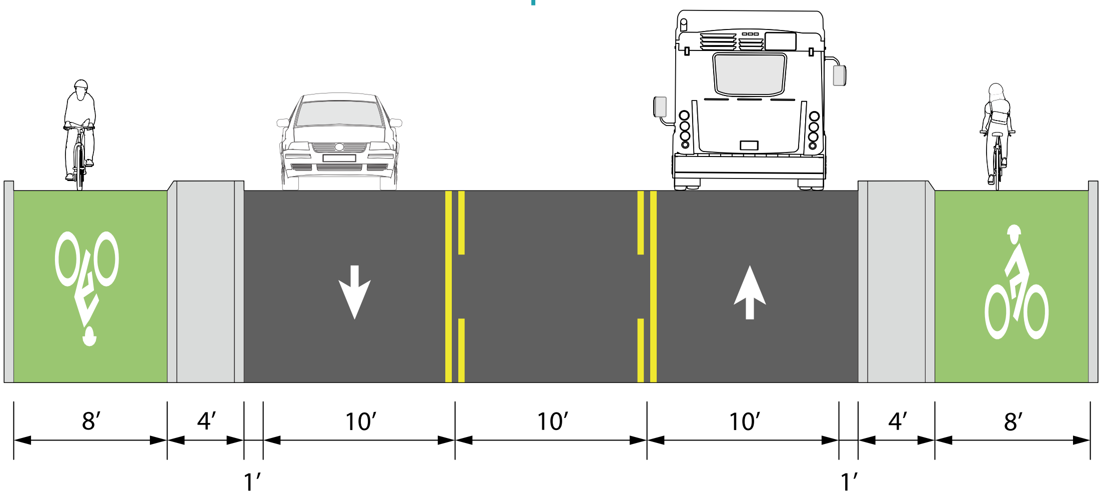


56-foot two-way roadway
PBL option Da and C



Two-Way Roadways

56-foot two-way roadway
PBL option Mb

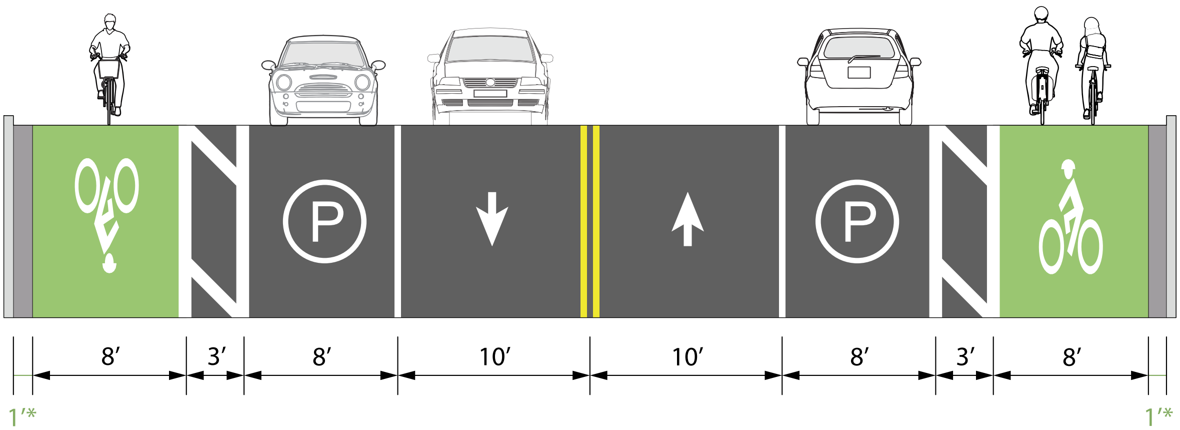


Representative Roadways

82nd Ave
SE 7th/Sandy
NE 12th Ave (I-84-Burnside)
N Basin
NE Glisan (22nd - 33rd)
N Greeley
N Smith

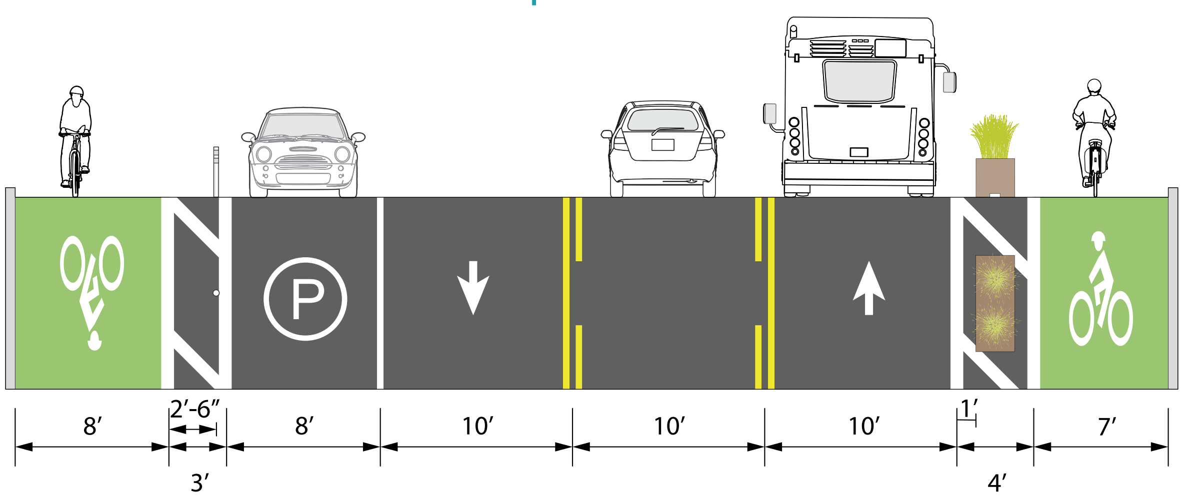
Two-Way Roadways

60-foot two-way roadway
PBL option A



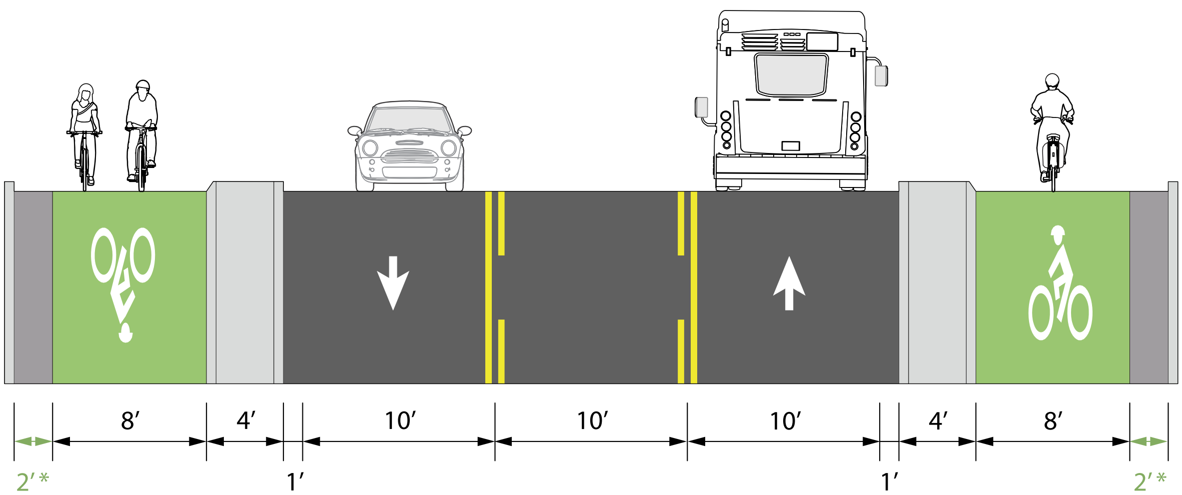
***Unassigned roadway width; available to other elements in the roadway.**

60-foot two-way roadway
PBL option Pb and Ad



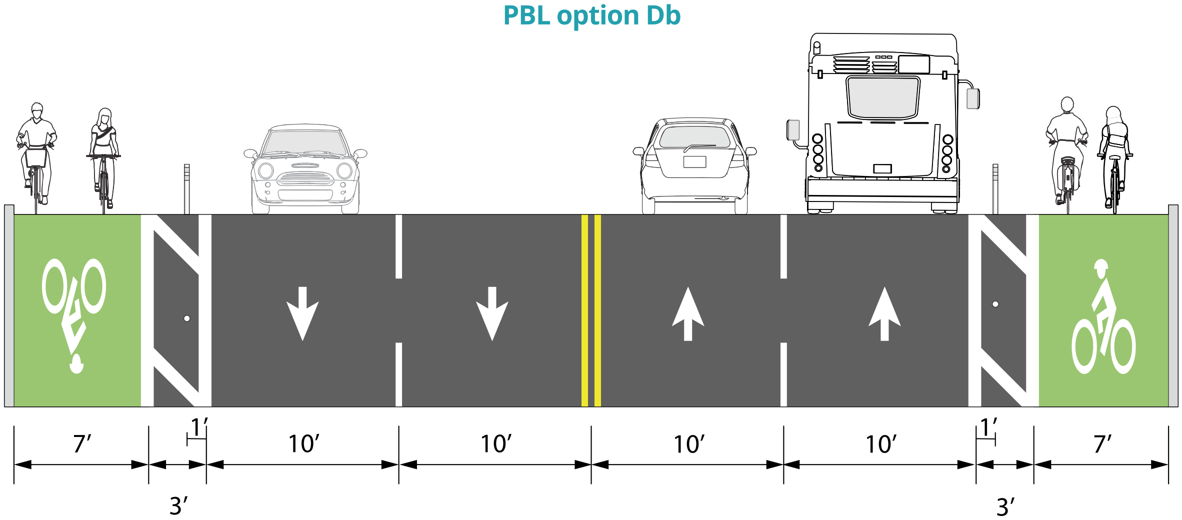
Two-Way Roadways

60-foot two-way roadway
PBL option Mb



***Unassigned roadway width; available to other elements in the roadway.**

60-foot two-way roadway
PBL option Db



Representative Roadways

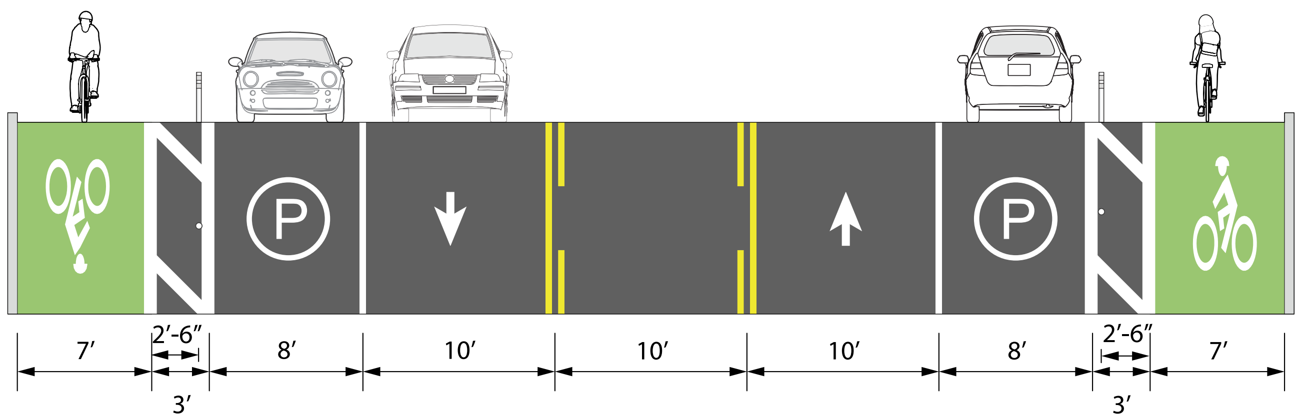
NE Lloyd
NE Multnomah
NE Sandy Blvd (12th - I-205)
NE Martin Luther King Jr
SW Terwilliger
SW Barbur (inner)

SW Capitol (southern)
N Lombard (n of St. Johns)
N Rosa Parks
N Denver
NE 82nd Ave (Fremont - Killingsworth)
SE 82nd Ave (Burnside – Springwater)

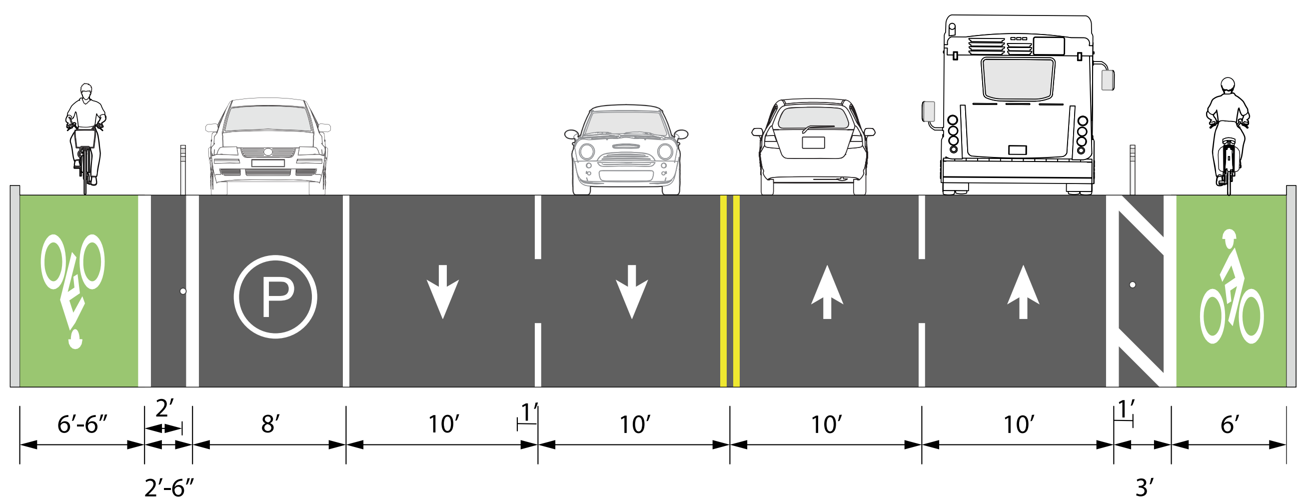
SE Powell Blvd (west of 90th)
SE Foster (w of 72nd)
SE McLoughlin Blvd (Tacoma - Tolman)
SW Capitol Hwy (Hillsdale District)
SW Barbur (through the curves; n of Naito)

Two-Way Roadways

66-foot two-way roadway
PBL option Bd



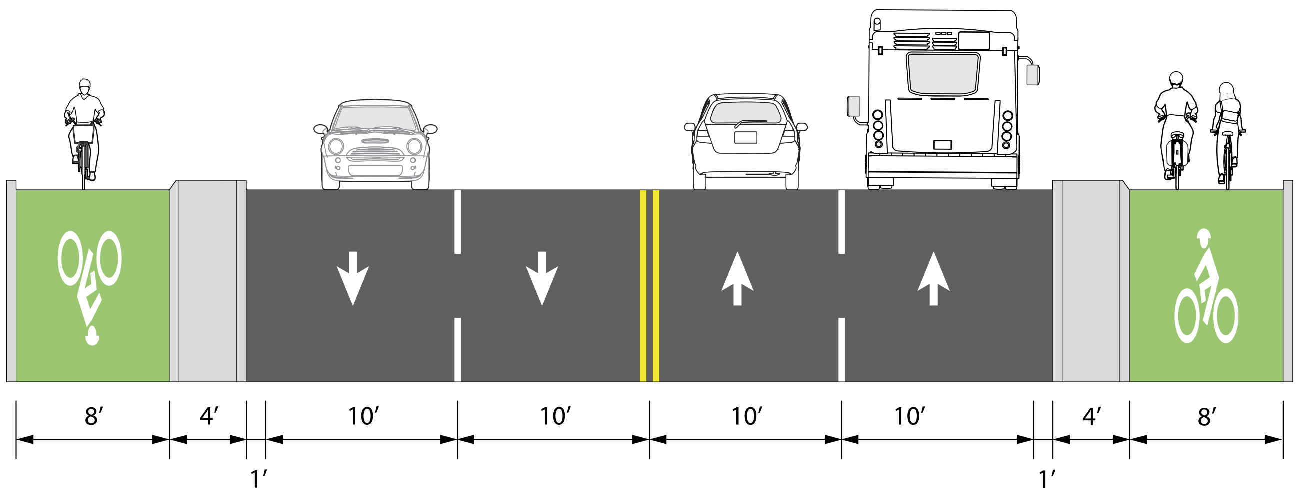
66-foot two-way roadway
PBL option Cd



Two-Way Roadways

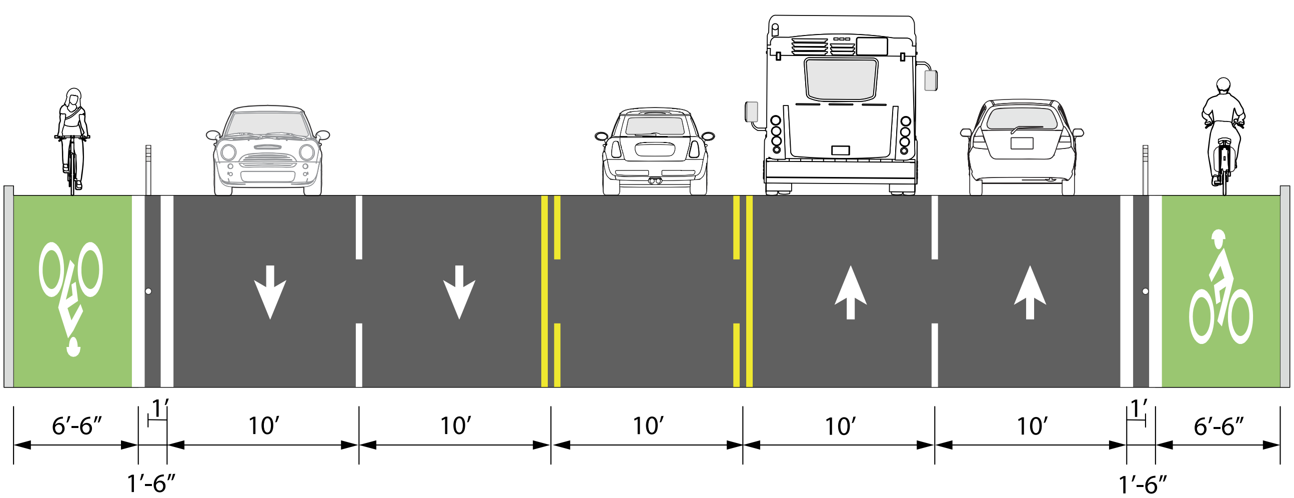
66-foot two-way roadway

PBL option Mb



66-foot two-way roadway

PBL option Dd



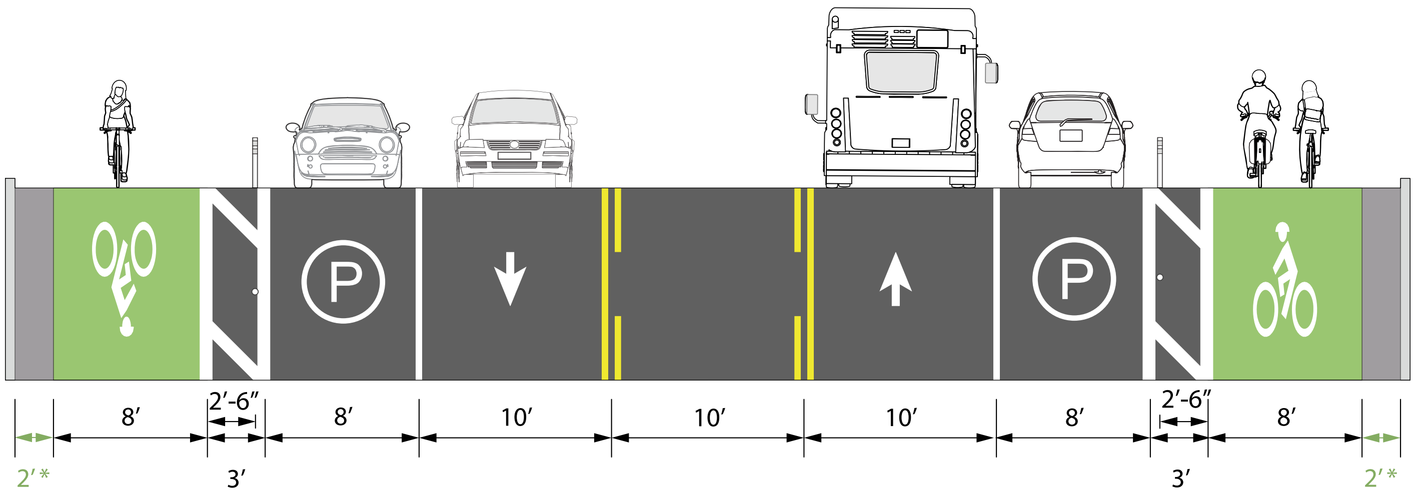
Representative Roadways

NE Halsey (e of 135th)
NE Glisan (w of 139th)
NE 148th (s of Division; Glisan - I-84)
SE Stark (e of 109th)
102nd (Halsey - Pine)
SE Holgate (96th - 122nd)
SE 92nd (Franklin - Lincoln)
NE Killingsworth (w of 47th)
NE Cully (Failing to Prescott)
N Columbia (Lombard - MLK)

Two-Way Roadways

72-foot two-way roadway

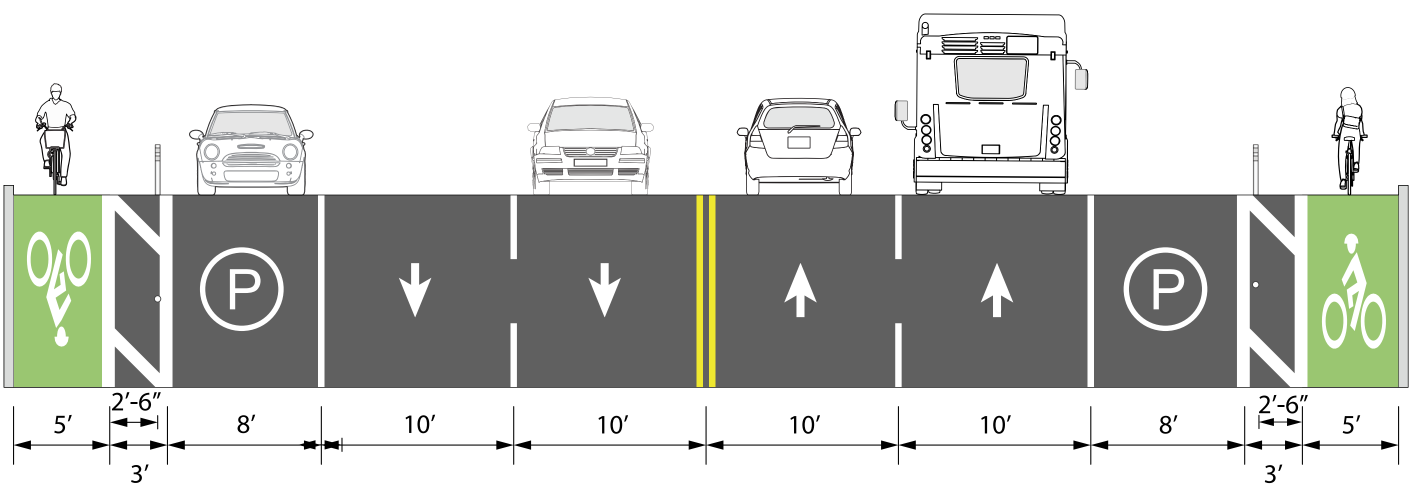
PBL option Ad



*Unassigned roadway width; available to other elements in the roadway.

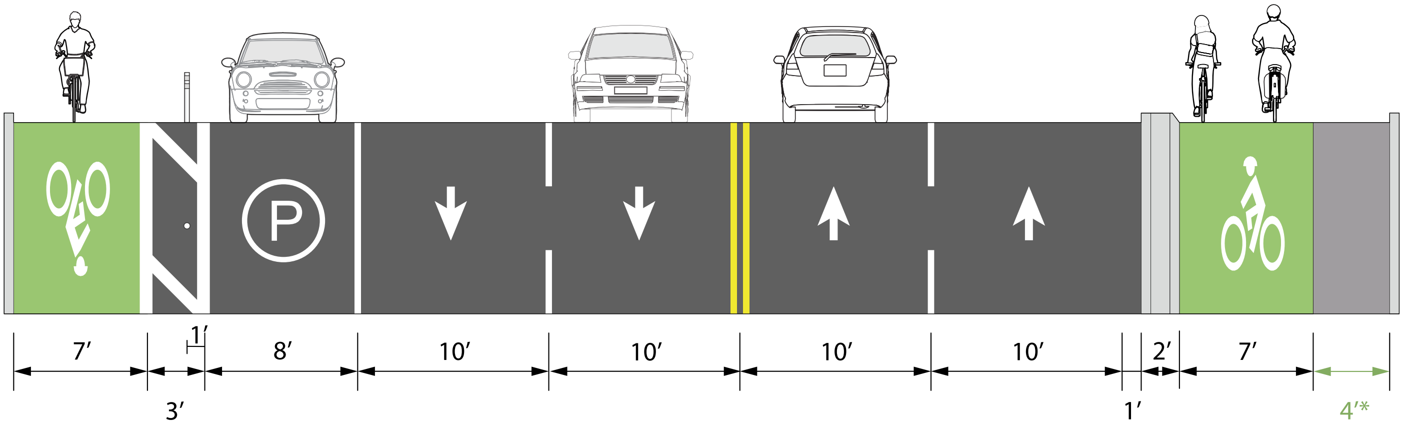
72-foot two-way roadway

PBL option Ed



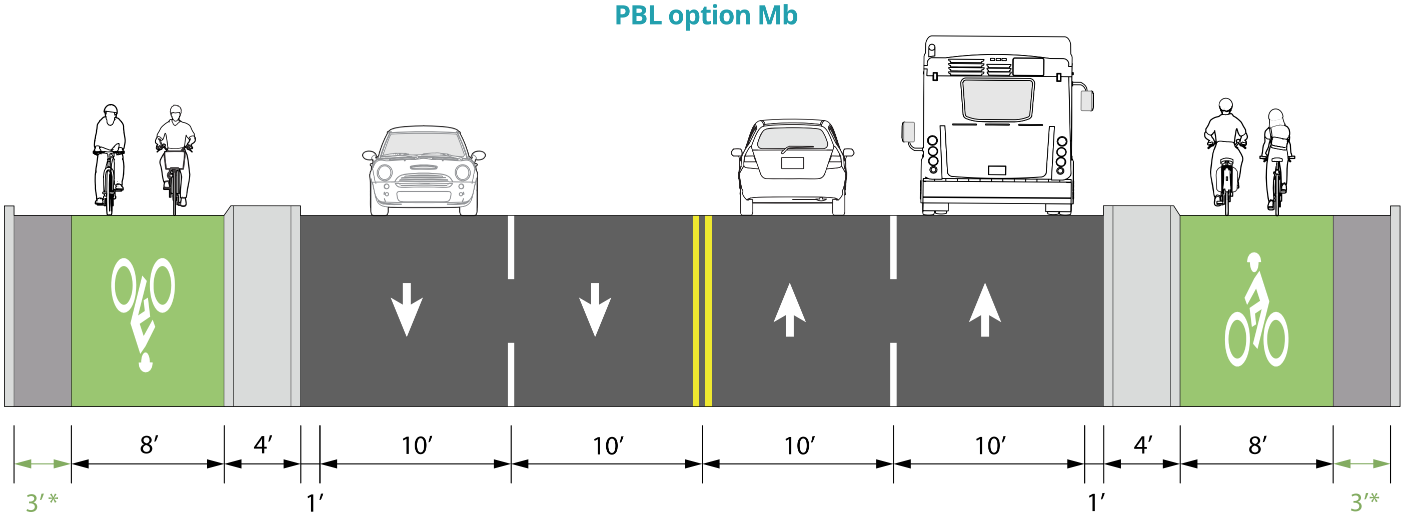
Two-Way Roadways

72-foot two-way roadway
PBL option Bd



*Unassigned roadway width; available to other elements in the roadway.

72-foot two-way roadway
PBL option Mb



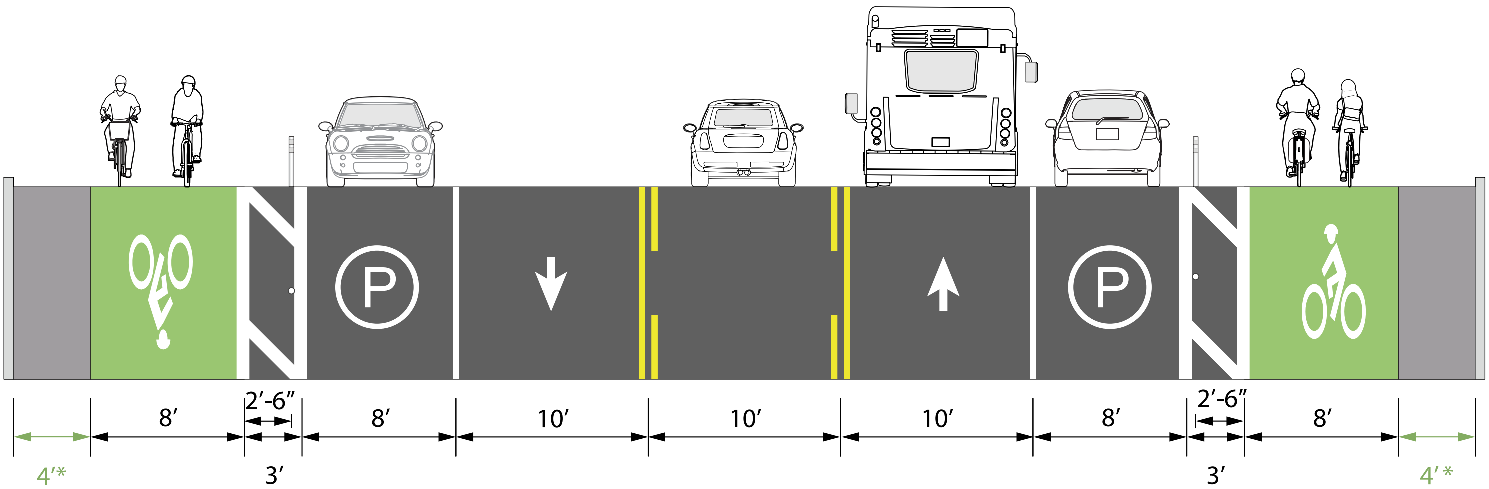
*Unassigned roadway width; available to other elements in the roadway.

Representative Roadways

NW St. Helens Rd (112th - 3700′ s of St Johns Bridge)
NE Lombard (12th - Cully)
NE Going (Interstate - Greeley ramps)
NE Killingsworth (Cully - 92nd)
NE 102nd (Prescott - Weidler)
NE Glisan (100th - 133rd)
SE 162nd (Division - Powell)
SW Beaverton-Hillsdale Hwy (Capitol - City Limit)

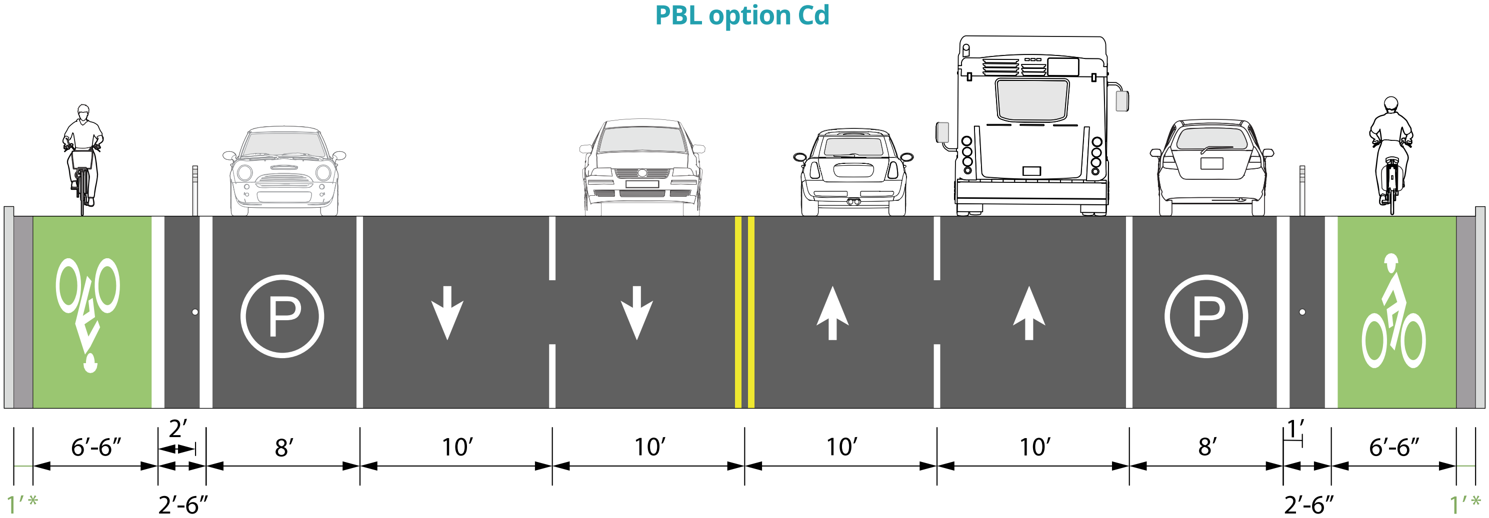
Two-Way Roadways

76-foot two-way roadway
PBL option Ad



*Unassigned roadway width; available to other elements in the roadway.

76-foot two-way roadway
PBL option Cd

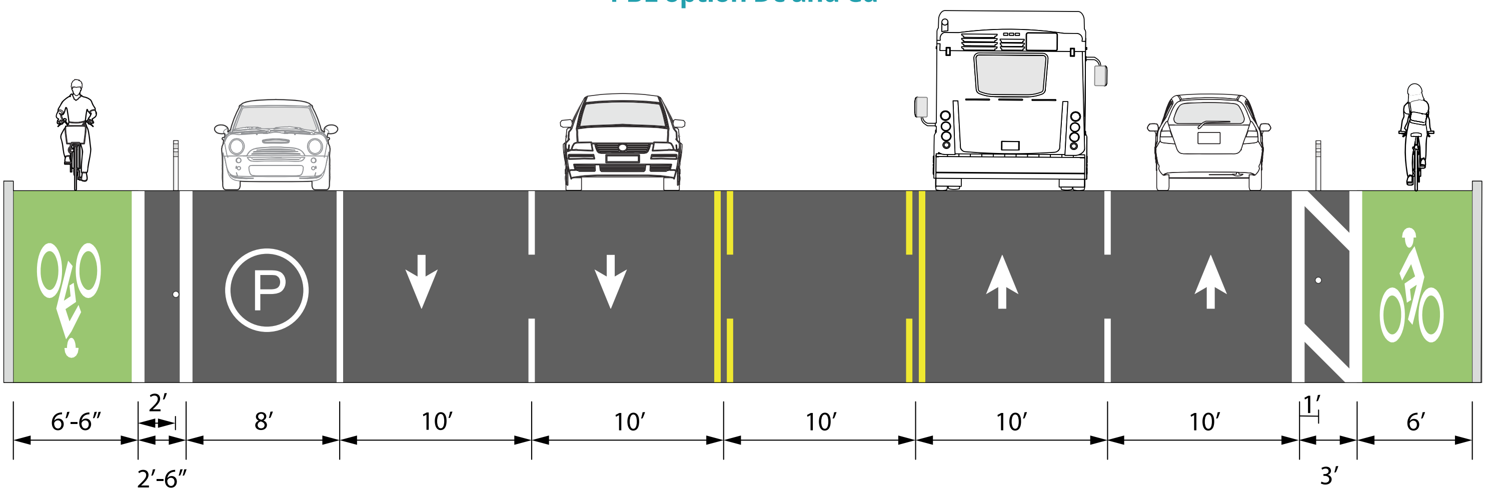


*Unassigned roadway width; available to other elements in the roadway.

Two-Way Roadways

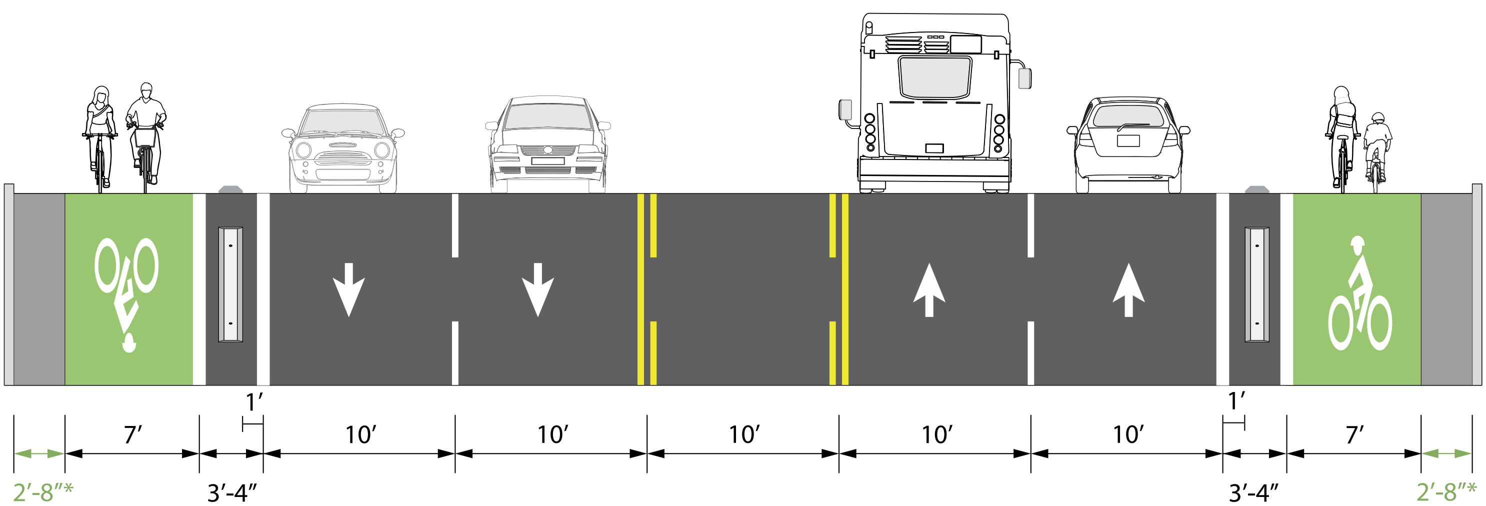
76-foot two-way roadway

PBL option Dc and Cd



76-foot two-way roadway

PBL option TSb

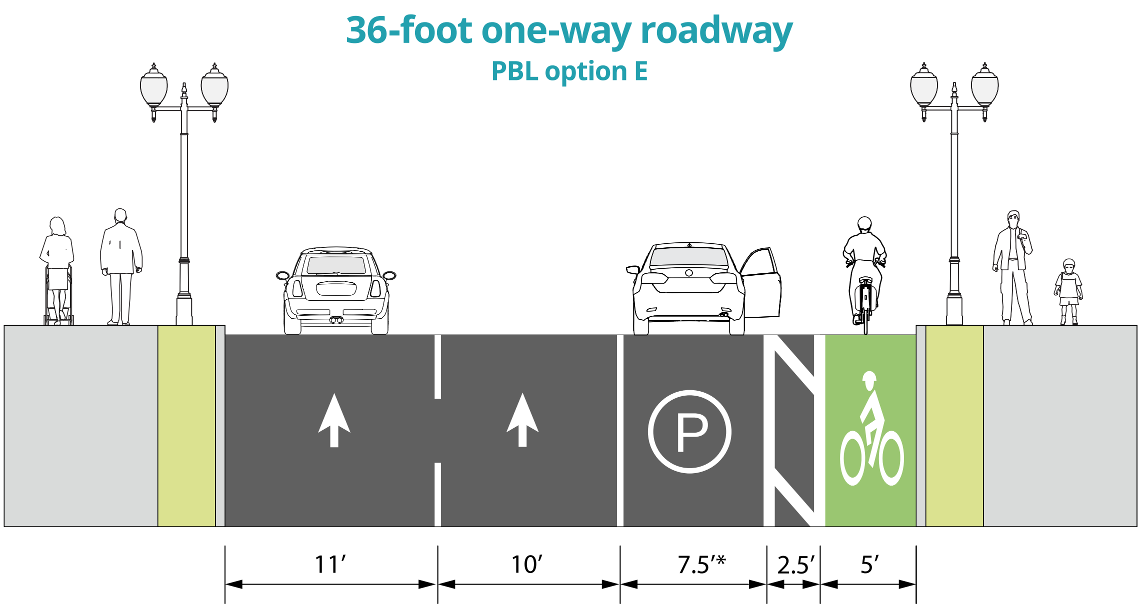


***Unassigned roadway width; available to other elements in the roadway.**

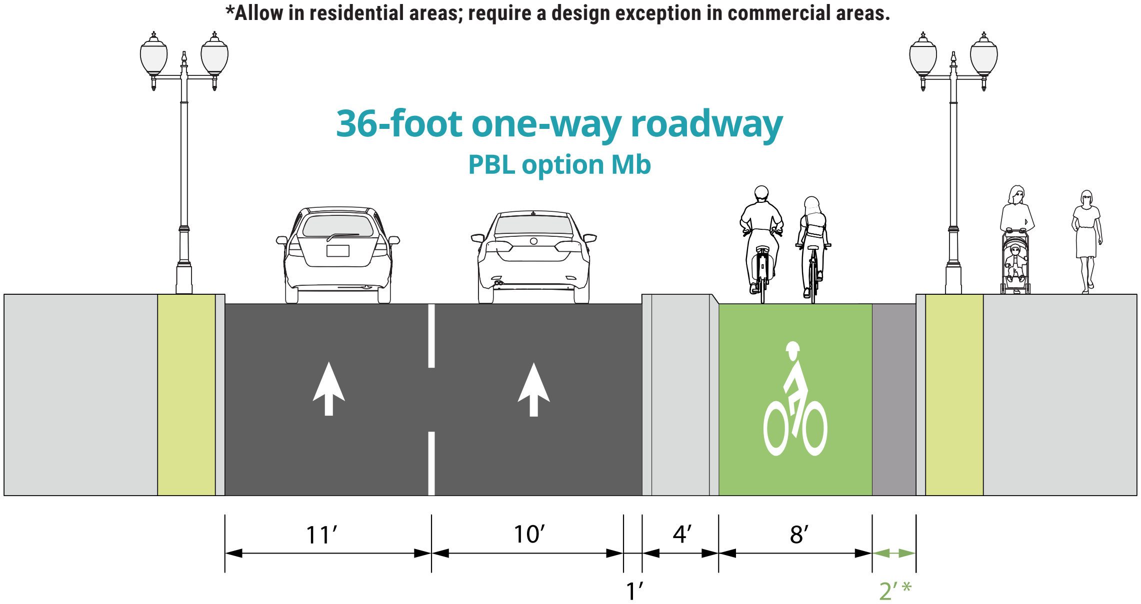
Representative Roadways

NW St Helens Rd (city limit - 107th)
NW Front Ave (Nicolai - 26th)
SW Barbur (segments)
SE McLoughlin (Ross Island Br - Knight)
SE Division (78th - City limit)
SE 162nd
122nd Avenue
NE Halsey (114th to 136th)

One-Way Roadways



*Allow in residential areas; require a design exception in commercial areas.



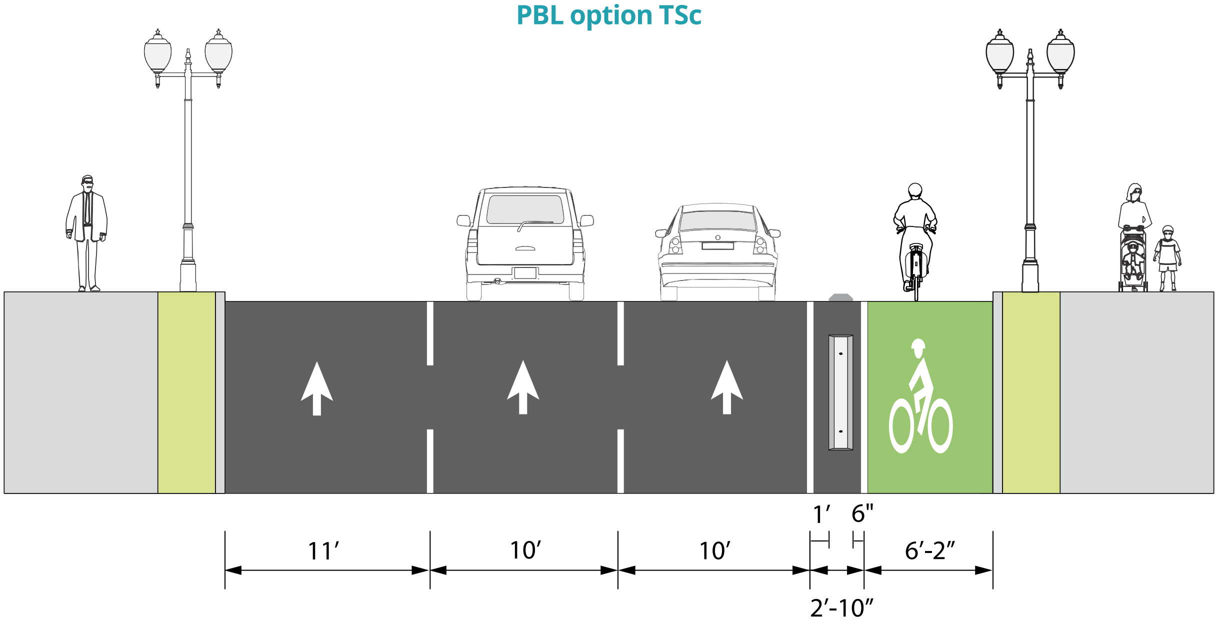
*Unassigned roadway width; available to other elements in the roadway.

Representative Roadways

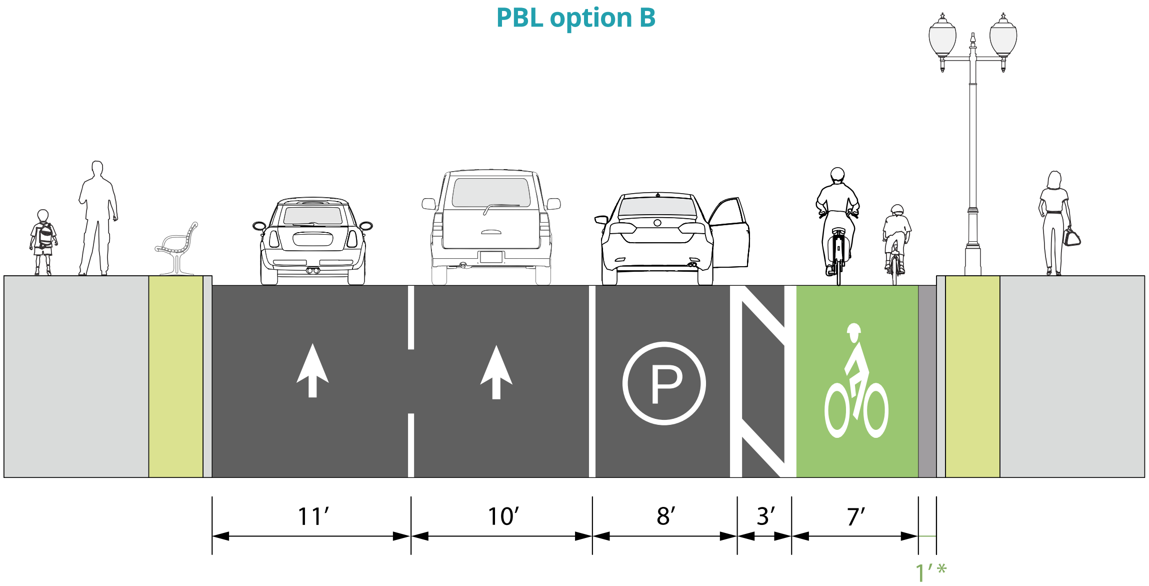
NW Glisan
NW 16th Ave (Thurman - Johnson)
NW 14th (Thurman - Everett)
NW 14th
NW 18th
NW 19th
NW Everett
SW Columbia (18th - 1st; segments)
SW Salmon
SW Alder
SW Stark
SW Oak
SW Jefferson (Park - 1st)
SW Madison (Park - 1st)
SW 14th (Columbia - Taylor)
SW 13th (Mill - Taylor)
SE Madison (Grand - 12th)
SE 11th
SE 12th
SE Morrison (12th - 23rd)
N Vancouver (many segments between Alberta - Hancock)
NE Weidler (16th - 21st)
NE Couch
SE Morrison

One-Way Roadways

40-foot one-way roadway
PBL option TSc



40-foot one-way roadway
PBL option B



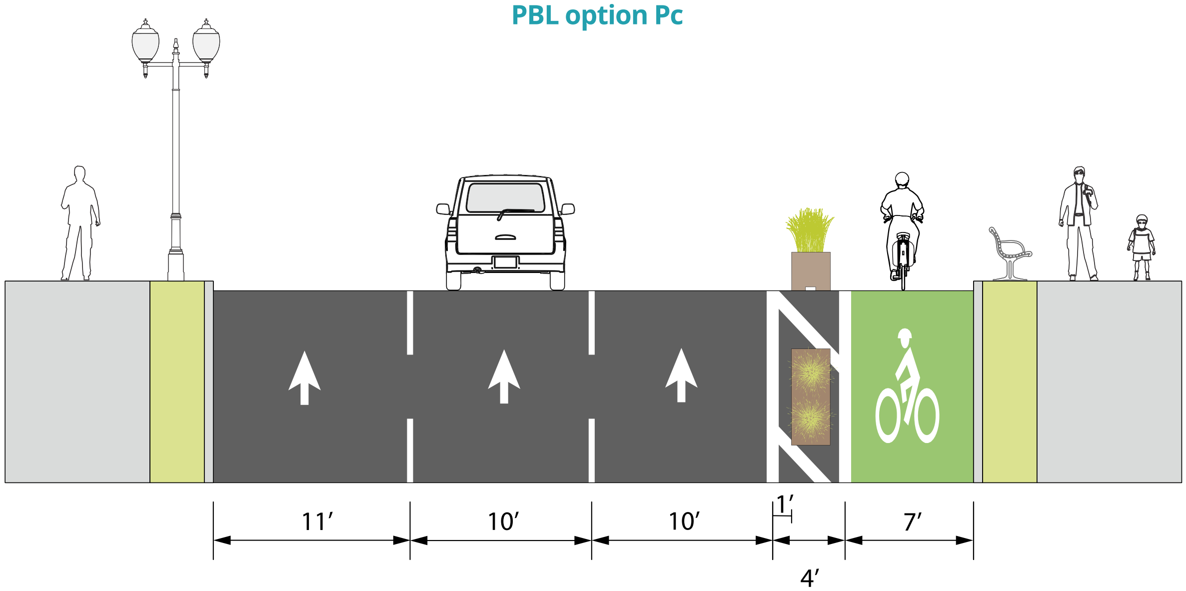
***Unassigned roadway width; available to other elements in the roadway.**

Representative Roadways

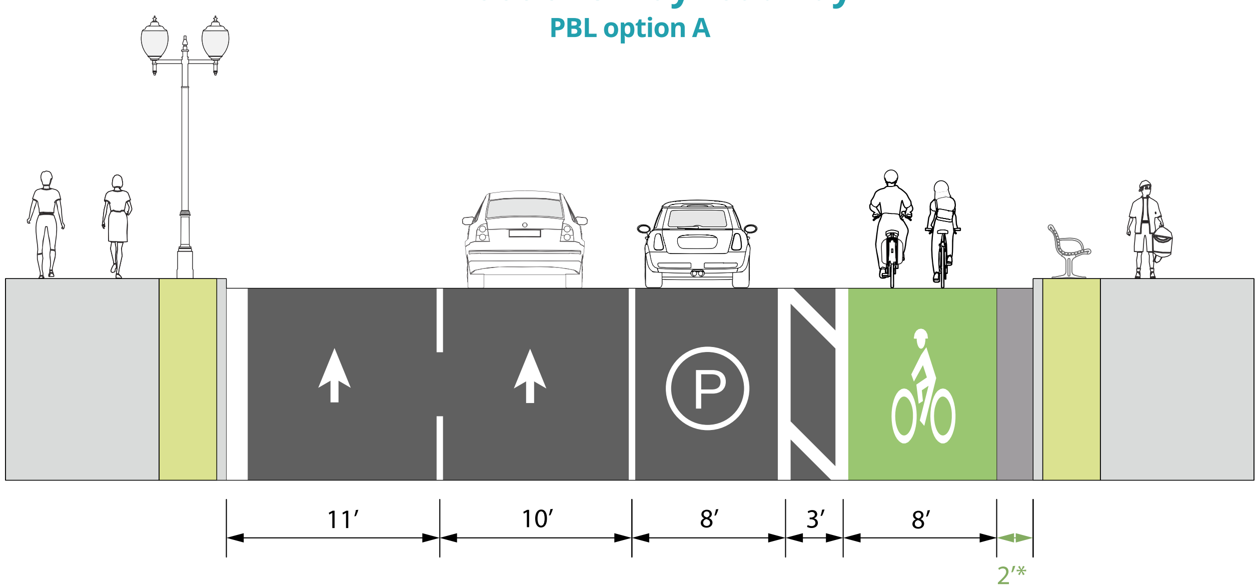
N Williams

One-Way Roadways

42-foot one-way roadway
PBL option Pc



42-foot one-way roadway
PBL option A



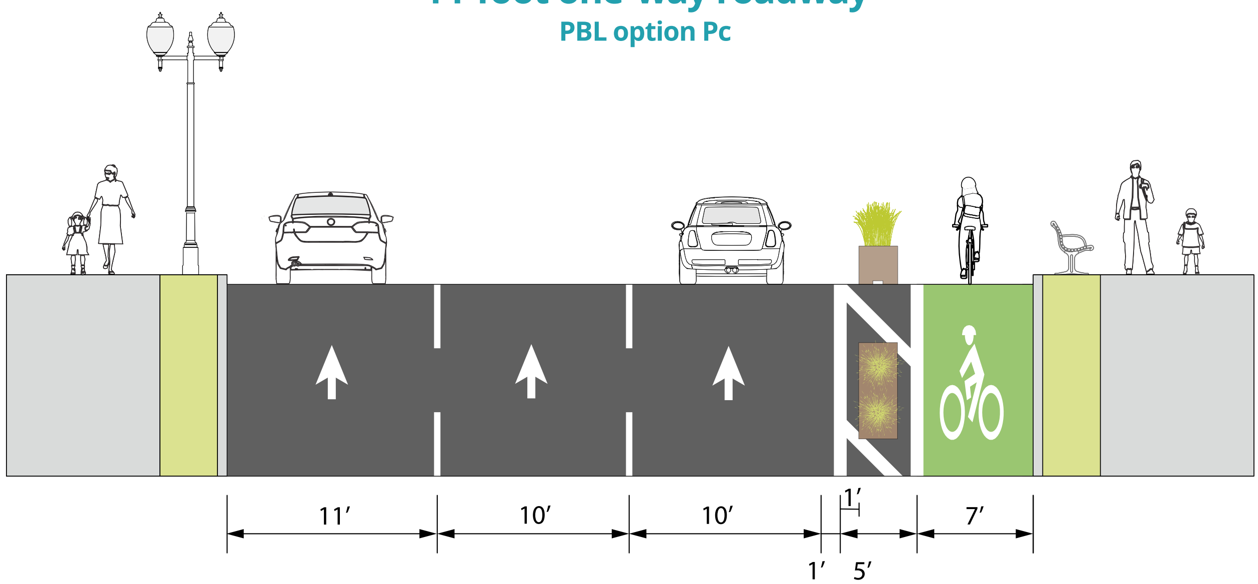
***Unassigned roadway width; available to other elements in the roadway.**

Representative Roadways

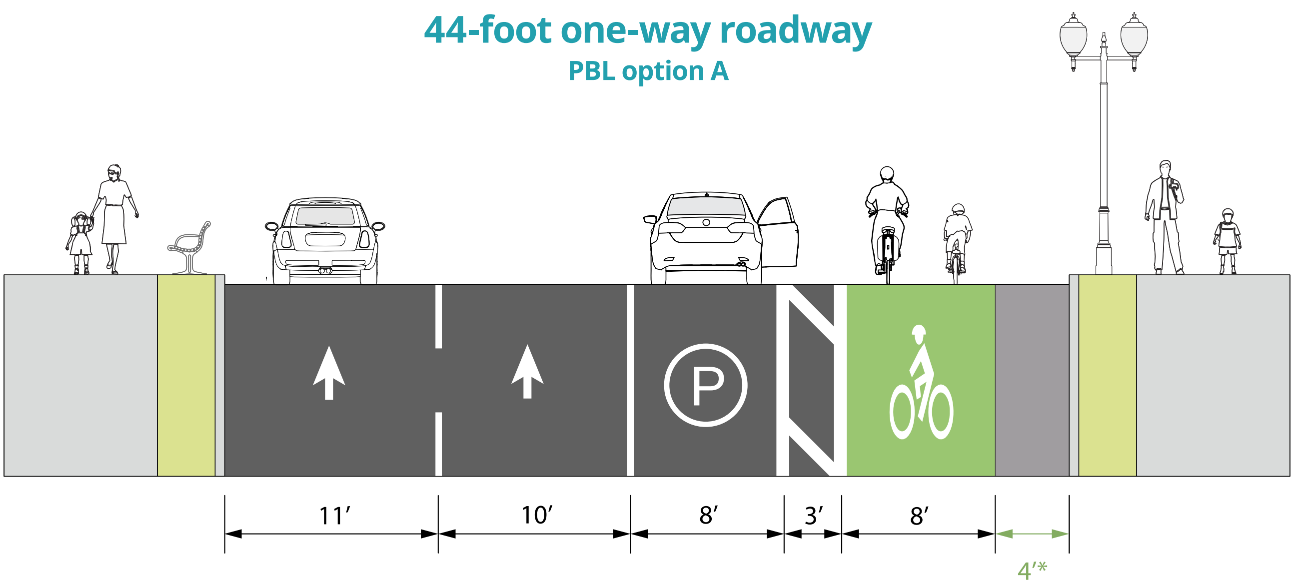
SE Belmont (12th-26th)

One-Way Roadways

44-foot one-way roadway
PBL option Pc



44-foot one-way roadway
PBL option A



***Unassigned roadway width; available to other elements in the roadway.**

Representative Roadways

NE Halsey

NE Weidler

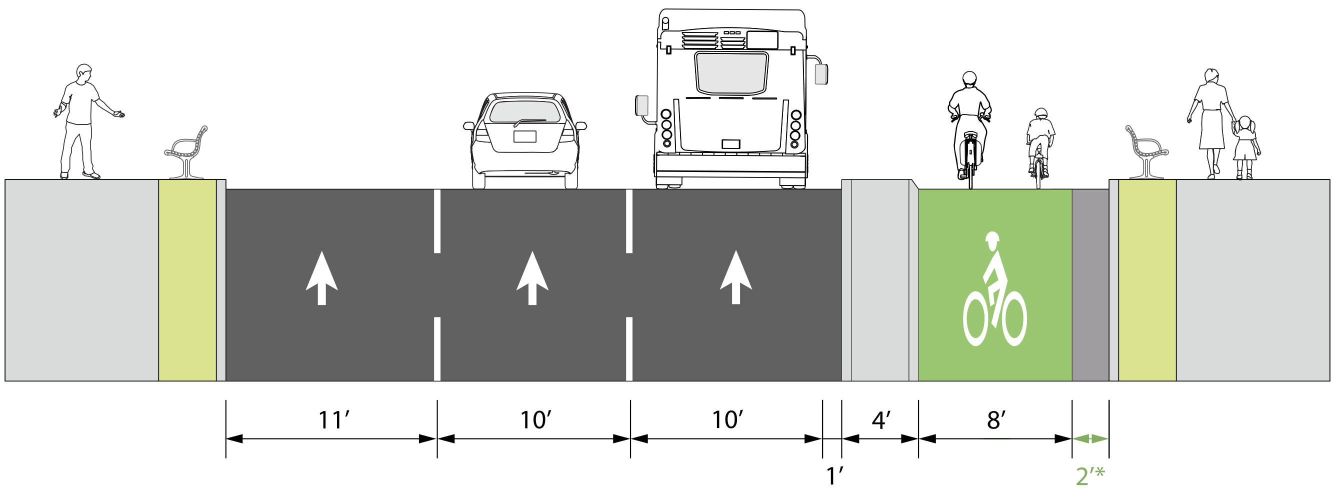
SE Stark (w of 92nd)

NE Grand Ave (N of Holladay)

SE 102/103rd (s of Stark)

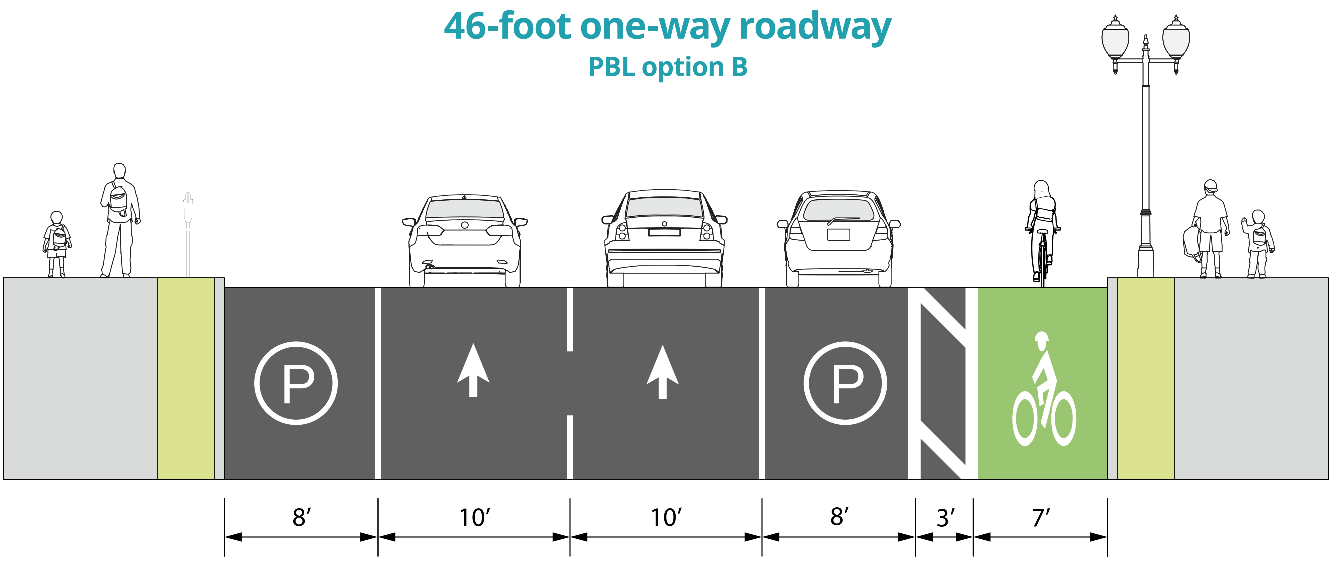
One-Way Roadways

46-foot one-way roadway
PBL option Mb



***Unassigned roadway width; available to other elements in the roadway.**

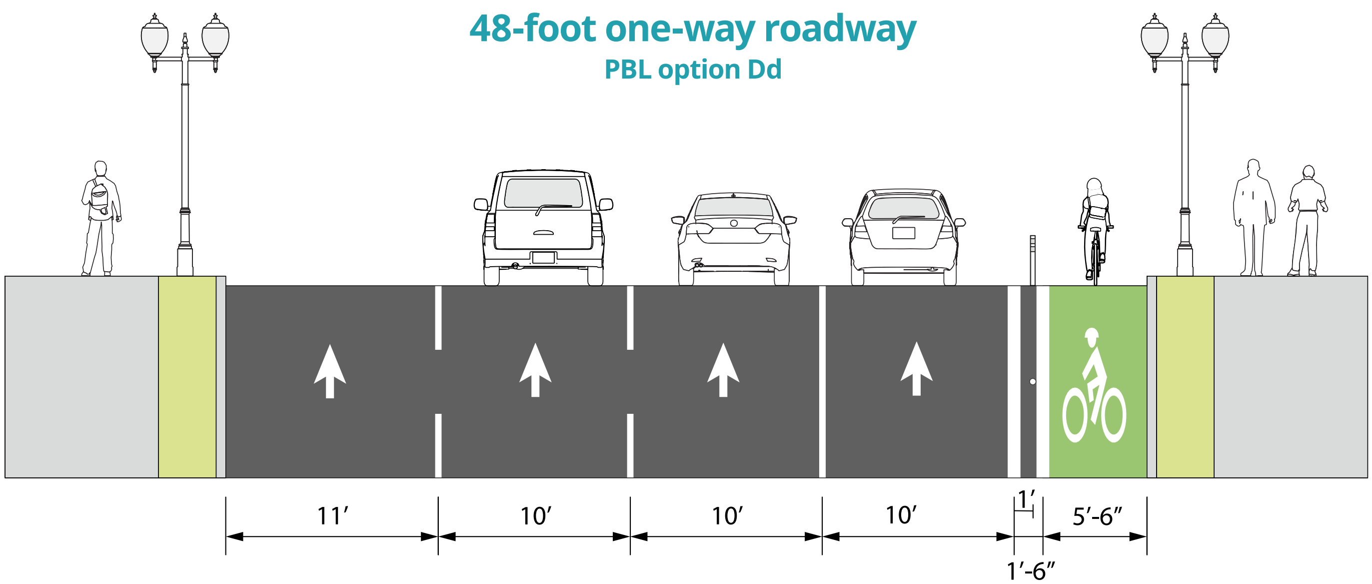
46-foot one-way roadway
PBL option B

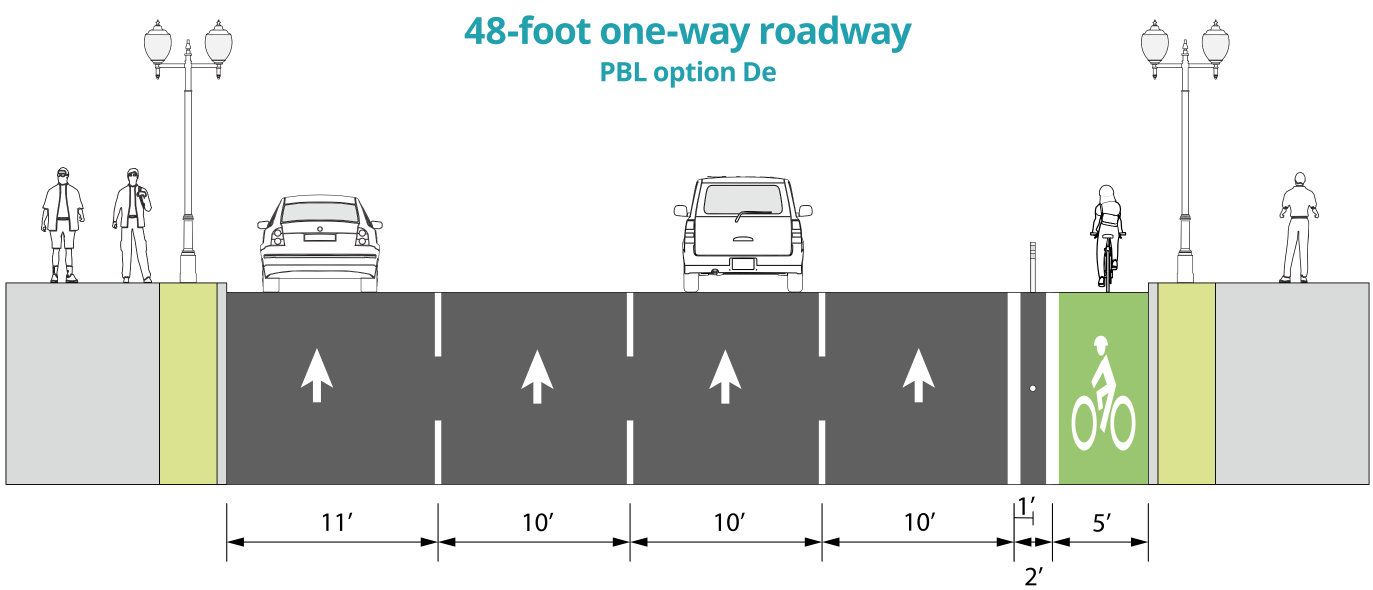


Representative Roadways

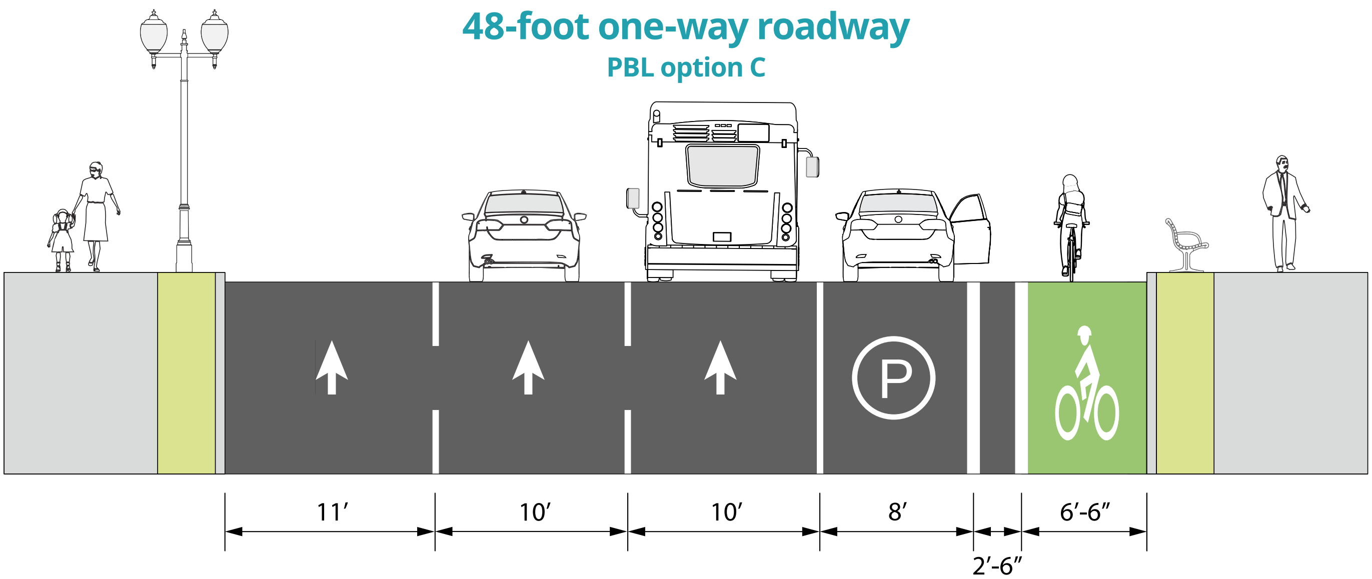
SW/NW 2nd Ave (Flanders - Main)
NW 3rd Ave (Davis - Burnside)

One-Way Roadways





One-Way Roadways



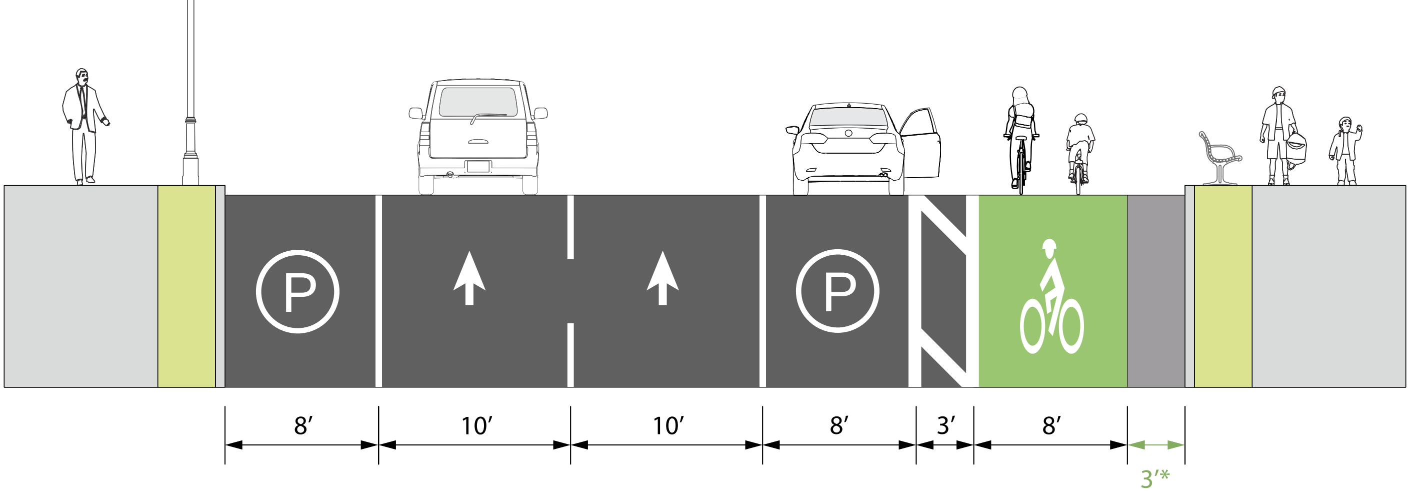
Representative Roadways

SE Washington (east of I-205)

SW Broadway (6th - I-405)

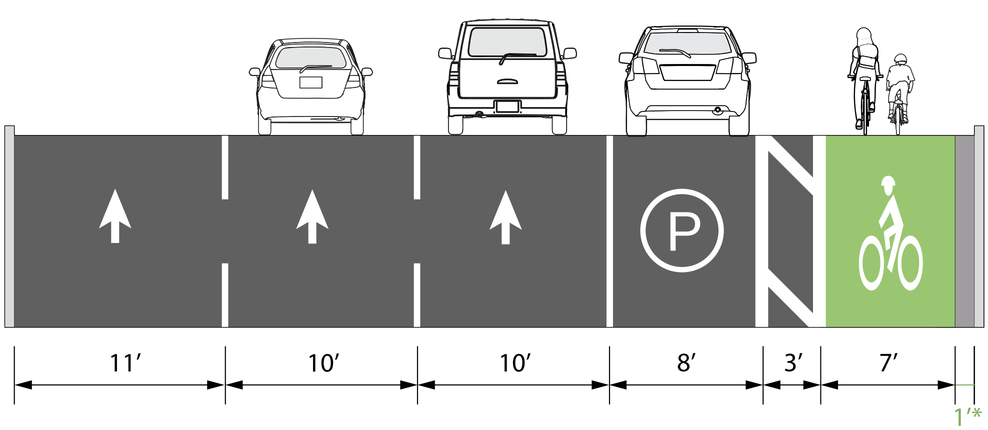
One-Way Roadways

50-foot one-way roadway
PBL option A



*Unassigned roadway width; available to other elements in the roadway.

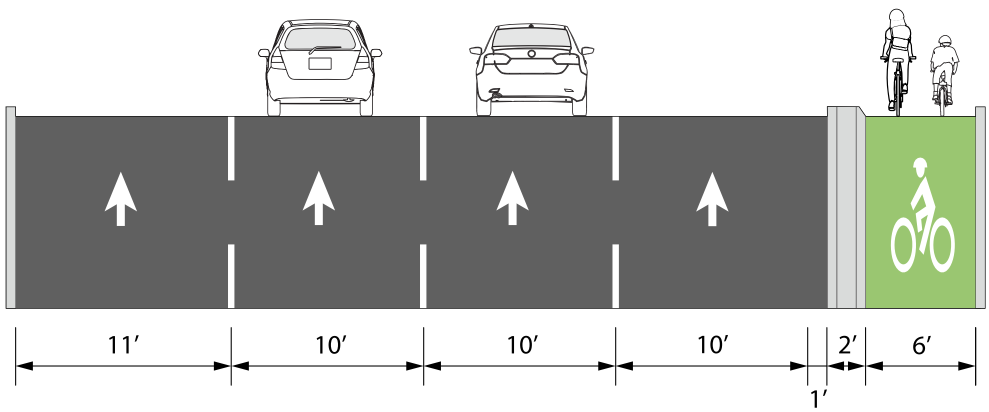
50-foot one-way roadway
PBL option B



*Unassigned roadway width; available to other elements in the roadway.

One-Way Roadways

50-foot one-way roadway
PBL option Mc

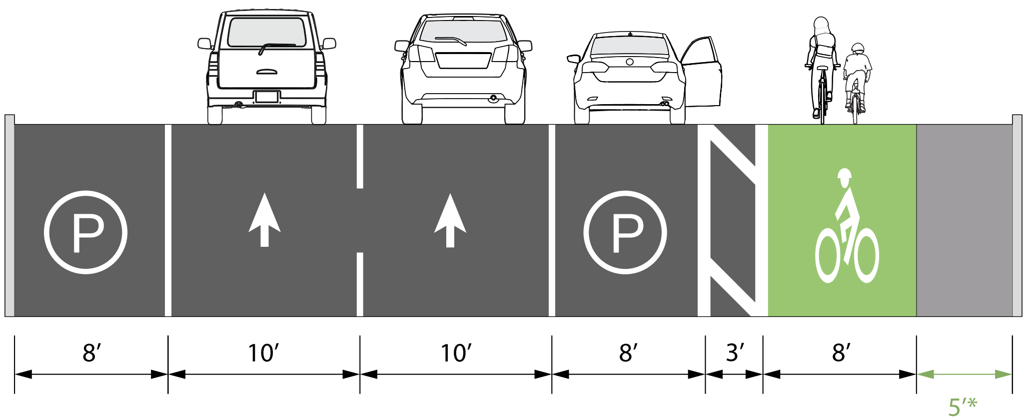


Representative Roadways

SW Broadway (Burnside - Jackson)
SW 4th (Burnside - Jackson)
SW 3rd (Ash - Salmon)
SW 12th (Stark - Montgomery)
NE Weidler (MLK - Victoria)

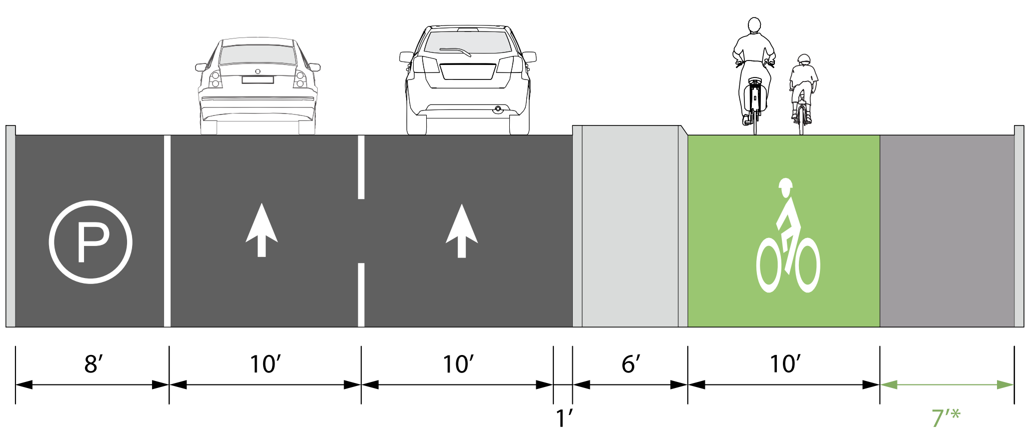
One-Way Roadways

52-foot one-way roadway
PBL option A



*Unassigned roadway width; available to other elements in the roadway.

52-foot one-way roadway
PBL option Ma



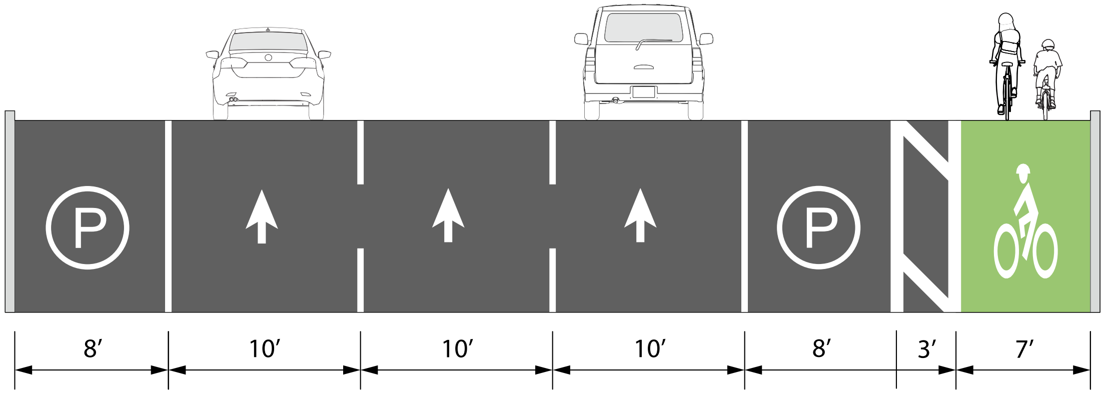
*Unassigned roadway width; available to other elements in the roadway.

Representative Roadways

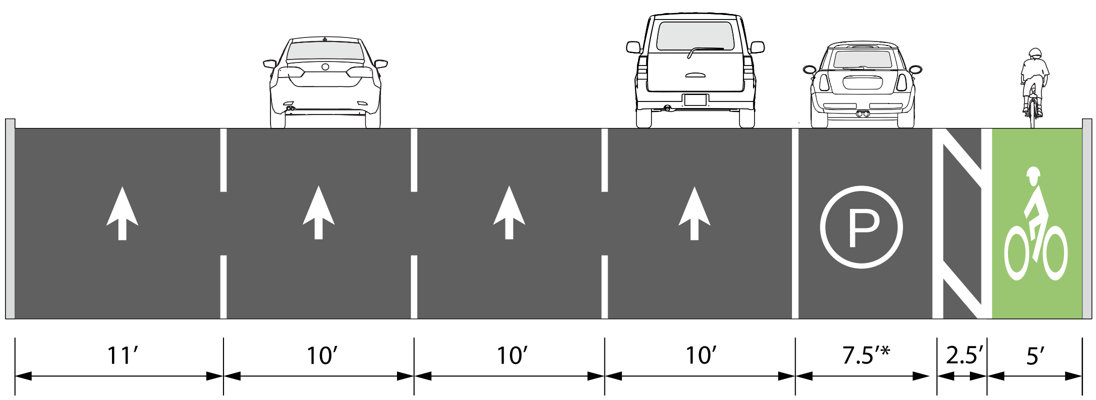
NE Broadway (Williams - Grand; 10th - 17th)
NE Weidler (8th - 16th)
SE Hawthorne (Grand-12th)

One-Way Roadways

56-foot one-way roadway
PBL option B



56-foot one-way roadway
PBL option E

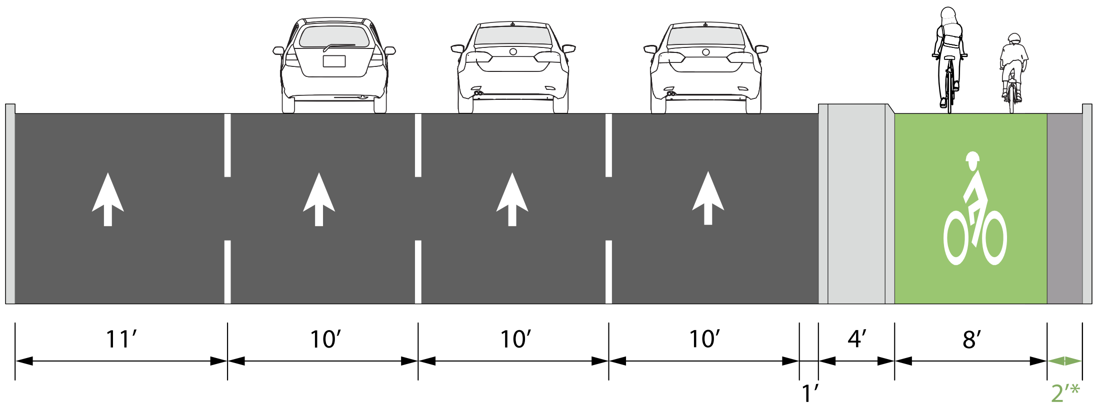


***Allow in residential areas. Require design exception in commercial areas**

One-Way Roadways

56-foot one-way roadway

PBL option Mb



***Unassigned roadway width; available to other elements in the roadway.**

Representative Roadways

NE Broadway (segments east of Grand; 17th - 24th)

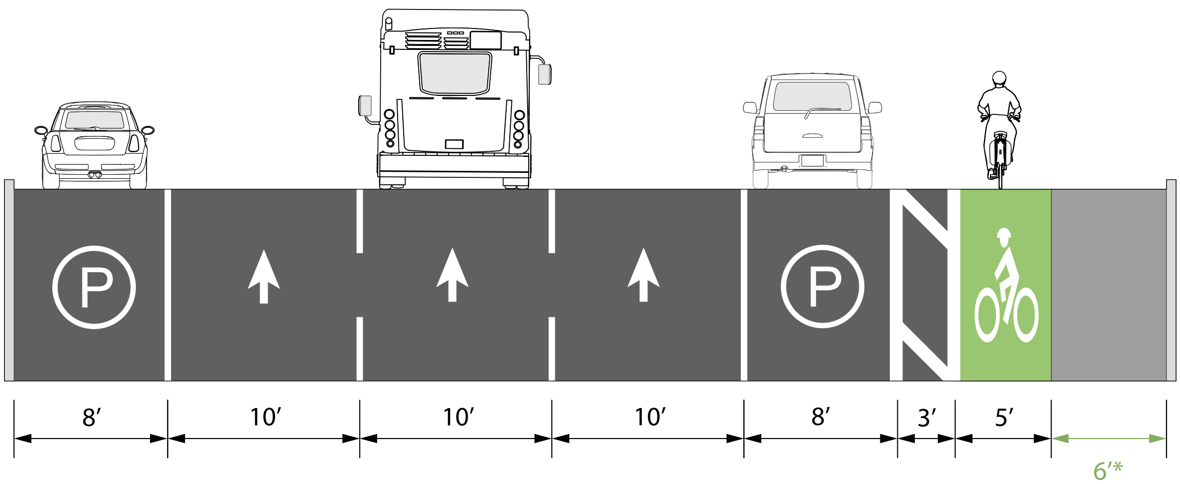
Martin Luther King Jr. Blvd (multiple segments Lincoln - Hancock)

Grand Avenue (multiple segments s of Holladay)

E Burnside (Couch - 11th)

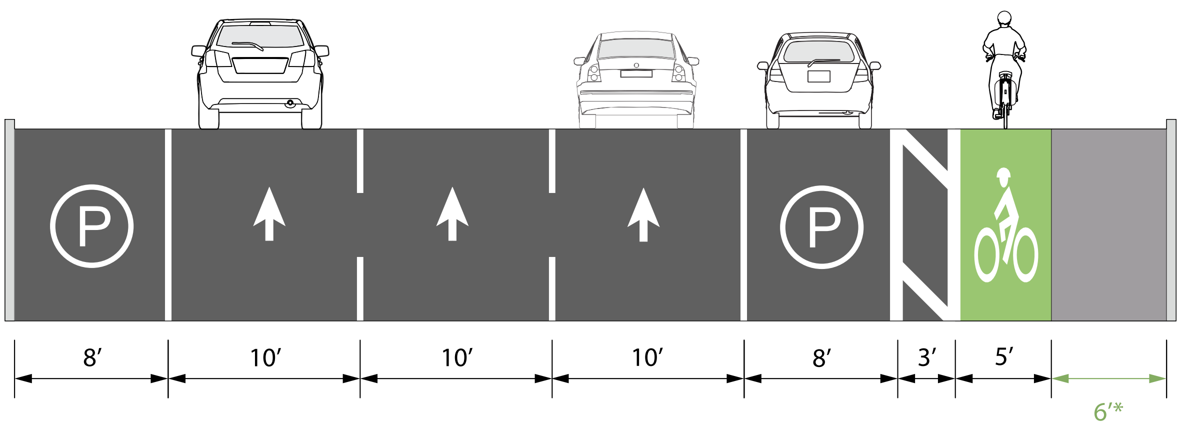
One-Way Roadways

60-foot one-way roadway
PBL option E



***Unassigned roadway width; available to other elements in the roadway.**

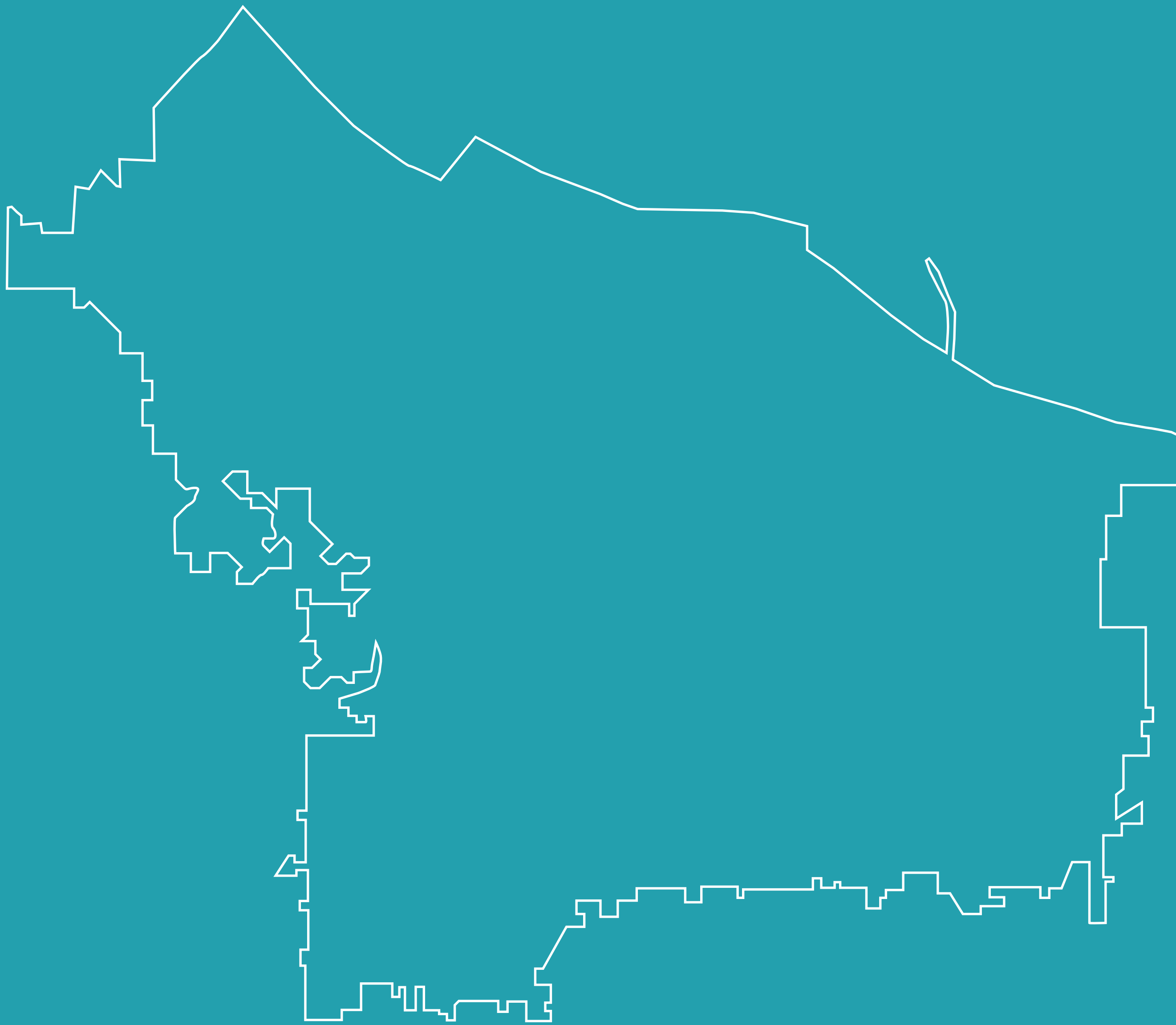
66-foot one-way roadway
PBL option B



***Unassigned roadway width; available to other elements in the roadway.**

Representative Roadways

SE Stark Street (93rd - 106th)



SECTION FOUR

Portland roadways identified for separated bikeway treatment

Planning level considerations and maps of Portland roadways to be considered for protected bicycle lanes

This section provides a detailed look at the extent and location of the two-way and one-way roadways identified in Portland's *Transportation System Plan* and *Central City 2035 Plan* as either City Bikeways or Major City Bikeways and that are called out in the *Bicycle Plan for 2030* as requiring separated treatment. Examples of the types of facilities that can be provided on these roadways were shown in Section 3. A more complete list of how protected bicycle lanes can be provided at each roadway width is shown in tables in **Appendix C**.

The following maps show those identified roadways by width and traffic pattern (one- vs. two-way). The most common width roadways are shown in **Figure 19** with large bold text. Other widths that can be accommodated by similar protected bikeway designs are identified and included in the assessment of each principal width.

Separated In-Roadway Bikeways

The maps in this section display approximately 460 centerline miles of roadways identified for separated bicycle lane treatments. [21] Four hundred and fifteen (415) miles are two-way roadways, representing 90% of the total. The other 45 miles are one-way roadways.

Portland has relatively narrow roadways. As shown in **Figure 19**, approximately 45% of Portland's classified bikeways requiring separation are 36 feet or less in width. Other roadway widths are more evenly distributed up to 76-feet curb-to-curb. Thirty-six feet is the most common width for both one and two-way roadways.

Following are brief descriptions of each width category. Each category includes roadways of similar width, with the predominant width at each category identified in the sub-heading, and subsequent map titles.

33-foot and narrower roadways
(includes streets as narrow as 20 feet)

As displayed in **Figure 19**, there are 110 miles of two-way roadways in Portland narrower than 34-feet and classified as City Bikeways where the intended bikeway treatment requires separation (none are Major City Bikeways). The narrowest protected bicycle lane design in this guide requires seven-feet outside the travel lane (design De). Under the best conditions, this requires a two-way roadway width of 34-feet to allow for two 10-foot travel lanes. For this reason, two-way roadways with widths of 33-feet or narrower cannot be retrofit with protected bicycle lanes.

Such roadways can be re-striped to provide standard bicycle lanes. They can also be reconstructed to provide protected bicycle lanes in a wider cross-section or, can be reconstructed with raised bicycle lanes. But, for the purposes of this guide, such roadways cannot be retrofit with protected bicycle lanes. As shown in **Figure 20**, most of these narrow two-way roadways are in SW Portland.

[21] This data is derived from PBOT's pavement layer shapefile. Because there are gaps in coverage in that shapefile for most roadways, the total does not equal the 493 miles of separated in-roadway bicycles identified in the city's bicycle shapefile. The 493-mile figure is considered the accurate number.

	Two-Way			One-Way			Entire SIR Network Miles
	Miles	*% of two-way network*	*% of overall SIR network*	Miles	*% of one-way network*	*% of overall SIR network*	
Less than 34 feet	**110**	*27%*	*24%*	**3**	*7%*	*1%*	**113**
36 feet (includes 34, 35, 37 and 38 feet, too)	**73**	*18%*	*16%*	**17**	*38%*	*4%*	**90**
40 feet (includes 39, 41 and 42 feet, too)	**35**	*8%*	*8%*	**4**	*9%*	*1%*	**39**
44 feet (includes 43 and 45 feet, too)	**27**	*7%*	*6%*	**5**	*11%*	*1%*	**32**
46 feet (includes 47 feet, too)	**11**	*3%*	*2%*	**2**	*4%*	*0%*	**13**
50 feet (includes 48, 49, 51, 52 and 53 feet, too)	**29**	*7%*	*6%*	**7**	*16%*	*2%*	**36**
56 feet (includes 54, 55 and 57 feet, too)	**17**	*4%*	*4%*	**4**	*9%*	*1%*	**21**
60 feet (includes 58, 59, 61 and 62 feet, too)	**33**	*8%*	*7%*	**2**	*4%*	*0%*	**35**
66 feet (includes 63, 64, 65 and 67 feet, too)	**24**	*6%*	*5%*	**1**	*2%*	*0%*	**25**
72 feet (includes 68, 69, 70, 71 and 73 feet, too)	**25**	*6%*	*5%*	**0**	*0%*	*0%*	**25**
76 feet (includes 74, 75 and all wider than 76 feet, too)	**31**	*7%*	*7%*	**0**	*0%*	*0%*	**31**
Total	**415**		*90%*	**45**		*10%*	**460**

Figure 19. Portland roadways by width identified for "separated in-roadway" bicycle treatments. This data is derived from PBOT's pavement layer shapefile. Because there are gaps in coverage in that shapefile for most roadways, the total does not equal the 493 miles of separated in-roadway bicycles identified in the city's bicycle shapefile. The 493 mile figure is considered the accurate number. This table provides a very close representation and approximation of miles by street width and roadway function (one-way vs two-way).

36-foot roadways
(includes streets at 34 feet, 35 feet, 37 feet and 38 feet)

Thirty-six feet of curb-to-curb width is the most common width for both two-way and one-way roadways identified for separated treatment. Including in this category widths ranging from 34 feet to 38 feet yields 73 miles of two-way roadways and 17 miles of one-way roadways. This represents 20% of separated in-roadway bikeway streets. Providing separation on two-way streets will require the removal of all on-street parking. Parking can be maintained on one side of 36-foot one-way roadways.

Figures 21 and 22 show the extent of 36-foot roadways in Portland identified for separated bicycle lane treatment. Of the 90 miles total, approximately 40 miles are on streets with commercial zoning and 14 miles are in meter districts. Prominent 36-foot roadways include NE Knott Street, NW 9th Avenue (outside the Post Office site), N Ida Avenue, NE 15th Avenue for two-way roadways and SW Stark, SW Oak, NW 14th, NW 18th, NW 19th, SW Jefferson, SE 11th, SE 12th and many other for one-way roadways.

40-foot roadways
(includes streets at 39 feet, 41 feet and 42 feet)

There are approximately 39 miles of 40-foot-wide curb-to-curb roadways in Portland identified as part of the city's bikeway network that will require some type of separated treatment. This represents approximately 9% of all roadways suggested for physical separation. Thirty-five miles are two-way streets and 4 miles are one-way streets. Fifteen of these miles are along streets with commercial zoning and almost 3 miles are in meter districts. Providing separation on these streets will require the removal of all on-street parking for two-way streets and parking on one side for one-way streets.

Figures 23 and 24 show the extent of 40-foot roadways in Portland identified for separated bicycle lane treatment. Prominent 40-foot roadways include SE 52nd Avenue, SE 72nd Avenue, SE 92nd Avenue, N Willamette Boulevard, SE Market Street for two-way roadways. N Williams and SE Belmont are the only one-way roadways at these widths.

44-foot roadways
(includes streets at 43 feet and 45 feet)

There are approximately 32 miles of 44-foot-wide curb-to-curb roadways in Portland identified as part of the city's bikeway network that will require some type of separated treatment. This represents 7% of all roadways identified for separation. This is the first roadway width at which parking—on one side of the street—can be provided on two-way roadways. Approximately 15.5 miles of these roadways are on streets with commercial zoning and 2.5 miles are in meter districts.

Figures 25 and 26 show the extent of 44-foot roadways in Portland identified for separated bicycle lane treatment. Prominent 44-foot roadways include SE Flavel, SE Duke, SE Steele, SE Division (60th to 79th) E Burnside, SE Woodstock, SE 92nd, N Basin and SE Cherry Blossom/112th for two-way roadways. One-way 44-foot roadways include NE Halsey and Weidler, SE Stark (west of 82nd), NE Grand Ave (north of Holladay), SE Belmont and SE 102nd/103rd (south of Stark).

46-foot roadways
(includes streets at 47 feet)

There are approximately 13 miles of 46-foot-wide curb-to-curb roadways in Portland identified as part of the city's bikeway network that will require some type of separated treatment. This represents just under 3% of all such roadways. Eleven miles are on two-way roadways and 2 miles are one-way roadways. About half of 46-foot roadways are on streets with commercial zoning and just over 2 miles are in meter districts.

Figures 27 and 28 show the extent of 46-foot roadways in Portland identified for separated bicycle lane treatment. Prominent 46-foot roadways include NW Front Avenue, N Albina Street, NE 7th Avenue, NE Cully and SE Holgate for two-way roadways and West 2nd and 3rd Avenues for one-way roadways.

50-foot roadways

(includes streets at widths ranging from 48 feet to 53 feet)

There are 36 miles of 50-foot-wide curb-to-curb roadways in Portland identified as part of the city's bikeway network that will require some type of separated treatment. This represents almost 8% of the separated in-roadway network. Twenty-nine of these roadways are two-way and seven are one-way. Almost 20 miles are on streets with commercial zoning and slightly more than 7 miles are in meter districts. Fifty-two feet curb-to-curb width is the narrowest at which parking on both sides of two-way street can be provided with protected lanes.

Figures 29 and 30 show the extent of 50-foot roadways in Portland identified for separated bicycle lane treatment. Prominent roadways in this width range include N Portsmouth, N Lombard, N Denver, NE Glisan (47th to 82nd), SE Gladstone, SE Foster (west of 75th) SE Woodstock and SE 41st for two-way roadways. Prominent one-way roadways include SE Washington, SW Broadway, SW 4th, NE Weidler NE Broadway and SE Hawthorne.

56-foot roadways

(includes streets at 54 feet, 55 feet and 57 feet)

There are approximately 21 miles of 56-foot-wide curb-to-curb roadways in Portland identified as part of the city's bikeway network that will require some type of separated treatment. This represents approximately 4.5% of all such roadways. Seventeen of these miles are two-way and 4 miles are one-way. Thirteen of these miles are on streets with commercial zoning and 5 miles are in meter districts.

Figures 31 and 32 show the extent of 56-foot roadways in Portland identified for separated bicycle lane treatment. Prominent 56-foot roadways include 82nd Avenue, SE 7th/Sandy, NE 12th Avenue, N Basin Street, NE Glisan Street, N Greeley Avenue for two-way roadways and segments of NE Broadway, Martin Luther King Mr. Blvd and E Burnside for one-way roadways.

60-foot roadways

(includes streets ranging from 58 feet to 62 feet)

There are approximately 35 miles of 60-foot-wide curb-to-curb roadways in Portland identified as part of the city's bikeway network that will require some type of separated treatment. This represents 7.6% of all such roadways. Thirty-three of these miles are two-way and 2 miles are one-way. Twenty-four of these miles are on streets with commercial zoning and 4.6 miles are in meter districts. Protected bicycle lanes can be provided on two-way roadways at this width in a manner that allows a three-lane cross-section (with parking on one side) or a four-lane cross-section.

Figures 33 and 34 show the extent of 60-foot roadways in Portland identified for separated bicycle lane treatment. Prominent 60-foot roadways include NE Lloyd Boulevard, NE Sandy Boulevard, SW Terwilliger, SW Barbur (inner), SW Capitol (southern section), N Rosa Parks, N Denver, SE Powell (inner) for two-way roadways. Prominent one-way 60-foot roadways include SE Woodstock/Foster (within the I-205 interchange) and SE Morrison.

66-foot roadways
(includes streets ranging from 63 feet to 67 feet)

There are approximately 25 miles of 66-foot-wide curb-to-curb roadways in Portland identified as part of the city's bikeway network that will require some type of separated treatment. This represents 5.4% of all such roadways. Only one of these miles is on a one-way roadway. Ten miles are on streets with commercial zoning and less than 1 mile is within a meter district. Parking can be accommodated on both sides of two-way roadways at this width with a cross-section that provides three lanes for automobiles. Protected bicycle lanes can be provided on two-way roadways in a manner that allows a four-lane cross-section (with parking on one side) or a five-lane cross-section.

Figures 35 and 36 show the extent of 66-foot roadways in Portland identified for separated bicycle lane treatment. Prominent 66-foot roadways include SE Halsey (east of 135th), NE Glisan (west of 139th), NE 148th, SE Stark (east of 109th), 102nd (Halsey to Pine), NE Killingsworth (west of 47th) for two-way roadways. SE Stark (93rd to 106th) is a prominent one-way roadway at this width.

72-foot roadways
(includes streets ranging from 68 feet to 73 feet)

There are approximately 25 miles of Portland roadways at this curb-to-curb width identified as part of the city's bikeway network that will require some type of separated treatment. This represents 5.4% of all such roadways. There are no one-way roadways at this width. Nine miles at this width are on streets with commercial zoning and one mile is within a meter district. Parking can be accommodated on both sides of two-way roadways at this width with a cross-section that provides four lanes for automobiles. This is the narrowest roadway width at which parking-protected bicycle lanes can be provided with a four-lane cross-section. Protected bicycle lanes can be provided on these roadways in a manner that allows a five-lane cross-section with parking on one side.

Figure 37 shows the extent of 72-foot roadways in Portland identified for separated bicycle lane treatment. Prominent 72-foot roadways include SW Beaverton-Hillsdale Highway and NE Lombard (east of 12th).

76-foot two-way roadways
(includes streets at 74 feet, 75 feet and all streets wider than 76 feet)

There are approximately 14 miles of 76-foot-wide curb-to-curb roadways in Portland identified as part of the city's bikeway network that will require some type of separated treatment. This represents 3.4% of all such two-way roadways. Parking can be accommodated on both sides of roadways at this width with a cross-section that provides four lanes for automobiles. Parking can also be provided on one side of the roadway with a five-lane cross-section. Eighty-two feet is the narrowest width at which a five-lane cross-section can be provided with protected bicycle lanes on both sides.

Figure 38 shows the extent of 76-foot roadways in Portland identified for separated bicycle lane treatment. Prominent 76-foot roadways include SE Division Street, SE 162nd Avenue, 122nd Avenue, NE Halsey Street (114th to 136th) and SW Barbur (segments).

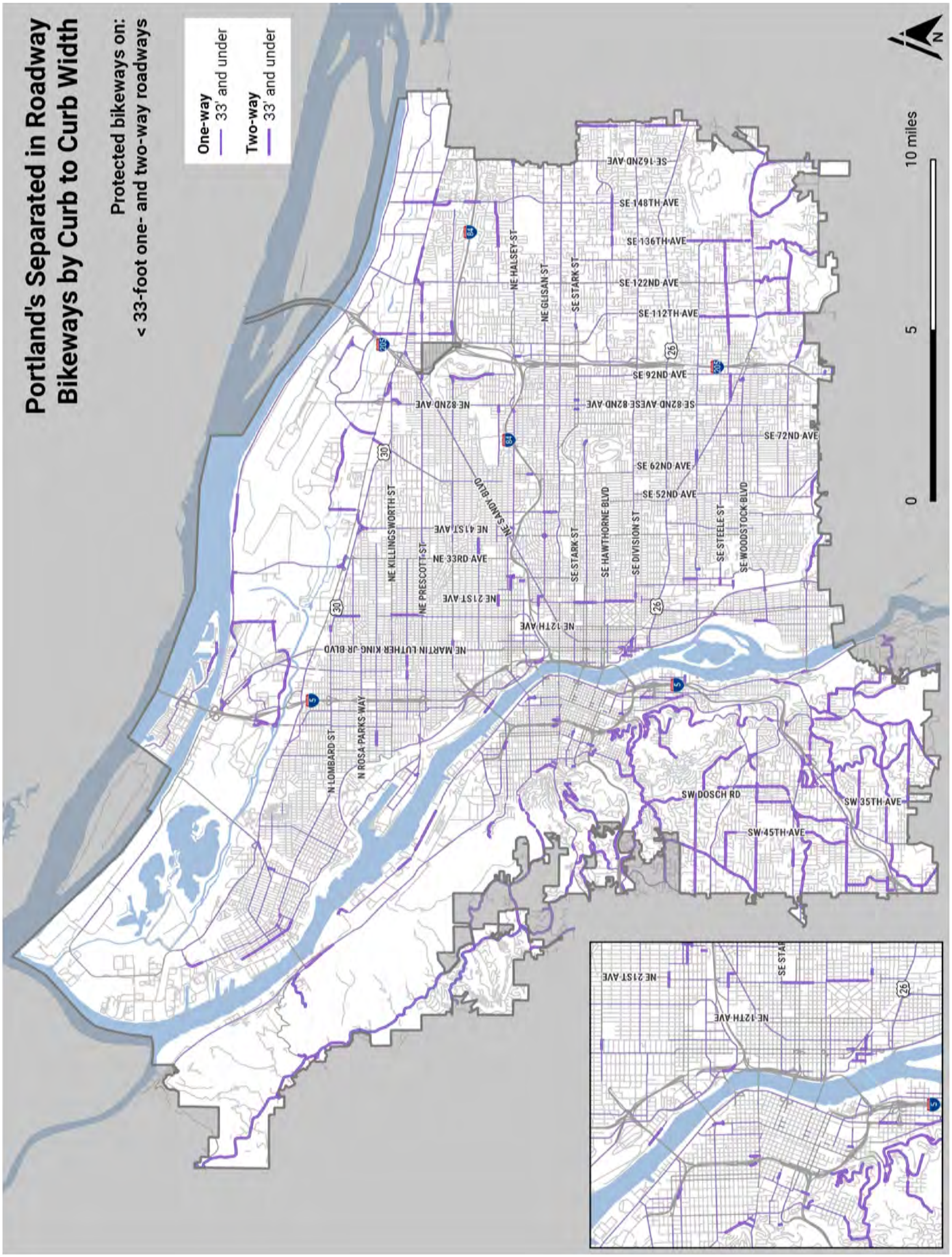


Figure 20. Two-way and one-way roadways identified for separation with widths of 33-feet or less.

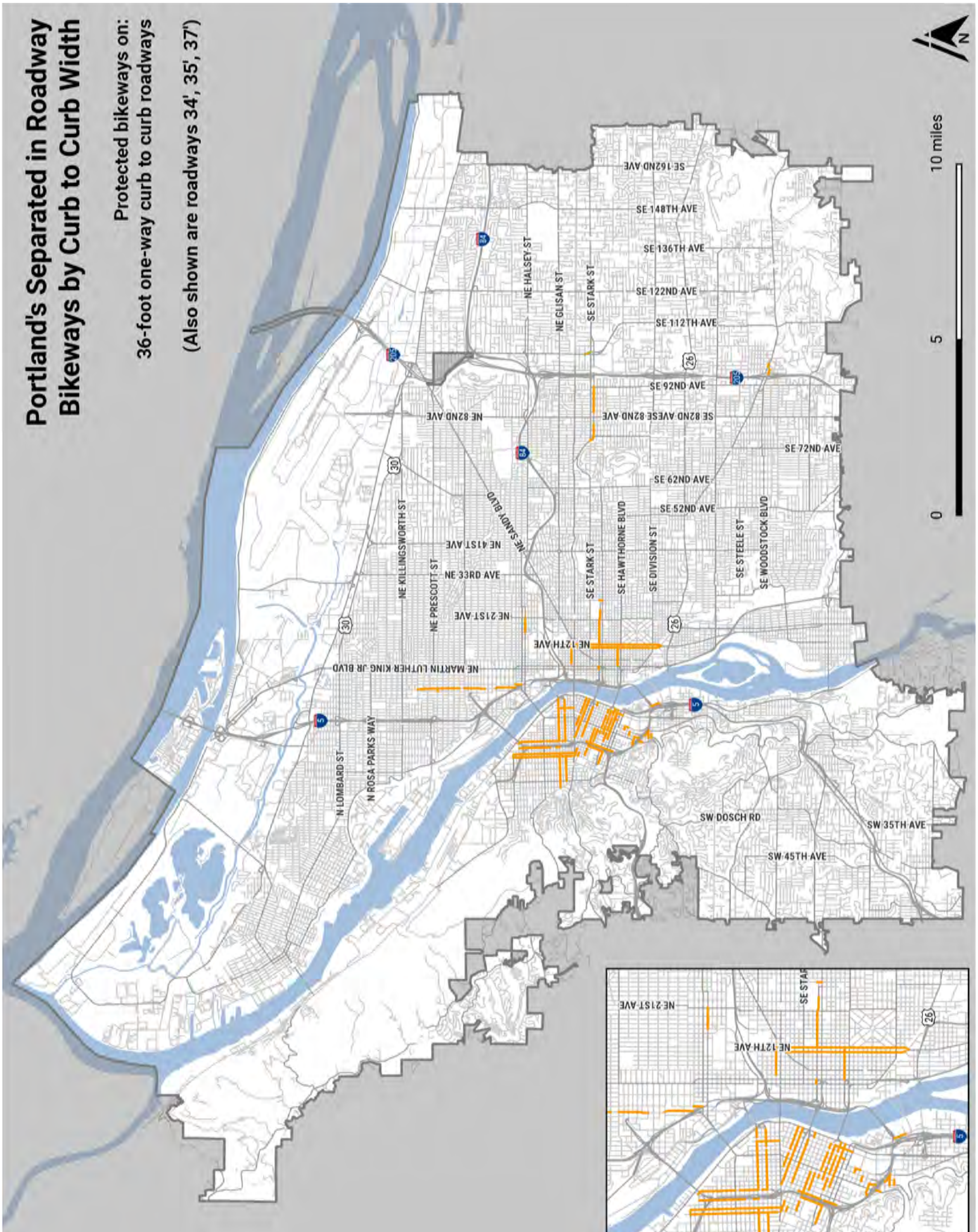


Figure 21. Protected bikeways on 36' one-way roadways

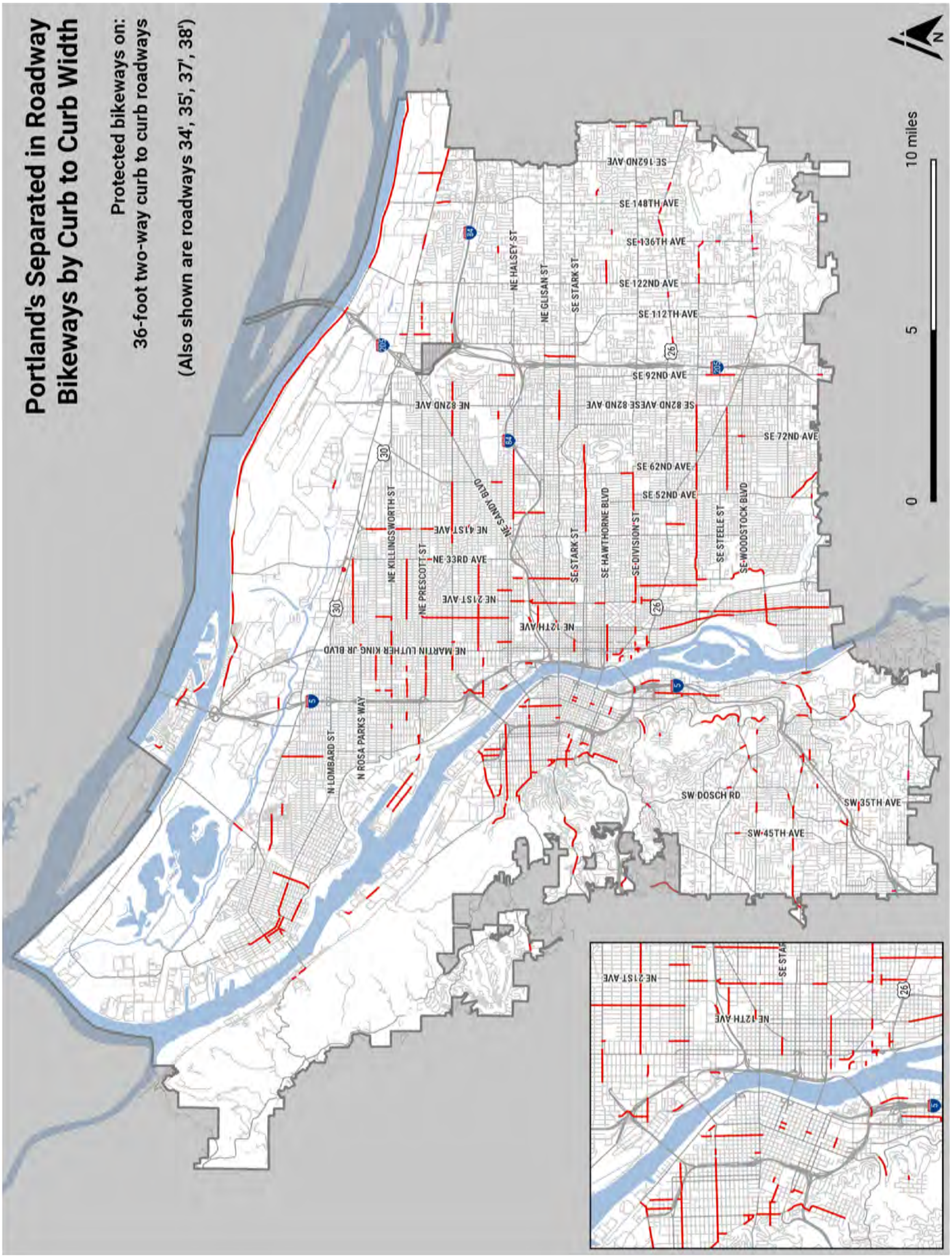


Figure 22. Protected bikeways on 36' two-way roadways

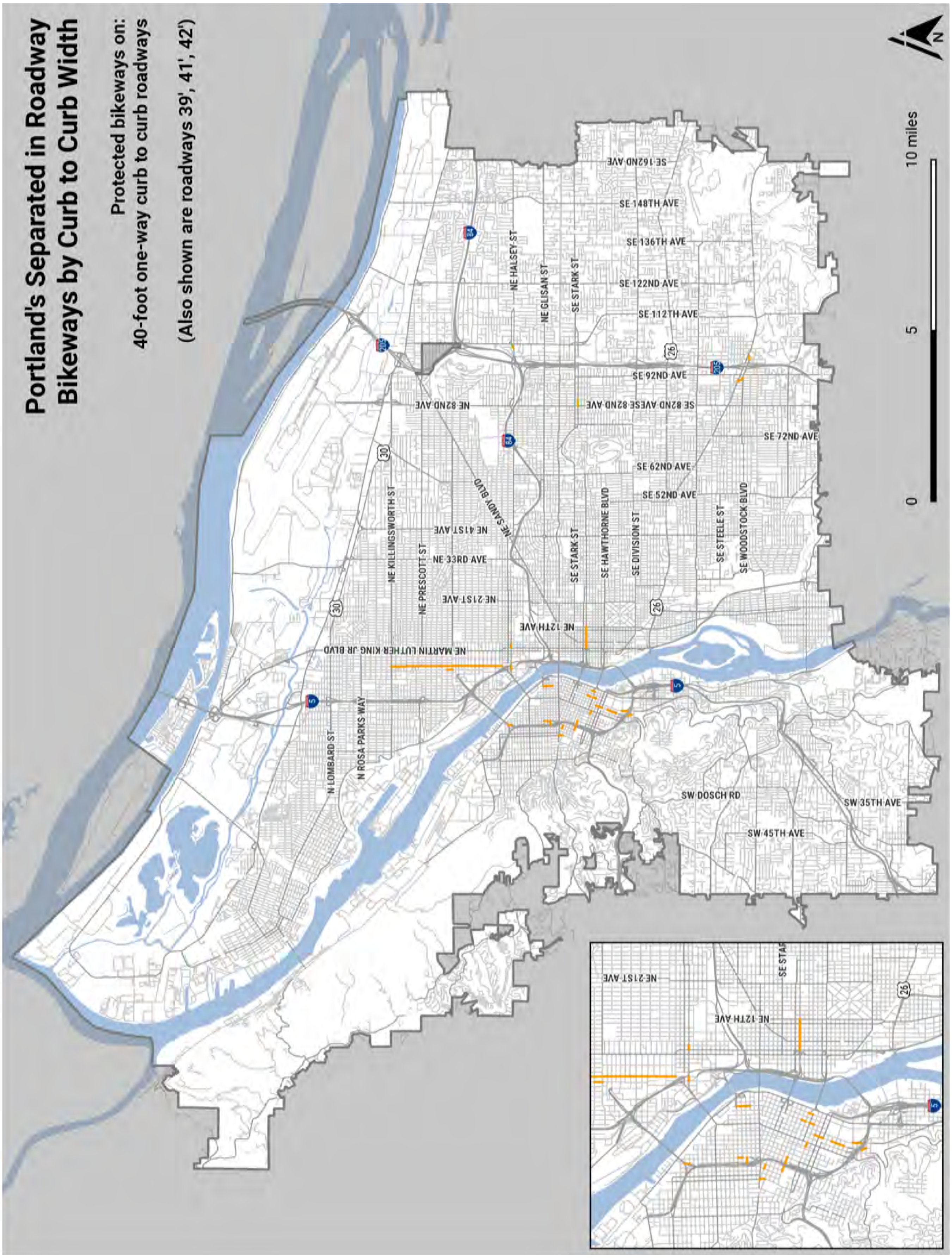


Figure 23. Protected bikeways on 40' one-way roadways

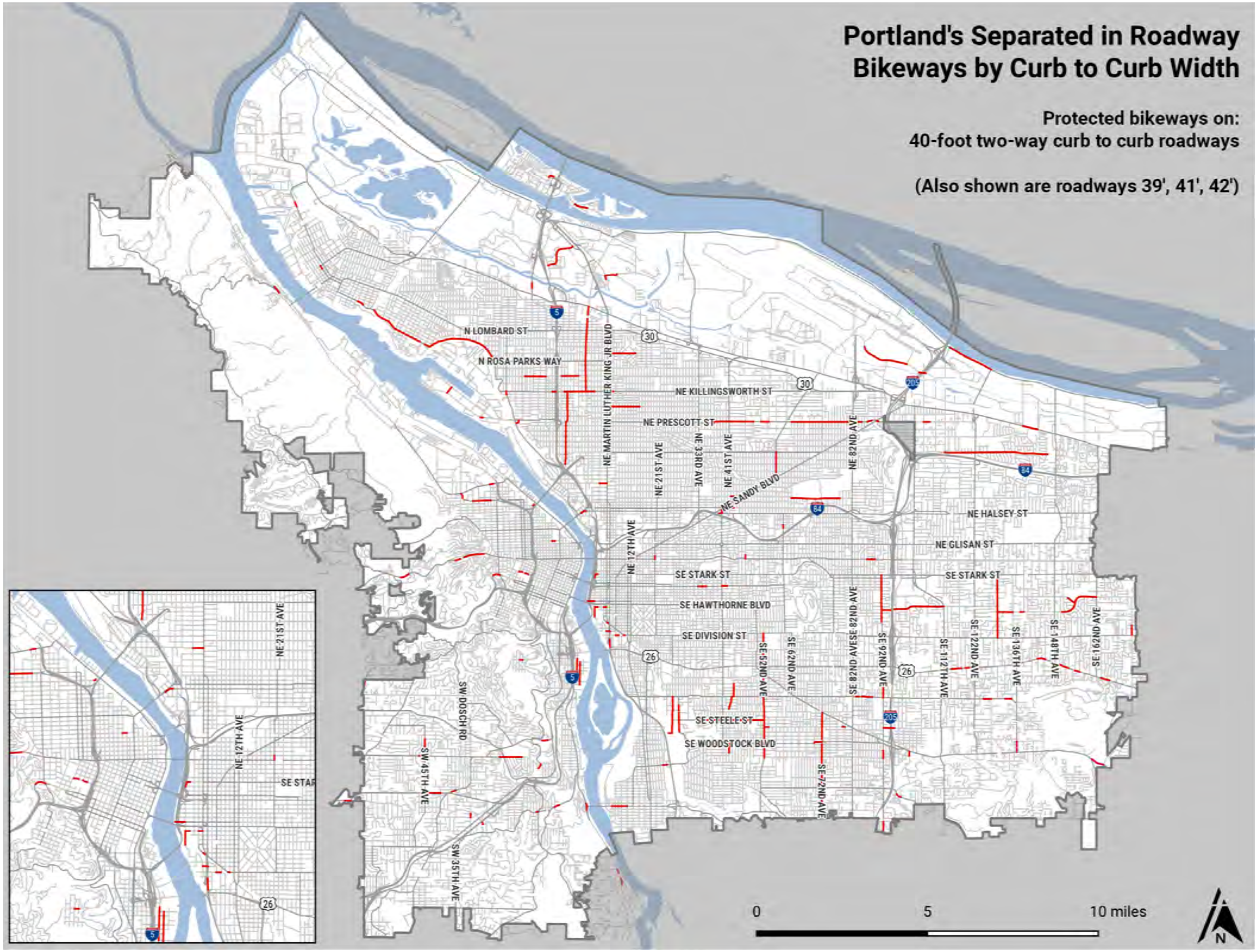


Figure 24. Protected bikeways on 40' two-way roadways

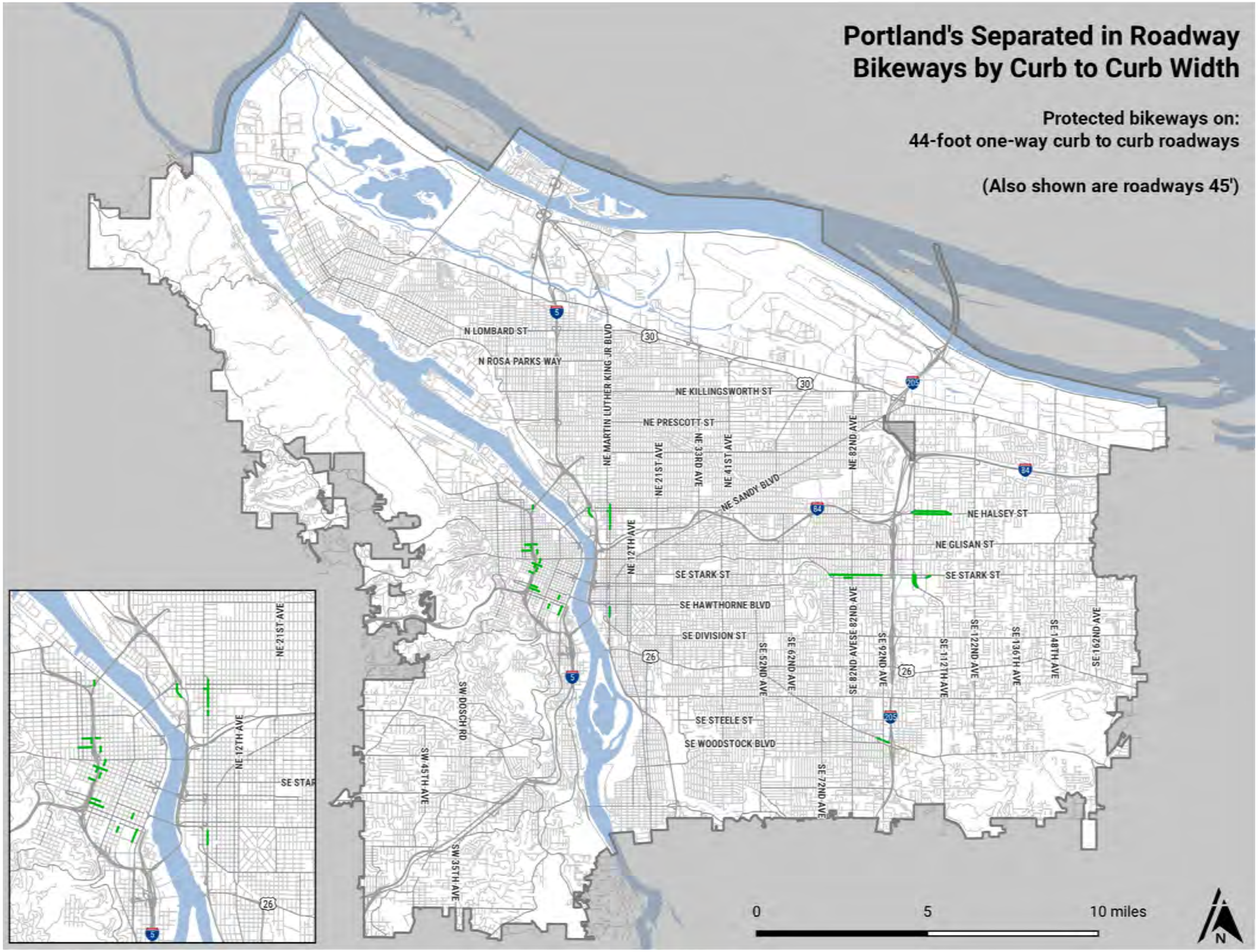


Figure 25. Protected bikeways on 44' one-way roadways

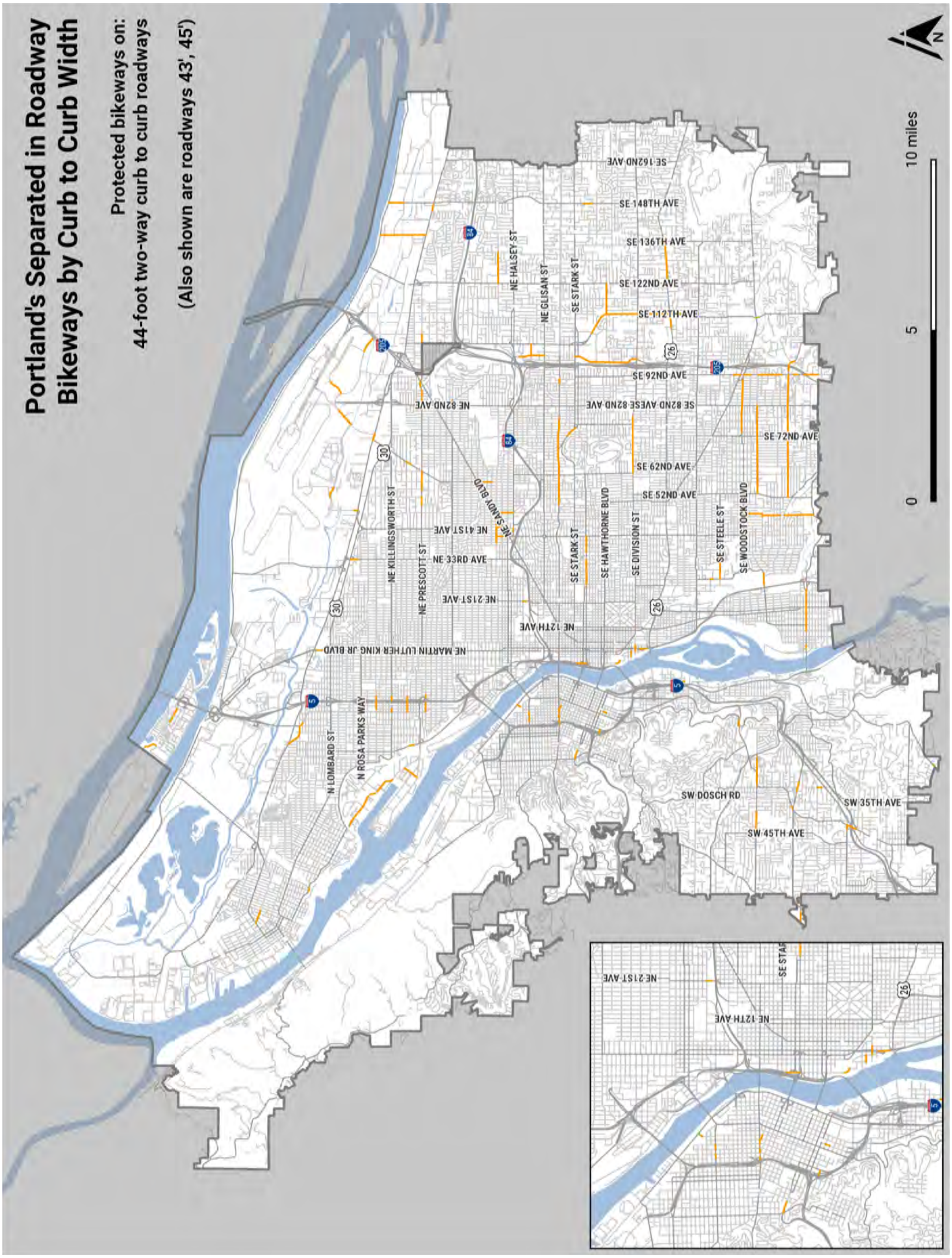


Figure 26. Protected bikeways on 44' two-way roadways

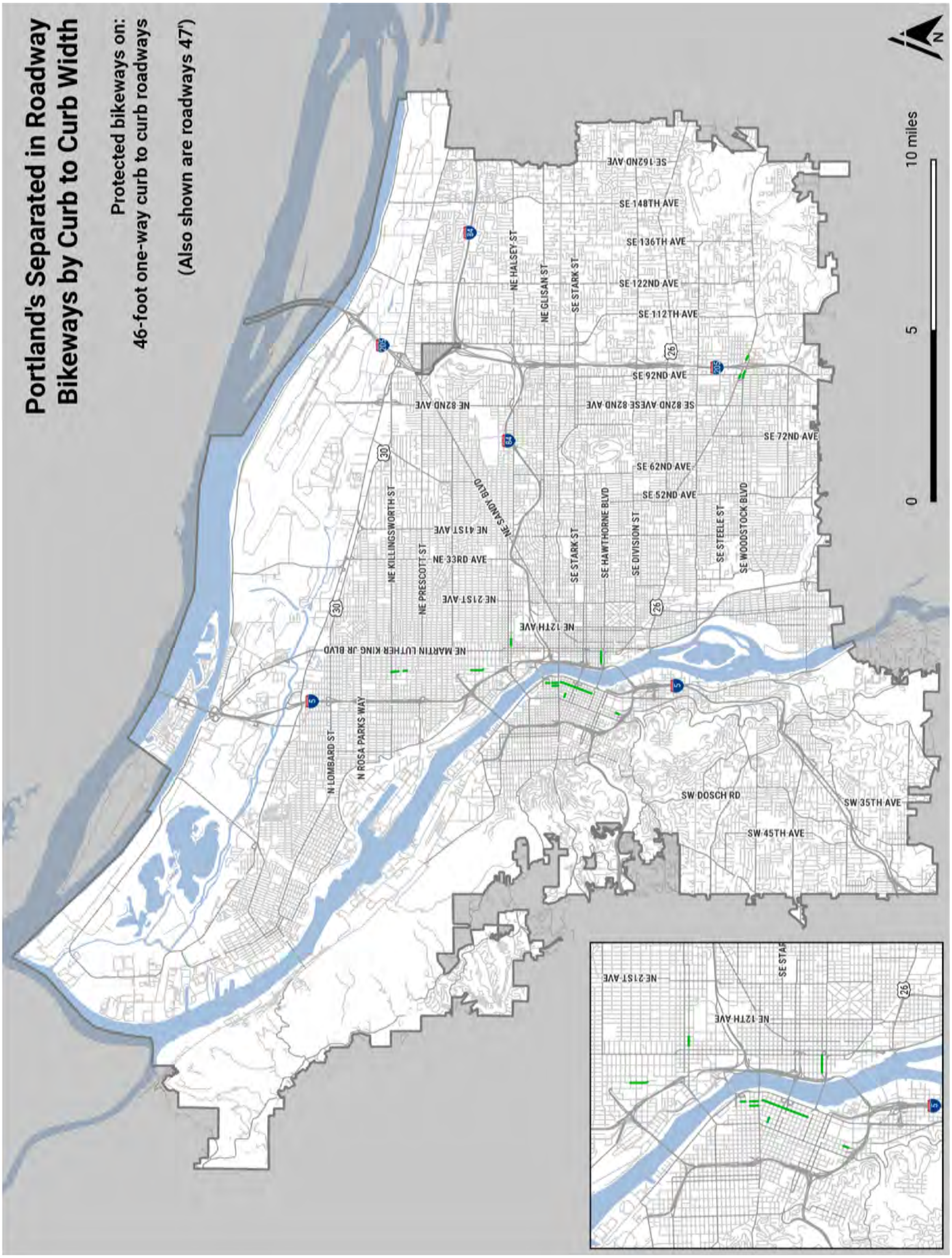


Figure 27. Protected bikeways on 46' one-way roadways

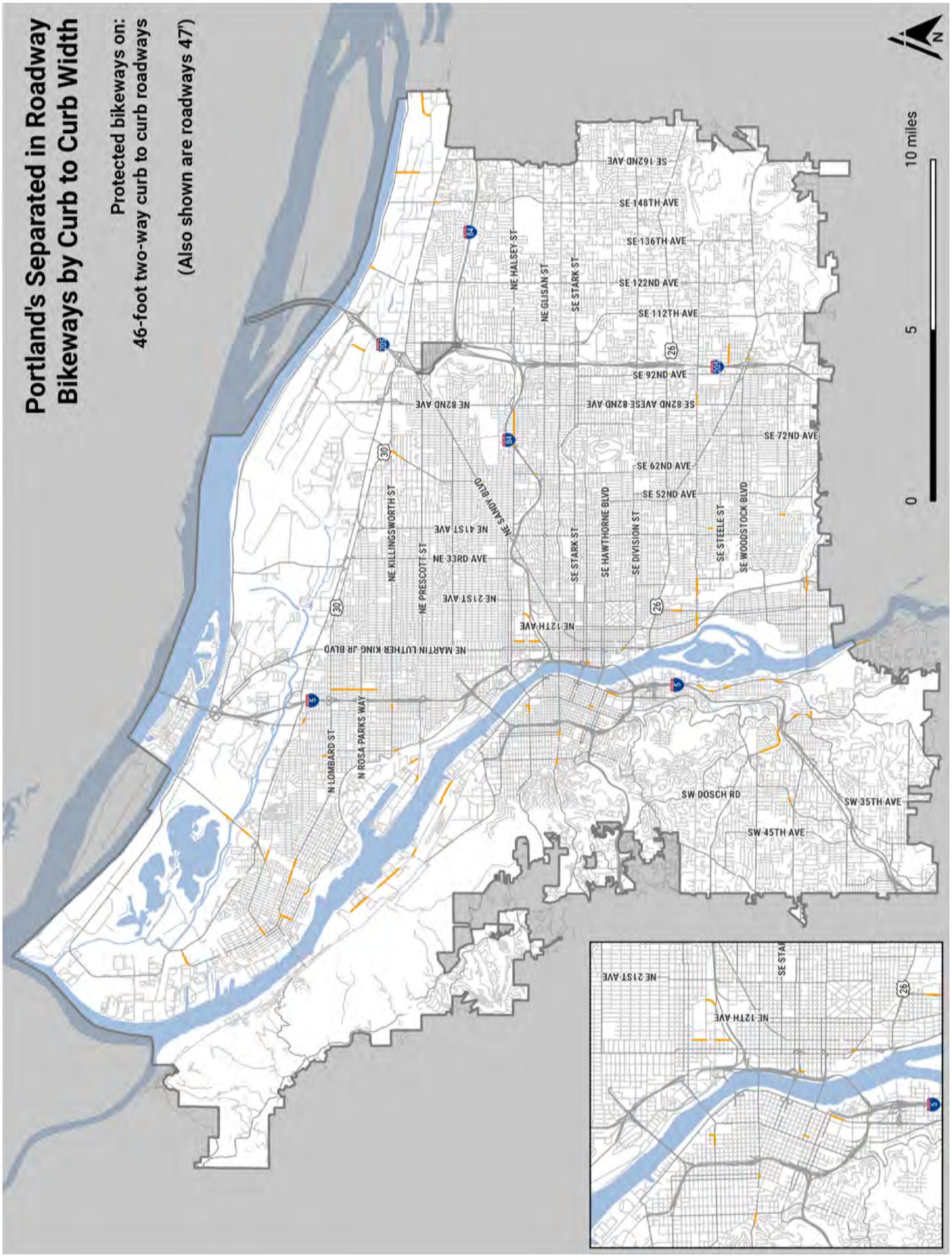


Figure 28. Protected bikeways on 46' two-way roadways

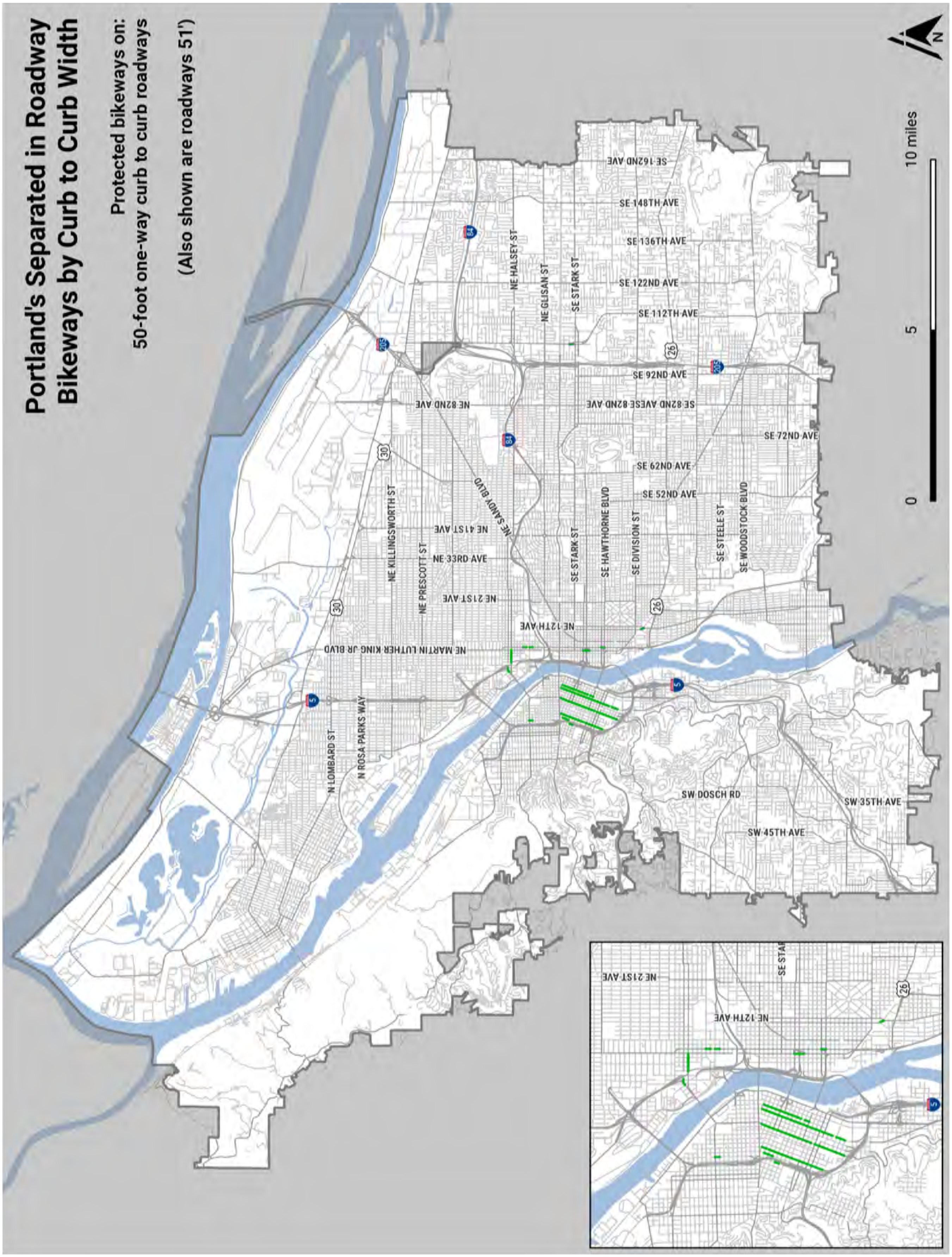


Figure 29. Protected bikeways on 50' one-way roadways

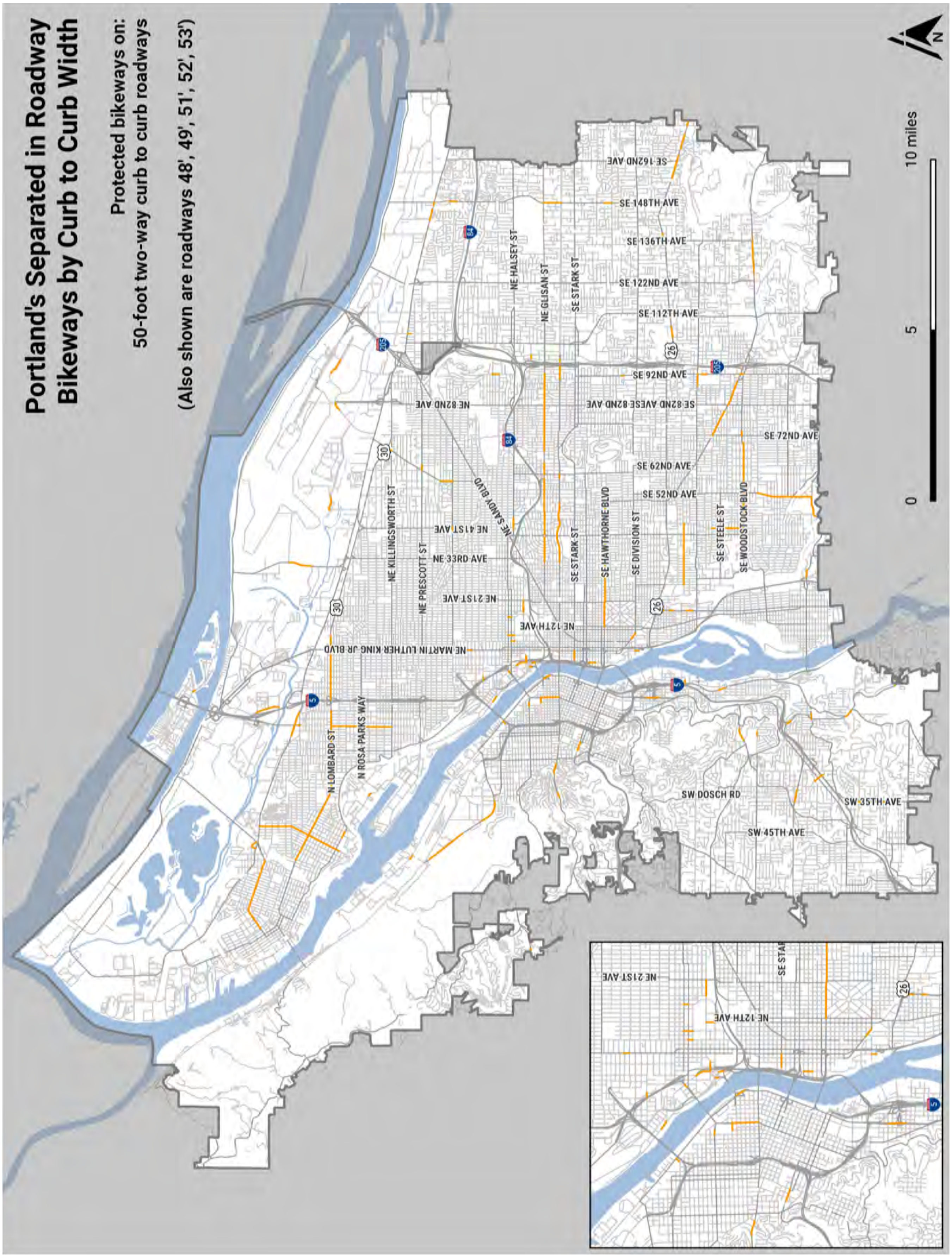


Figure 30. Protected bikeways on 50' two-way roadways

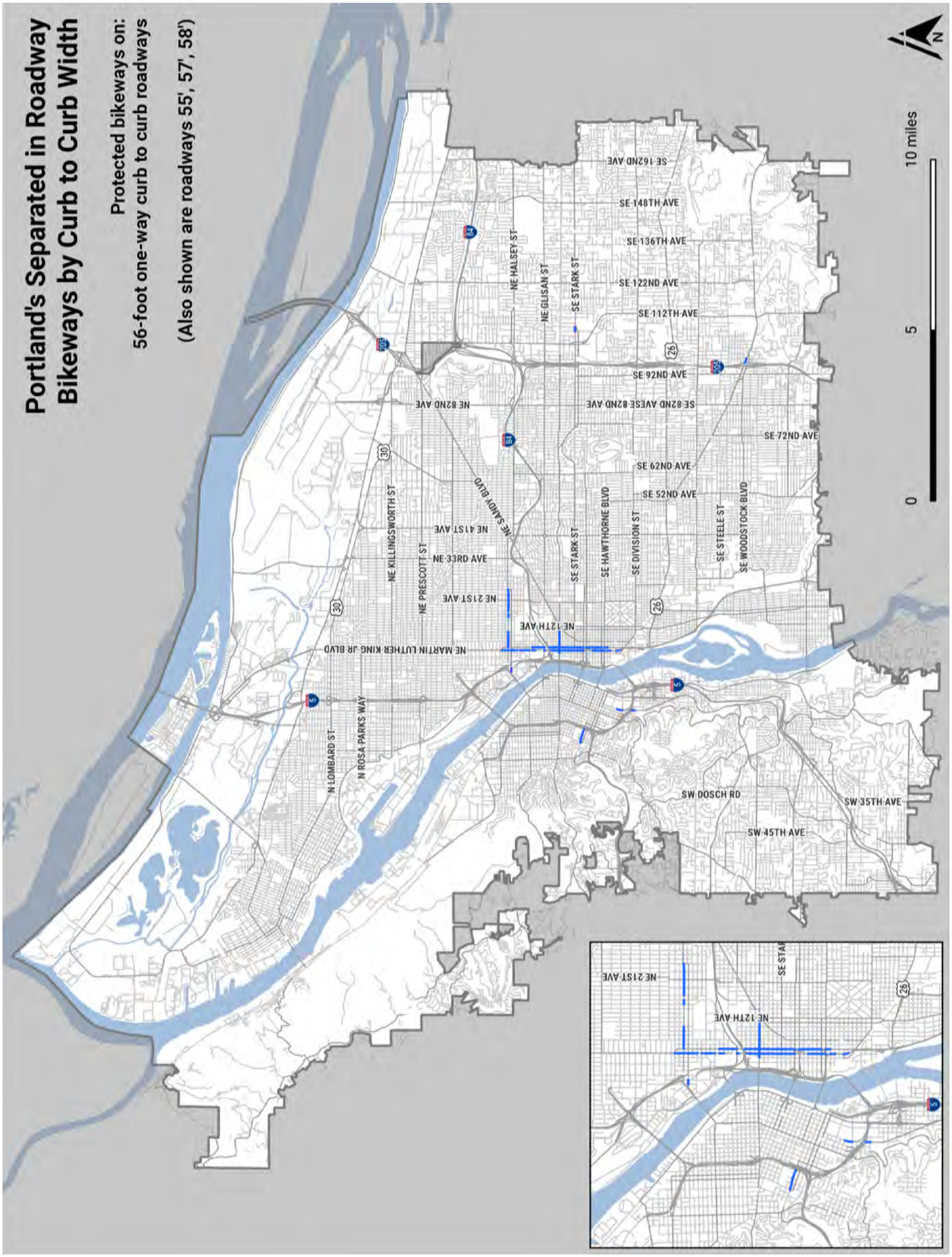


Figure 31. Protected bikeways on 56' one-way roadways

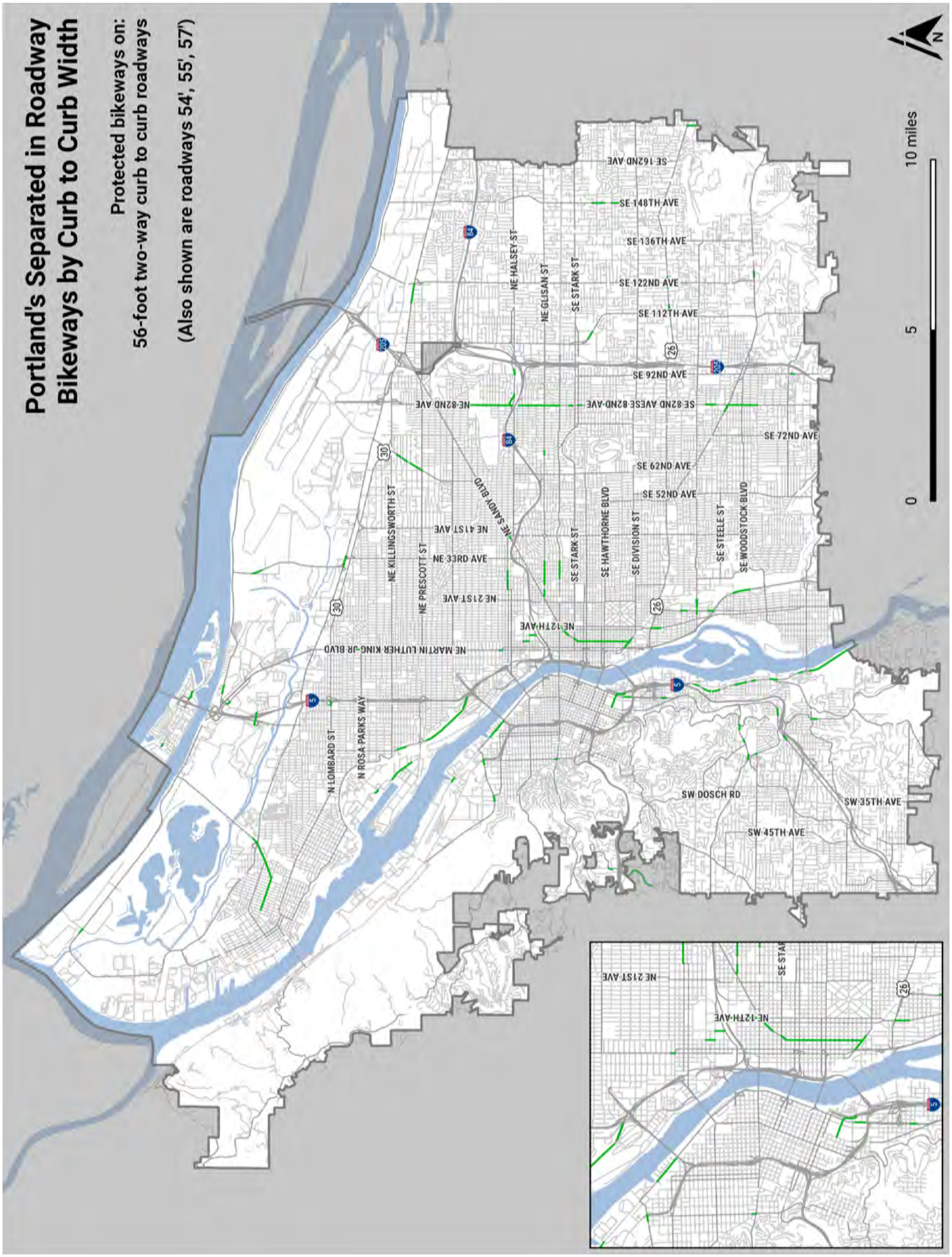


Figure 32. Protected bikeways on 56' two-way roadways

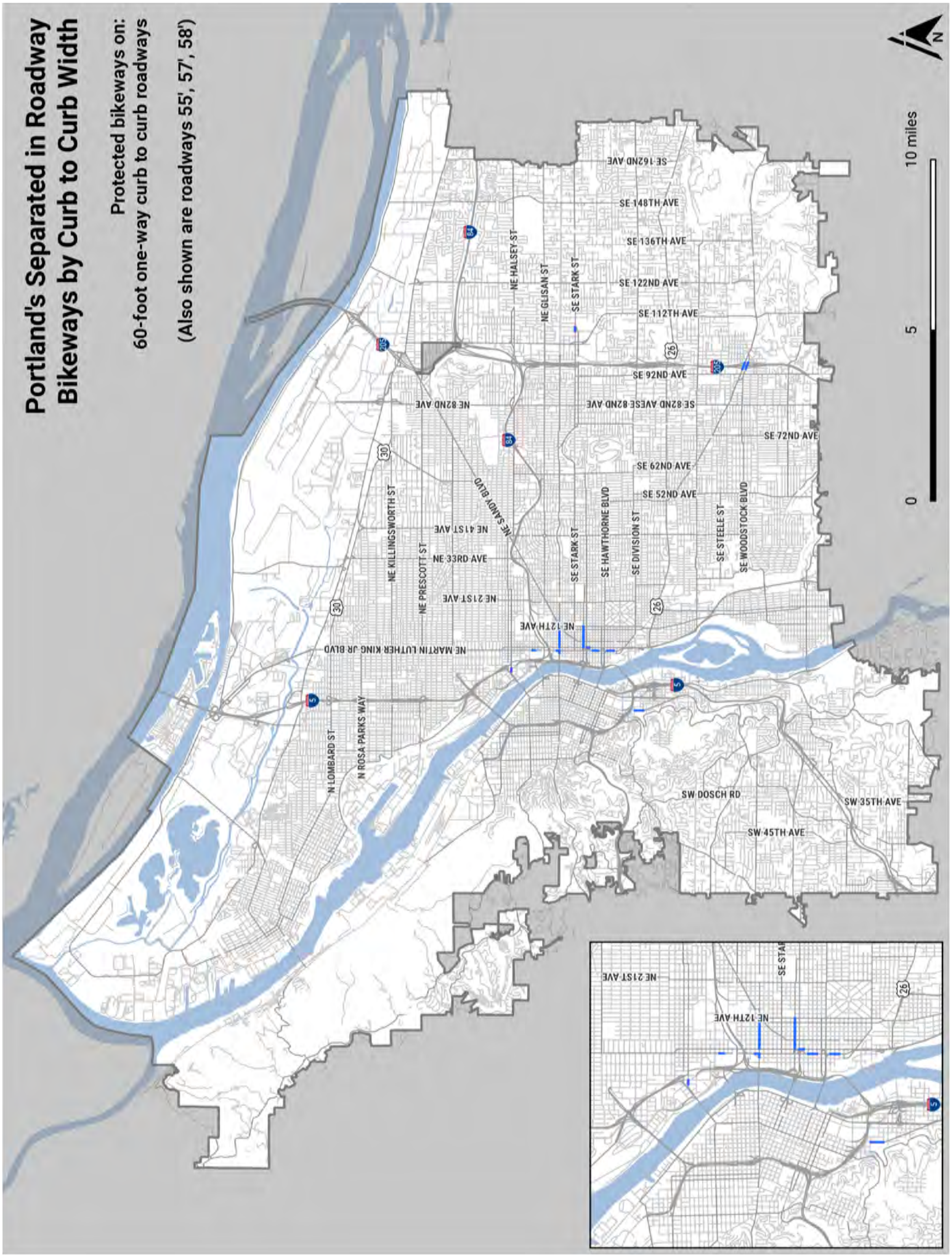


Figure 33. Protected bikeways on 60' one-way roadways

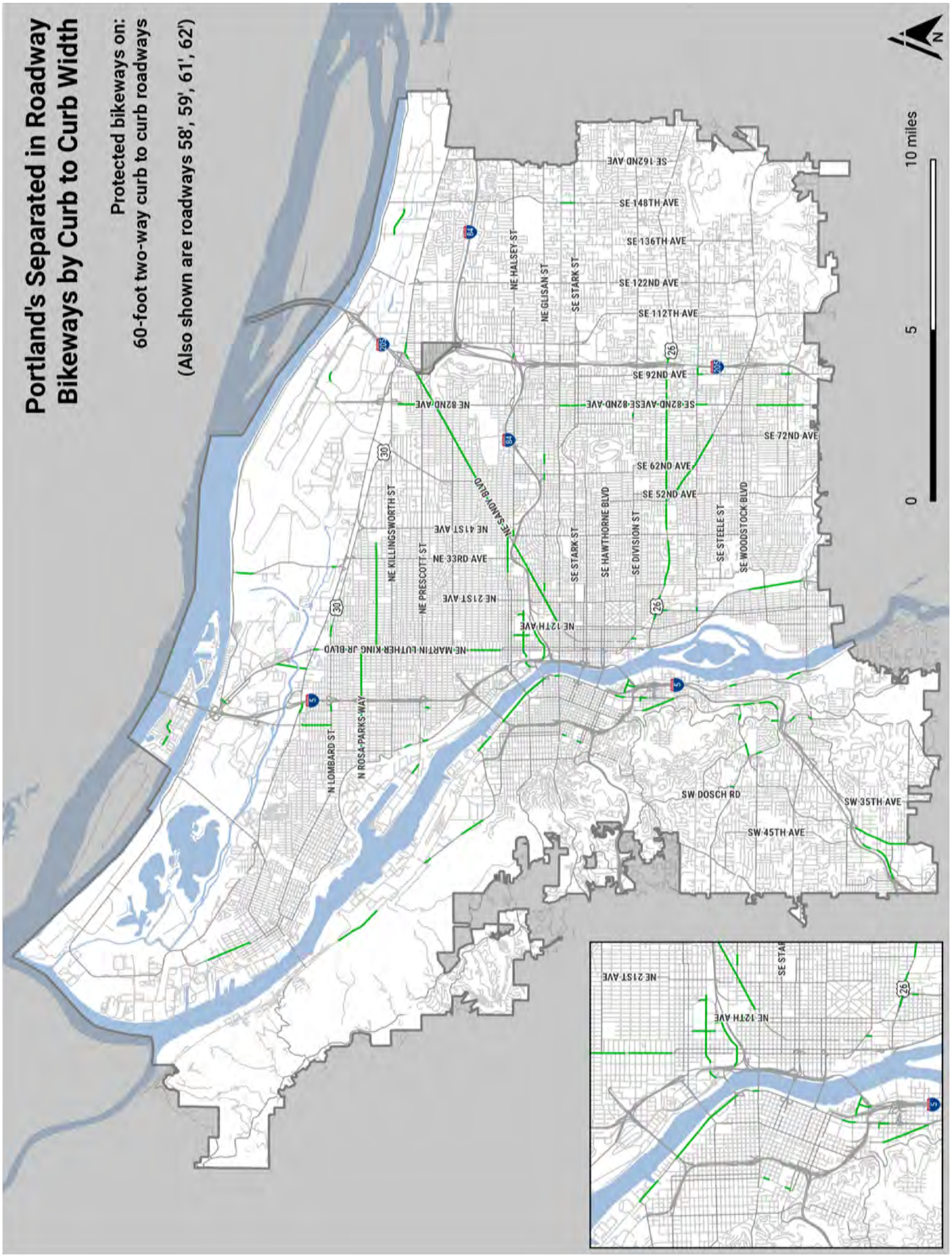


Figure 34. Protected bikeways on 60' two-way roadways

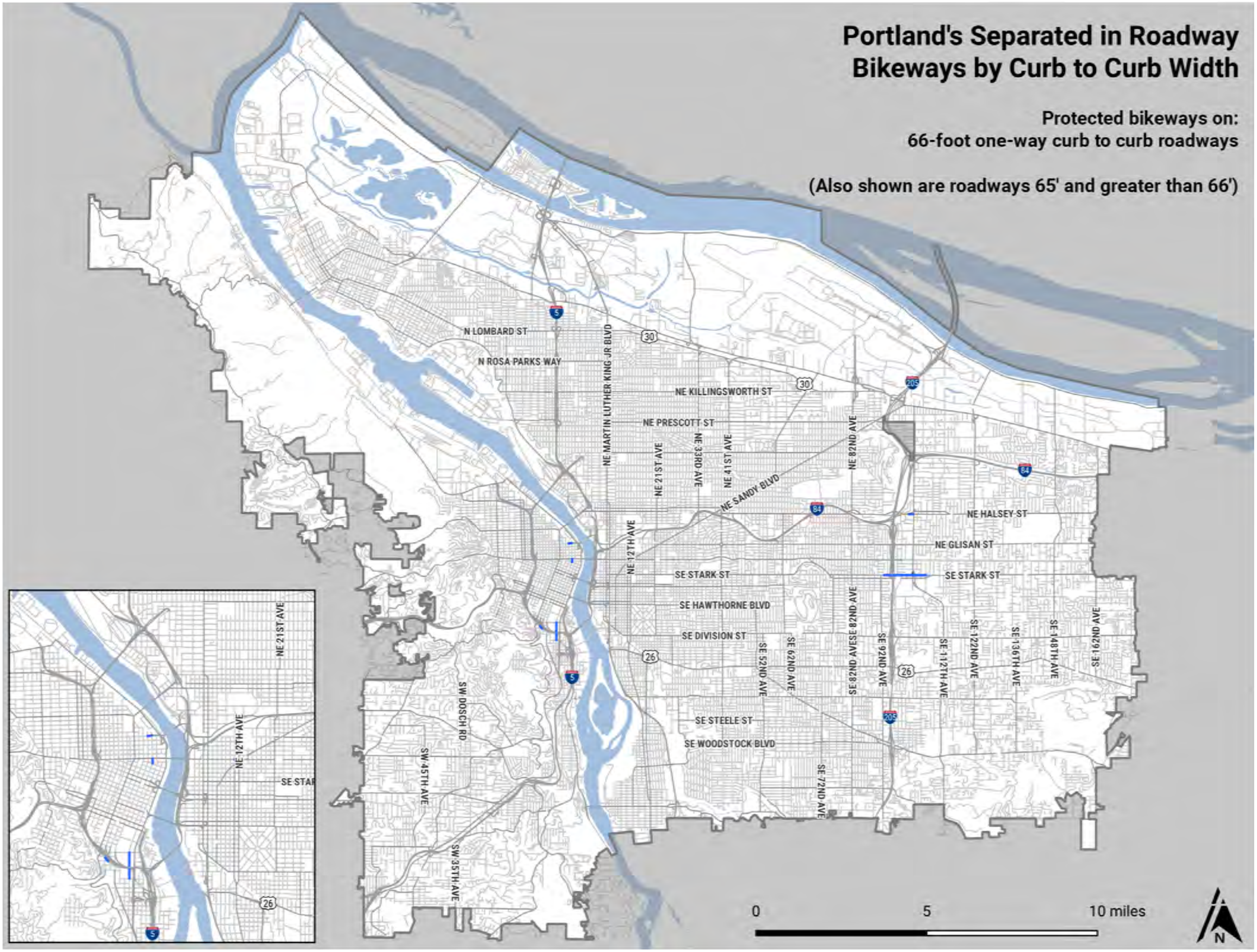


Figure 35. Protected bikeways on 66' one-way roadways

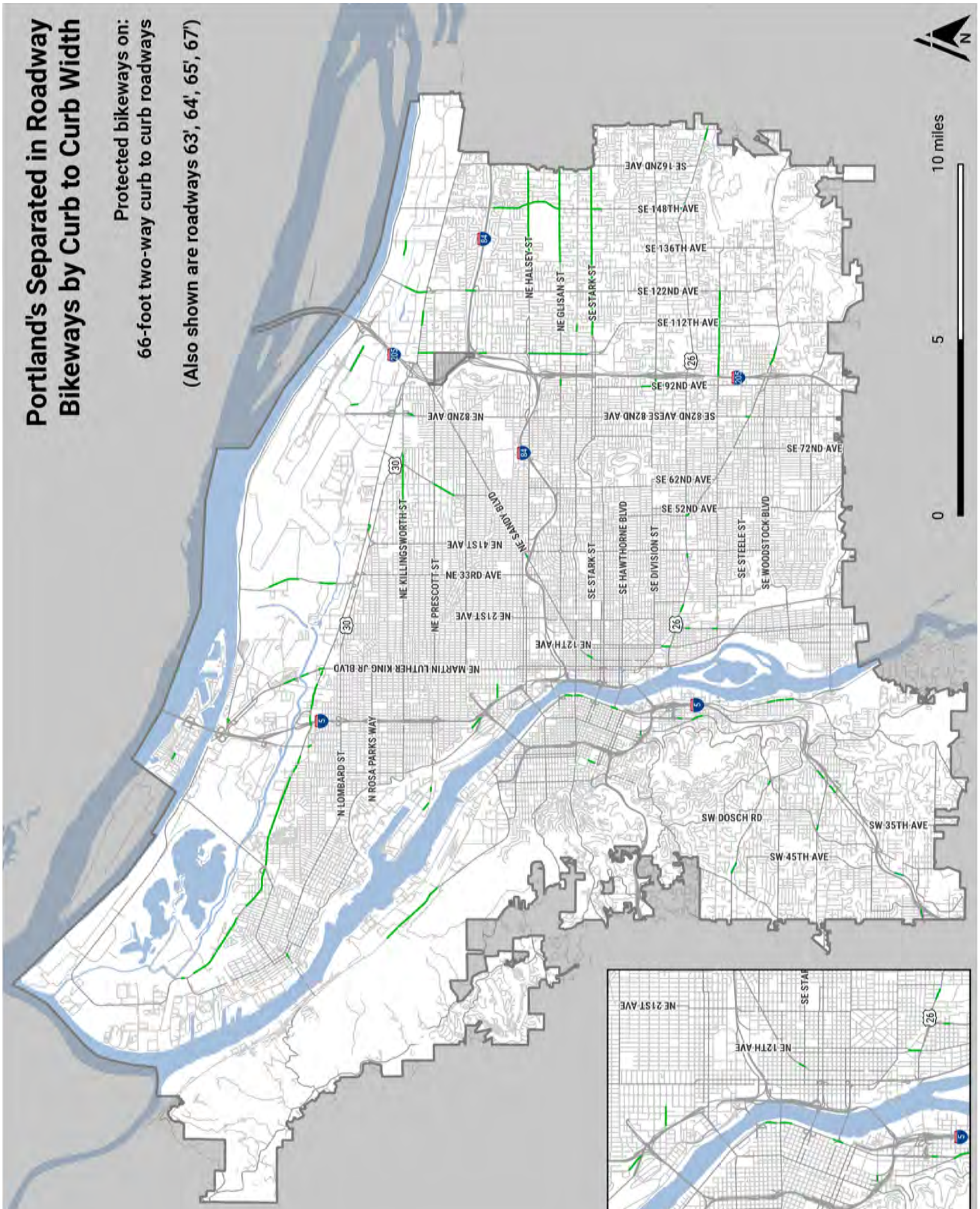


Figure 36. Protected bikeways on 66' two-way roadways

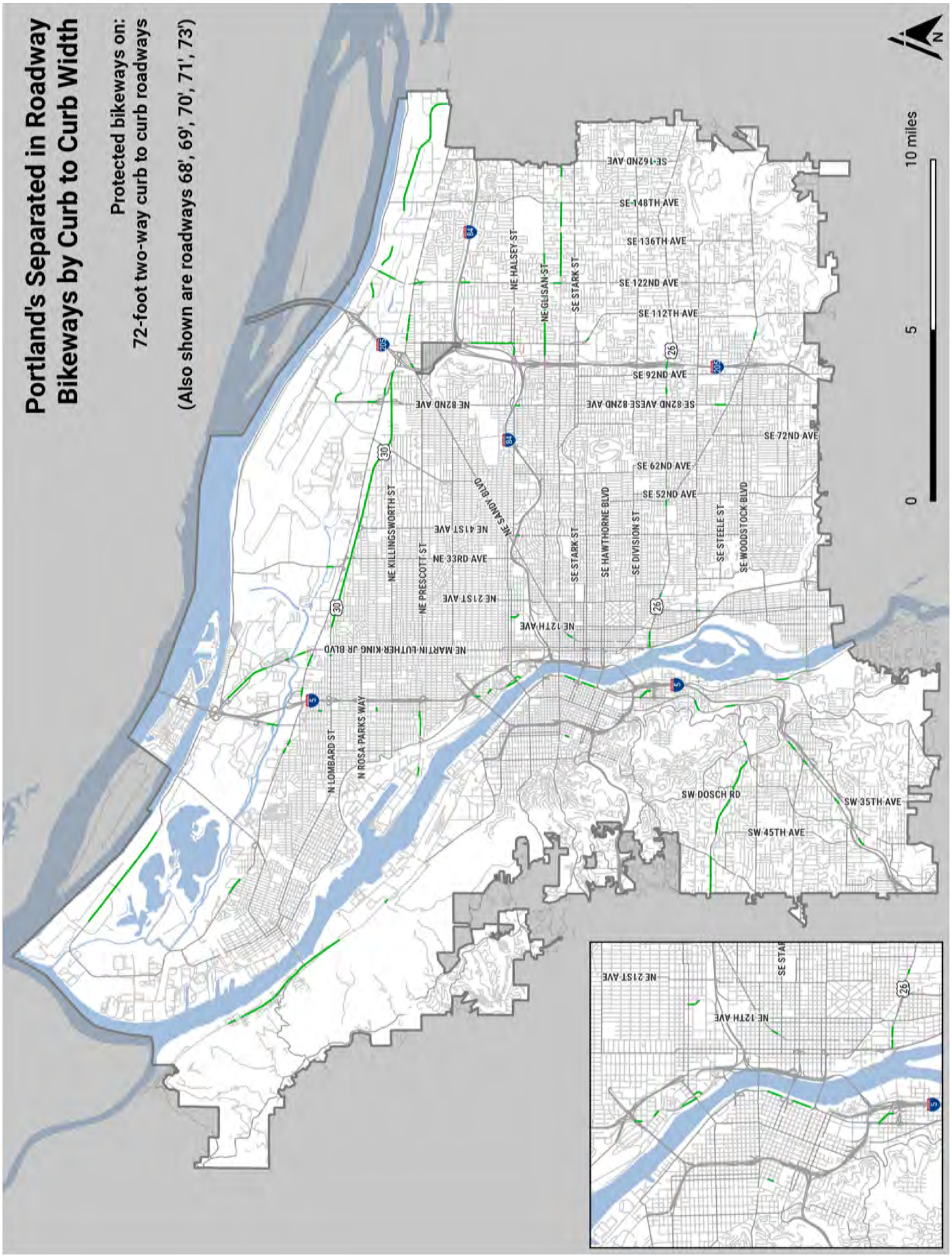


Figure 37. Protected bikeways on 72' two-way roadways

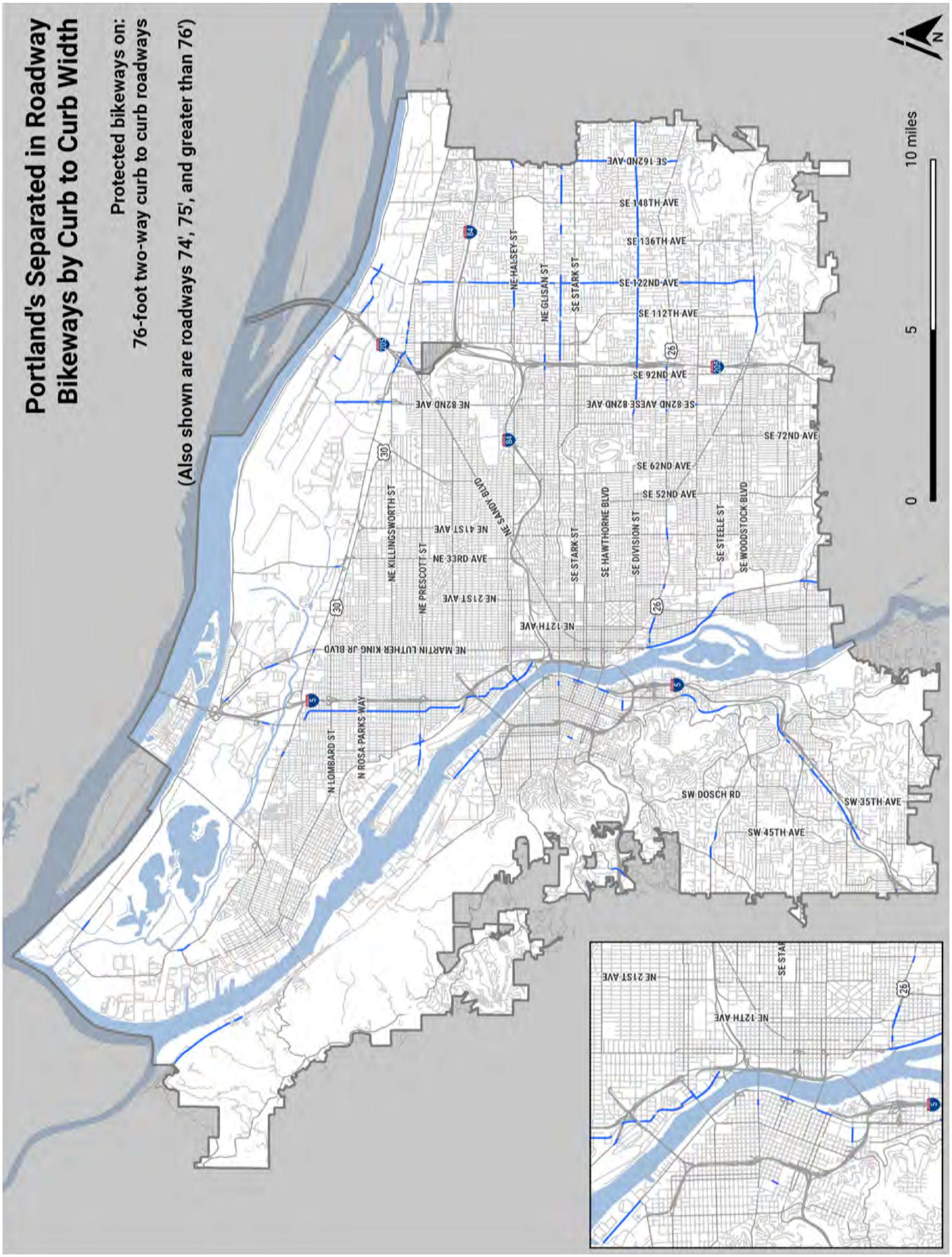
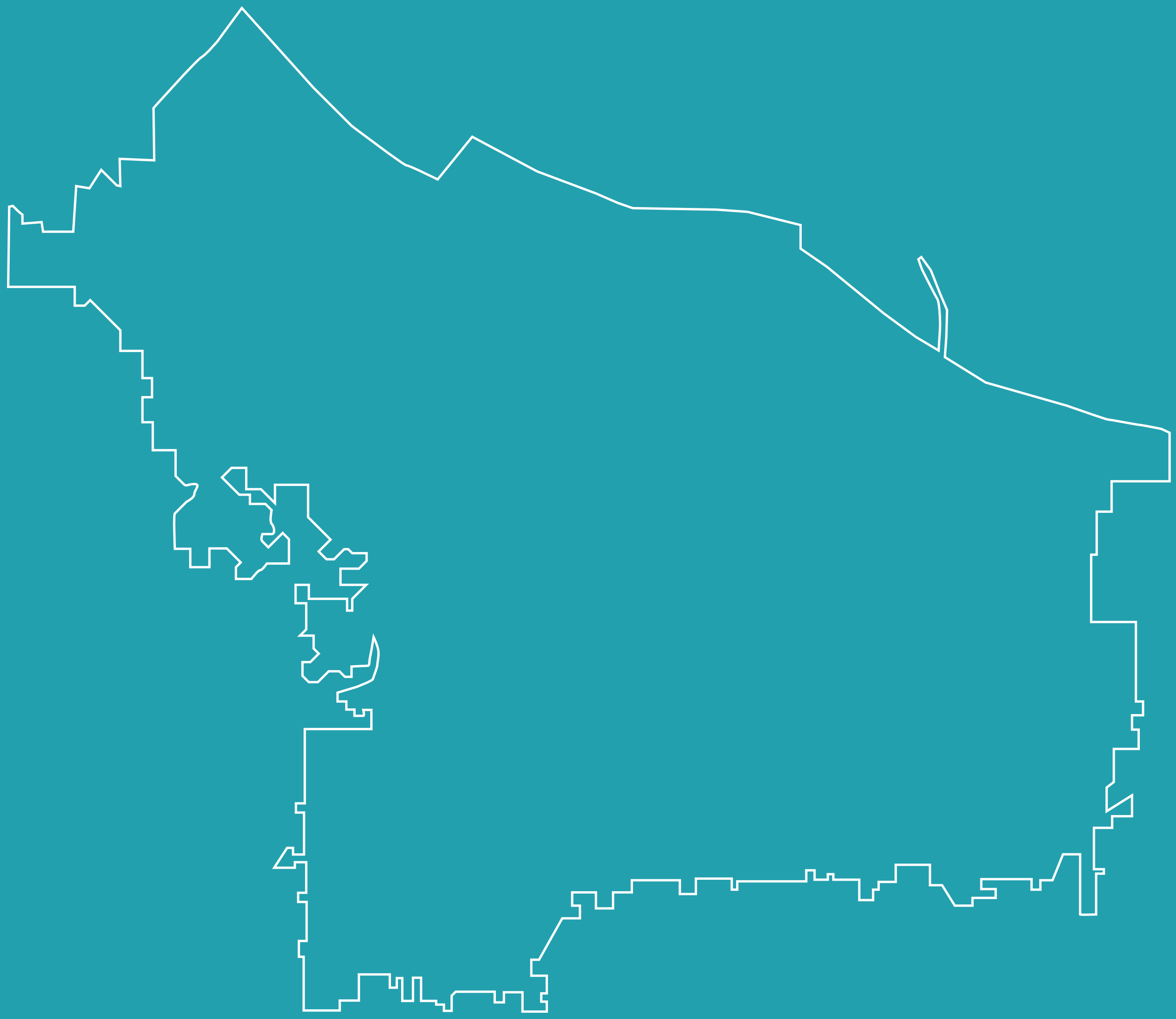


Figure 38. Protected bikeways on 76' two-way roadways

Photo: City of Portland



SECTION FIVE

Appendices

Appendices

A. On-Street Parking and Protected Bicycle Lanes

Discusses implications for on-street parking with an approximately 30% implementation of protected bicycle lanes in the coming years.

B. Protected Bicycle Lane Retrofit Costs: Estimated Unit Construction Costs and Estimated Network Implementation Costs

Provides estimated per mile construction costs for an average configuration for each facility type at each roadway width and an overall estimate for a build-out including 30% implementation of protected bicycle lanes.

C. Protected Bicycle Lane Design Tables

Displays tables identifying those designs that will fit onto different cross-sections and the number of travel lanes and on-street parking that is possible to provide with each design.[22] Also shown is the width that remains in the cross-section when using each design, the width a sweeper would have to fit in ("Sweeper Width"), representative roadways at that width and number of miles at the width. These tables are generated using an Excel spreadsheet tool that can also be made available.

[22] Parking is not specifically called out in the tables. When "Width Remaining" shows 7.5-8 feet or more, then it is possible to provide on-street parking.

Appendix A: On-Street Parking and Protected Bicycle Lanes

As noted previously many of the recommended Portland protected bicycle lane designs limit the availability of on-street parking. This is especially true for Portland's narrowest two-way roadways.

To estimate the effect implementing protected lanes will have on available on-street parking spaces the assumptions shown in **Figure 38** were made about level of implementation at each common roadway width. This table also includes estimates about the extent of roadways that would retain parking on both sides, would have parking on only one side or no on-street parking. To be more pertinent, this analysis considers the effects of implementation at the city level, on streets with commercial zoning and on streets within meter districts.

Figure 38 shows the assumptions made in identifying how many of the SIR roadways would have protected bicycle lanes implemented in the next five-ten years.

Percent implementation of Portland's protected bicycle lane network and implications for on-street parking

The assumptions shown in **Figure 38** produce the results in **Figure 39**. The bottom row of this table is the most informative. It estimates that 30% implementation of protected bicycle lanes city-wide on the 460 total miles of SIR roadway in Portland (137.2 miles implemented) would result in a loss of 4% of the overall on-street parking supply. A 52% implementation on the 44.3 miles of SIR roadways in the meter districts is estimated to result in a loss of 8% of existing parking supply. Finally, for the 191.4 miles of SIR roadways with commercial zoning, 41% implementation in those districts is estimated to result in a loss of 21% of the existing on-street parking supply in those districts.

Photo: City of Portland

Assumptions about implementing protected bicycle lanes and its impact on on-street parking

Roadway Widths	City Wide						On streets with commercial zoning						On streets within meter districts					
	Percent implementation		streets w/ no parking		streets w/ one-side parking		Percent implementation		streets w/ no parking		streets w/ one-side parking		Percent implementation		streets w/ no parking		streets w/ one-side parking	
	Two-way	One-way	Two-way	One-way	Two-way	One-way	Two-way	One-way	Two-way	One-way	Two-way	One-way	Two-way	One-way	Two-way	One-way	Two-way	One-way
Less than 34 feet	0%	0%	100%	20%	0%	80%	0%	0%	100%	20%	0%	80%	0%	0%	100%	20%	0%	80%
36 feet (includes 34, 35, 37 and 38 feet, too)	10%	50%	100%	5%	0%	95%	10%	50%	100%	5%	0%	95%	10%	50%	100%	5%	0%	95%
40 feet (includes 39, 41 and 42 feet, too)	10%	50%	100%	5%	0%	95%	10%	100%	100%	5%	0%	95%	10%	100%	100%	5%	0%	95%
44 feet (includes 43 and 45 feet, too)	20%	60%	75%	0%	25%	50%	20%	100%	75%	0%	25%	50%	20%	100%	75%	0%	25%	50%
46 feet (includes 47 feet, too)	70%	100%	75%	0%	25%	5%	70%	100%	75%	0%	25%	5%	70%	100%	75%	0%	25%	5%
50 feet (includes 48, 49, 51, 52 and 53 feet, too)	60%	60%	75%	0%	25%	0%	60%	100%	75%	0%	25%	0%	60%	100%	75%	0%	25%	0%
56 feet (includes 54, 55 and 57 feet, too)	60%	100%	55%	0%	25%	0%	60%	10%	55%	0%	25%	0%	60%	10%	55%	0%	25%	0%
60 feet (includes 58, 59, 61 and 62 feet, too)	50%	100%	55%	0%	25%	0%	50%	100%	55%	0%	25%	0%	50%	100%	55%	0%	25%	0%
66 feet (includes 63, 64, 65 and 67 feet, too)	50%	100%	20%	0%	25%	0%	50%	100%	20%	0%	25%	0%	50%	100%	20%	0%	25%	0%
72 feet (includes 68, 69, 70, 71 and 73 feet, too)	60%	0%	20%	0%	20%	0%	60%	0%	20%	0%	20%	0%	60%	0%	20%	0%	20%	0%
76 feet (includes 74, 75 and all wider than 76 feet, too)	50%	0%	20%	0%	20%	0%	50%	0%	20%	0%	20%	0%	50%	0%	20%	0%	20%	0%

Figure 39. "Percent implementation" identifies the percentage of roadways at a width expected to be retrofit with protected bicycle lanes in the next 5-10 years. "Streets with No Parking" estimates the proportion of streets implemented at any one width that will result in no on-street parking. "Streets with one-side parking" estimates the streets that will have parking remaining on one side. Streets with parking on both sides is assumed as the remainder after taking into account no parking and one-side parking.

Percent implementation of Portland's protected bicycle lane network and implications for on-street parking

	City Wide Implementation			Meter District Implementation			Commercial Street Implementation			Miles of SIR roadways implemented city wide
	Miles	*percent implemented*	*percent loss of existing parking spaces*	**Miles**	*percent implemented*	*percent loss of existing parking spaces*	**Miles**	*percent implemented*	*percent loss of existing parking spaces*	
Less than 34 feet	113	0%	0%	3.2	0%	0%	17.3	0%	0%	0
36 feet (includes 34, 35, 37 and 38 feet, too)	90	18%	13%	13.9	40%	22%	40.2	23%	15%	15.8
40 feet (includes 39, 41 and 42 feet, too)	39	14%	12%	2.9	53%	31%	15	26%	18%	5.5
44 feet (includes 43 and 45 feet, too)	32	26%	17%	2.5	68%	22%	15.4	44%	20%	8.4
46 feet (includes 47 feet, too)	13	75%	52%	2.1	86%	30%	6.5	76%	50%	9.7
50 feet (includes 48, 49, 51, 52 and 53 feet, too)	36	60%	42%	7.2	91%	12%	19.5	70%	39%	21.6
56 feet (includes 54, 55 and 57 feet, too)	21	68%	33%	4.9	31%	17%	13.1	46%	29%	14.2
60 feet (includes 58, 59, 61 and 62 feet, too)	35	53%	32%	4.6	63%	25%	23.6	53%	32%	18.5
66 feet (includes 63, 64, 65 and 67 feet, too)	25	52%	16%	0.7	71%	9%	10	56%	14%	13
72 feet (includes 68, 69, 70, 71 and 73 feet, too)	25	60%	18%	1	48%	14%	9.1	59%	18%	15
76 feet (includes 74, 75 and all wider than 76 feet, too)	31	50%	15%	1.3	46%	14%	21.7	50%	15%	15.5
	460	**30%**	**4%**	**44.3**	**52%**	**8%**	**191.4**	**41%**	**21%**	**137.2**

Figure 40. Percent Implementation of Portland's protected bicycle lane network and implications for on-street parking

Appendix B: Protected Bicycle Lane Retrofit Costs: Estimated Unit Construction Costs and Estimated Network Implementation Costs

The six retrofit facility types present widely varying implementation costs. This appendix presents a planning-level estimate of construction costs associated with these designs based on the following three basic assumptions:

- Existing pavement markings will need to be eradicated and repainted
- Costs of removing and installing are based on painted lines (rather than thermoplastic)
- Curbs will not be moved

This appendix also provides an initial per-approach construction cost estimate for impacts at existing traffic signals. The actual signal costs will vary depending on a number of factors, including the nature of the bicycle improvement and the existing signal infrastructure. A protected bicycle lane design that includes parking-protected bicycle lanes on one side of the roadway and a barrier-protected bicycle lane on the other can create sufficient imbalance in the roadway design that loops may have to be moved (a relatively minor expense) and/or the traffic signal heads may need to be relocated. The expense to relocate signal heads can be relatively minor if the mast arms are long enough—or very expensive if the mast arms, and potentially the entire signal need to be replaced. Other elements that can result in significant signal costs are two-way bikeways and protected bicycle phases at intersections.

Figure 40 displays the unit costs and other assumptions used to produce the cost estimates. With the exception of the per-approach signal estimates, they are either based on construction bid item costs, or, where not, are based on material costs multiplied by 1.8. The intent is for them to represent fully loaded construction costs.

Figure 41 displays a range of representative per mile construction costs for developing protected bicycle lanes on roadways of different widths. As there are often multiple configurations that can be employed on any roadway—especially the wider roads—the cost estimates in **Figure 41** are based on an "average" retrofit that takes into account typical changes that might be made by the retrofits shown in **Section 3** of this Guide ("Representative Graphics"). The starting points at every width were representative roadways classified as Major City Bikeways for each width and directionality. Multiply these per mile construction cost estimates to arrive at an estimated per mile project cost, which includes design, management and overhead.

For traffic-separator protected bikeways the construction cost estimates include the cost of grinding off the top two inches of asphalt for the width of the bicycling zone (assumed to be seven feet) and the width of the buffer zone (assumed to be three feet). The estimate also includes the cost of restoring the asphalt with a two-inch lift. For concrete island protected bikeways the same grinding estimate is used, though the cost of restoring the two inches of asphalt is applied only to the width of the bicycling zone as the concrete island is assumed to be embedded two inches below the finished surface of the buffer zone.

For traffic separator protected bicycle lanes this adds approximately $160,000 per mile for two-way roadways and $80,000 per mile for one-way roadways. For concrete island protected bicycle lanes this adds approximately $130,000 per mile for two-way roadways and $65,000 for one-way roadways. These costs can be subtracted from the construction cost estimates if that treatment is not required because of good pavement quality (PCI greater than 70).

Appendix A provided an analysis of potential parking impacts based on implementing approximately 30% of the city's protected bicycle lanes (137 miles out of 460 total miles). Applying those same assumptions here provides a planning level estimate of the range of costs associated with implementing those 137 miles. Using the same percentage implementation by roadway width and direction (displayed in **Figure 38**), and the per-mile construction costs from **Figure 41**, produces the total range of costs by facility type as displayed in **Figure 42**

To further refine the cost estimate would require identifying the specific roadways to be retrofit and what treatment would be used on each. However, assuming that a majority would be implemented using delineator posts, this analysis suggests that the 137 miles of protected bicycle lanes could be implemented for planning-level fully loaded estimated cost of approximately $57 million. Fully-loaded project costs are derived by multiplying the construction cost by 2.5. This multiplier takes into account non-construction costs associated with any capital project, including design, management, overhead, etc.

Unit costs and measurements for estimating cost for protected bicycle lane retrofits* ($2018)

Grinding Costs		
Grinding 4" lines (cost per lf)		
Paint	$ 2.69	
Thermoplastic	$ 2.69	
Legend removal (per unit)	$ 84.00	
Installation Costs		
Painting 4" lines (cost per lf)		
Paint	$ 0.46	
Thermoplastic	$ 2.05	
Bicycle lane symbol	$ 354.00	
Pedestrian symbol	$ 143.00	
Hatch Marks		
Paint	$ 40.00	
Thermoplastic	$ 80.00	

Barrier Costs		
Delineator posts	$ 82.56	per unit
Traffic separator	$ 32.85	per linear foot
Planter	$ 450.00	per unit
Median barrier	$ 24.70	per sf
Concrete curb	$ 39.63	per linear foot
Tough curb	$ 72.00	per linear foot
Two-inch pavement grind**	$ 0.50	per sf
Two-inch AC inlay**	$ 1.50	per sf
Other Unit Inputs		
Spacing between hatch marks	30	feet
Spacing between pedestrian legends	50	feet
Spacing between delineator posts	20	feet
Spacing between traffic separators	1.25	feet
Length of traffic separators	25	feet
Spacing between planters (on center)	20	feet
Bicycle legends per mile	8	per mile
Other Cost Considerations		
Revise existing signal detection	$ 30,000.00	per approach
Replace existing signal equipment with new mast arm pole	$ 50,000.00	per approach

**Costs are PBOT bid item costs for contract jobs of less than $1 million*
***These costs apply only for traffic separators and concrete islands and reflect grinding the width of the bicycling zone and barrier and then applying an overlay to the bicycling zone.*

Figure 41. Unit cost assumptions used to develop protected bicycle lane cost estimates. Pedestrian symbols are used only for parking protected lanes. Cost estimates for 8" lines simply double the cost for 4" lines

Estimated per mile construction costs for retrofitting Portland roadways with protected bicycle lanes based on roadway width*

Curb to curb width (feet)	Parking protected	Parking protected w/ delineators	Delineator posts	Traffic separator+	Planter	Concrete island+
Two-way roadways						
36	-	-	$ 73,000	$ 421,000	$ 212,000	$ 448,000
40	-	-	$ 179,000	$ 563,000	$ 318,000	$ 554,000
44	$ 203,000	$ 237,000	$ 145,000	$ 530,000	$ 346,000	$ 1,096,000
46	$ 192,000	$ 225,000	$ 131,000	$ 573,000	$ 332,000	$ 1,082,000
50	$ 192,000	$ 225,000	$ 188,000	$ 573,000	$ 332,000	$ 1,053,000
56	$ 194,000	$ 228,000	$ 195,000	$ 580,000	$ 299,000	$ 1,049,000
60	$ 223,000	$ 256,000	$ 224,000	$ 608,000	$ 368,000	$ 1,049,000
66	$ 161,000	$ 195,000	$ 131,000	$ 516,000	$ 365,000	$ 1,115,000
72	$ 155,000	$ 189,000	$ 159,000	$ 543,000	$ 293,000	$ 1,043,000
76	$ 258,000	$ 292,000	$ 131,000	$ 516,000	$ 270,000	$ 677,000
One-way roadways						
36	$ 140,000	$ 157,000	$ 139,000	$ 331,000	$ 209,000	$ 584,000
40	$ 182,000	$ 199,000	$ 182,000	$ 374,000	$ 251,000	$ 403,000
42	$ 126,000	$ 142,000	$ 125,000	$ 317,000	$ 195,000	$ 569,000
44	$ 97,000	$ 114,000	$ 99,000	$ 291,000	$ 169,000	$ 320,000
46	$ 70,000	$ 87,000	$ 70,000	$ 262,000	$ 139,000	$ 514,000
48	$ 80,000	$ 97,000	$ 66,000	$ 258,000	$ 135,000	$ 304,000
50	$ 114,000	$ 131,000	$ 113,000	$ 305,000	$ 183,000	$ 352,000
52	$ 114,000	$ 131,000	$ 113,000	$ 305,000	$ 183,000	$ 763,000
56	$ 83,000	$ 97,000	$ 82,000	$ 275,000	$ 185,000	$ 560,000
60	$ 116,000	$ 132,000	$ 117,000	$ 310,000	$ 187,000	$ 459,000
66	$ 83,000	$ 100,000	$ 85,000	$ 277,000	$ 154,000	$ 426,000

**Costs do not include needed signals work.*

+ Concrete island and traffic separator costs include two-inch grind for width of combined bicycling zone and barrier and two-inch asphalt overlay for width of bicycling zone. This work is to be performed when the condition of the bicycling and buffer zones are in poor condition (PCI of 70 or less). In both cases the bicycle zone is assumed to be seven feet. For two-way roadways this adds per mile costs of approximately $130,000 and $160,000 to the construction costs of concrete island protected lanes and traffic separator protected lanes, respectively. It adds per mile costs of approximately $65,000 or $80,000 to the cost of those facilities on one-way roadways, respectively.

Figure 42. Estimated per mile construction costs for protected bicycle lanes on Portland roadways. These costs represent costs of an averaged treatment based on the most typical existing configurations at each width and the average number of traffic lines shifted using recommended designs as shown in Section 3 of this guide.

Estimated total implementation costs for 137 miles of protected bicycle lanes by facilty type and street width*

Curb to curb width (feet)	Parking protected	Parking protected w/ delineators	Delineator posts	Traffic separator+	Planter	Concrete island+	Below costs refer to the total miles implemented, as shown below
Estimated construction costs for two-way roadways							**110.5**
36			$ 530,000	$ 3,070,000	$ 1,550,000	$ 3,270,000	7.3
40			$ 630,000	$ 1,970,000	$ 1,110,000	$ 1,940,000	3.5
44	$ 1,100,000	$ 1,280,000	$ 780,000	$ 2,860,000	$ 1,870,000	$ 5,920,000	5.4
46	$ 1,480,000	$ 1,740,000	$ 1,010,000	$ 4,410,000	$ 2,560,000	$ 8,330,000	7.7
50	$ 3,340,000	$ 3,920,000	$ 3,270,000	$ 9,970,000	$ 5,780,000	$ 18,330,000	17.4
56	$ 1,980,000	$ 2,320,000	$ 1,990,000	$ 5,920,000	$ 3,050,000	$ 10,700,000	10.2
60	$ 3,670,000	$ 4,230,000	$ 3,690,000	$ 10,040,000	$ 6,070,000	$ 17,300,000	16.5
66	$ 1,930,000	$ 2,330,000	$ 1,570,000	$ 6,190,000	$ 4,390,000	$ 13,380,000	12
72	$ 2,330,000	$ 2,830,000	$ 2,380,000	$ 8,150,000	$ 4,400,000	$ 15,640,000	15
76	$ 4,000,000	$ 4,530,000	$ 2,030,000	$ 8,000,000	$ 4,190,000	$ 10,500,000	15.5
Estimated construction costs for one-way roadways							**26.7**
36	$ 1,190,000	$ 1,330,000	$ 1,180,000	$ 2,820,000	$ 1,770,000	$ 4,960,000	8.5
40	$ 360,000	$ 400,000	$ 360,000	$ 750,000	$ 500,000	$ 810,000	2
42							
44	$ 290,000	$ 340,000	$ 300,000	$ 870,000	$ 510,000	$ 960,000	3
46	$ 140,000	$ 170,000	$ 140,000	$ 520,000	$ 280,000	$ 1,030,000	2
48							
50	$ 480,000	$ 550,000	$ 470,000	$ 1,280,000	$ 770,000	$ 1,480,000	4.2
52							
56	$ 330,000	$ 390,000	$ 330,000	$ 1,100,000	$ 740,000	$ 2,240,000	4
60	$ 230,000	$ 260,000	$ 230,000	$ 620,000	$ 370,000	$ 920,000	2
66	$ 80,000	$ 100,000	$ 80,000	$ 280,000	$ 150,000	$ 430,000	1
Total Construction Costs by Facility Type	$ 22,930,000	$ 26,720,000	$ 20,970,000	$ 68,820,000	$ 40,060,000	$ 118,140,000	**Construction cost multiplier**
Total estimated projects costs applying a construction cost multiplier	$ 57,330,000	$ 66,800,000	$ 52,430,000	$ 172,050,000	$ 100,150,000	$ 295,350,000	**2.5**

"*Costs do not include needed signals work.
+ Concrete island and traffic separator costs include two-inch grind for width of combined bicycling zone and barrier and two-inch asphalt overlay for width of bicycling zone. This work is to be performed when the condition of the bicycling and buffer zones are in poor condition (PCI of 70 or less). In both cases the bicycle zone is assumed to be seven feet. For two-way roadways this adds per mile costs of approximately $130,000 and $160,000 to the construction costs of concrete island protected lanes and traffic separator protected lanes, respectively. It adds per mile costs of approximately $65,000 or $80,000 to the cost of those facilities on one-way roadways, respectively."

Figure 43. Estimated total construction and project costs for implementation of approximately one-third of Portland's projected protected bikeway network.

Appendix C: Protected Bicycle Lane Design Tables

The below tables show, by roadway width, the universe of retrofit protected bicycle lane configurations possible for each of the 28 retrofit cross-sections identified in Section 2. A number of options show a choice for the "# of travel lanes" column. This corresponds to the "Width remaining" column displaying a value greater than "10". The values shown in those rows correspond to a calculation using the smaller of the "# of travel lane" values. Assuming the higher of the values would necessarily subtract the width of a standard travel lane (10') from the "Width remaining" column. Width remaining could also be assigned to on-street parking, wider bicycle facilities, wider travel lanes or other purposes on the corridor.

These tables are calculated using a spreadsheet tool that is readily available from Portland's Bureau of Transportation.

One-way roadway widths

below table shows the more common widths, accounting for eighty percent of all one-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (includes all representative widths, too)	% of proposed 1-way SIR network
36' (representative roadways include those at 34', 35' and 37', too)	Standard bicycle lane	2 or 3	10	na	6	NW Glisan NW 16th Ave (Thurman - Johnson) NW 14th (Thurman - Everett) NW 14th NW 18th NW 19th NW Everett SW Columbia (18th - 1st; segments) SW Salmon SW Alder **SW Stark** **SW Oak** SW Jefferson (Park - 1st) SW Madison (Park - 1st) SW 14th (Columbia - Taylor) SW 13th (Mill - Taylor) **SE Madison** (Grand - 12th) SE 11th SE 12th SE Morrison (12th - 23rd) **N Vancouver** (many segments betw Alberta - Hancock) **NE Weidler** (16th - 21st) NE Couch SE Morrison	17	38%
	Barrier protected De	2	9.7	5.7	5			
	Buffered bicycle lane	2	8	na	5			
	Barrier protected Dd	2	8.7	6.7	6.5			
	Barrier protected Me	2	9	5	5			
	Barrier protected Tse	2	9	5.67	5			
	Barrier protected TSd	2	8.7	6	6			
	Barrier protected Dc	2	7.7	7.7	6			
	Barrier protected Pe	2	8	5.83	5			
	Barrier protected TSc	2	7.7	7	6.5			
	Barrier protected Db	2	6.7	8.7	7			
	Barrier protected Mc	2	7	7	7			
	Barrier protected Md	2	7	6	6			
	Barrier protected Pd	2	7	6.83	6			
	Barrier Protected TSb	2	6.7	8	7			
	Barrier Protected Pc	2	6.5	7.33	6.5			
	Barrier Protected Da	2	5.7	9.7	8			
	Barrier Protected Pb	2	6	7.83	7			
	Barrier Protected TSa	2	5.7	9	8			
	Barrier Protected Pa	2	5	8.83	8			
	Barrier Protected Mb	2	4	8	8			
	Parking protected E	2	0	8	5			
	Parking protected Ed	2	0	7.5	5			
	Barrier Protected Ma	2	0	10	10			

One-way roadway widths

below table shows the more common widths, accounting for eighty percent of all one-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (includes all representative widths, too)	% of proposed 1-way SIR network
40' (representative roadways include those at 38', 39' and 41', too)	Standard bicycle lane	2 or 3	14	na	6	**N Williams**	3	6.8%
	Barrier protected De	2 or 3	13.7	5.7	5			
	Buffered bicycle lane	2 or 3	12	na	5			
	Barrier protected Dd	2 or 3	12.7	6.7	6.5			
	Barrier protected Me	2 or 3	13	5	5			
	Barrier protected Tse	2 or 3	13	5.67	5			
	Barrier protected TSd	2 or 3	12.7	6	6			
	Barrier protected Dc	2 or 3	11.7	7.7	6			
	Barrier protected Pe	2 or 3	12	5.83	5			
	Barrier protected TSc	2 or 3	11.7	7	6.5			
	Barrier protected Db	2 or 3	10.7	8.7	7			
	Barrier protected Mc	2 or 3	11	7	7			
	Barrier protected Md	2 or 3	11	6	6			
	Barrier protected Pd	2 or 3	11	6.83	6			
	Barrier Protected TSb	2 or 3	10.7	8	7			
	Barrier Protected Pc	2 or 3	10.5	7.33	6.5			
	Barrier Protected Da	2	9.7	9.7	8			
	Barrier Protected Pb	2 or 3	10	7.83	7			
	Barrier Protected TSa	2	9.7	9	8			
	Barrier Protected Pa	2	9	8.83	8			
	Barrier Protected Mb	2	8	8	8			
	Parking protected E	2	4	8	5			
	Parking protected Ed	2	4	7.5	5			
	Parking protected C	2	3	9	6.5			
	Parking protected Cd	2	3	8.5	6.5			
	Barrier protected Ma	2	4	10	10			
	Parking protected B	2	2	10	7			
	Parking protected Bd	2	2	9.5	7			
	Parking protected A	2	1	11	8			
	Parking protected Ad	2	1	10.5	8			

One-way roadway widths

below table shows the more common widths, accounting for eighty percent of all one-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (includes all representative widths, too)	% of proposed 1-way SIR network
42 (representative roadways include those at 43', too)	Standard bicycle lane	2 or 3	16	na	6	SE Belmont (12th - 26th)	1.9	4.2%
	Barrier protected De	2 or 3	15.7	5.7	5			
	Buffered bicycle lane	2 or 3	14	na	5			
	Barrier protected Dd	2 or 3	14.7	6.7	6.5			
	Barrier protected Me	2 or 3	15	5	5			
	Barrier protected Tse	2 or 3	15	5.67	5			
	Barrier protected TSd	2 or 3	14.7	6	6			
	Barrier protected Dc	2 or 3	13.7	7.7	6			
	Barrier protected Pe	2 or 3	14	5.83	5			
	Barrier protected TSc	2 or 3	13.7	7	6.5			
	Barrier protected Db	2 or 3	12.7	8.7	7			
	Barrier protected Mc	2 or 3	13	7	7			
	Barrier protected Md	2 or 3	13	6	6			
	Barrier protected Pd	2 or 3	13	6.83	6			
	Barrier Protected TSb	2 or 3	12.7	8	7			
	Barrier Protected Pc	2 or 3	12.5	7.33	6.5			
	Barrier Protected Da	2 or 3	11.7	9.7	8			
	Barrier Protected Pb	2 or 3	12	7.83	7			
	Barrier Protected TSa	2 or 3	11.7	9	8			
	Barrier Protected Pa	2 or 3	11	8.83	8			
	Barrier Protected Mb	2 or 3	10	8	8			
	Parking protected E	2	6	8	5			
	Parking protected Ed	2	6	7.5	5			
	Parking protected C	2	5	9	6.5			
	Parking protected Cd	2	5	8.5	6.5			
	Barrier protected Ma	2	6	10	10			
	Parking protected B	2	4	10	7			
	Parking protected Bd	2	4	9.5	7			
	Parking protected A	2	3	11	8			
	Parking protected Ad	2	3	10.5	8			

One-way roadway widths

below table shows the more common widths, accounting for eighty percent of all one-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (includes all representative widths, too)	% of proposed 1-way SIR network
44 (representative roadways include those at 45', too)	Standard bicycle lane	2 or 3	18	na	6	**NE Halsey** **NE Weidler** SE Stark (w of 92nd) NE Grand Ave (N of Holladay) SE 102/103rd (s of Stark)	4.6	10.5%
	Barrier protected De	2 or 3	17.7	5.7	5			
	Buffered bicycle lane	2 or 3	16	na	5			
	Barrier protected Dd	2 or 3	16.7	6.7	6.5			
	Barrier protected Me	2 or 3	17	5	5			
	Barrier protected Tse	2 or 3	17	5.67	5			
	Barrier protected TSd	2 or 3	16.7	6	6			
	Barrier protected Dc	2 or 3	15.7	7.7	6			
	Barrier protected Pe	2 or 3	16	5.83	5			
	Barrier protected TSc	2 or 3	15.7	7	6.5			
	Barrier protected Db	2 or 3	14.7	8.7	7			
	Barrier protected Mc	2 or 3	15	7	7			
	Barrier protected Md	2 or 3	15	6	6			
	Barrier protected Pd	2 or 3	15	6.83	6			
	Barrier Protected TSb	2 or 3	14.7	8	7			
	Barrier Protected Pc	2 or 3	14.5	7.33	6.5			
	Barrier Protected Da	2 or 3	13.7	9.7	8			
	Barrier Protected Pb	2 or 3	14	7.83	7			
	Barrier Protected TSa	2 or 3	13.7	9	8			
	Barrier Protected Pa	2 or 3	13	8.83	8			
	Barrier Protected Mb	2 or 3	12	8	8			
	Parking protected E	2	8	8	5			
	Parking protected Ed	2	7	7.5	5			
	Parking protected C	2	7	9	6.5			
	Parking protected Cd	2	8	8.5	6.5			
	Barrier protected Ma	2	6	10	10			
	Parking protected B	2	6	10	7			
	Parking protected Bd	2	6	9.5	7			
	Parking protected A	2	5	11	8			
	Parking protected Ad	2	5	10.5	8			

One-way roadway widths

below table shows the more common widths, accounting for eighty percent of all one-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (includes all representative widths, too)	% of proposed 1-way SIR network
46 (representative roadways include those at 47', too)	Standard bicycle lane	3 or 4	10	na	6	SW/NW 2nd Ave (Flanders - Main) NW 3rd Ave (Davis - Burnside)	1.6	3.7%
	Barrier protected De	2 or 3	19.7	5.7	5			
	Buffered bicycle lane	2 or 3	18	na	5			
	Barrier protected Dd	2 or 3	18.7	6.7	6.5			
	Barrier protected Me	2 or 3	19	5	5			
	Barrier protected Tse	2 or 3	19	5.67	5			
	Barrier protected TSd	2 or 3	18.7	6	6			
	Barrier protected Dc	2 or 3	17.7	7.7	6			
	Barrier protected Pe	2 or 3	18	5.83	5			
	Barrier protected TSc	2 or 3	17.7	7	6.5			
	Barrier protected Db	2 or 3	16.7	8.7	7			
	Barrier protected Mc	2 or 3	17	7	7			
	Barrier protected Md	2 or 3	17	6	6			
	Barrier protected Pd	2 or 3	17	6.83	6			
	Barrier Protected TSb	2 or 3	16.7	8	7			
	Barrier Protected Pc	2 or 3	16.5	7.33	6.5			
	Barrier Protected Da	2 or 3	15.7	9.7	8			
	Barrier Protected Pb	2 or 3	16	7.83	7			
	Barrier Protected TSa	2 or 3	15.7	9	8			
	Barrier Protected Pa	2 or 3	15	8.83	8			
	Barrier Protected Mb	2 or 3	14	8	8			
	Parking protected E	2 or 3	10	8	5			
	Parking protected Ed	2 or 3	10	7.5	5			
	Parking protected C	2	9	9	6.5			
	Parking protected Cd	2	9	8.5	6.5			
	Barrier protected Ma	3	10	10	10			
	Parking protected B	2	8	10	7			
	Parking protected Bd	2	8	9.5	7			
	Parking protected A	2	7	11	8			
	Parking protected Ad	2	7	10.5	8			

One-way roadway widths

below table shows the more common widths, accounting for eighty percent of all one-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (includes all representative widths, too)	% of proposed 1-way SIR network
48 (representative roadways include those at 49', too)	Standard bicycle lane	3 or 4	12	na	6	SE Washington (east of I-205) **SW Broadway** (6th - I-405)	1.5	3.3%
	Barrier protected De	3 or 4	11.7	5.7	5			
	Buffered bicycle lane	3 or 4	10	na	5			
	Barrier protected Dd	3 or 4	10.7	6.7	6.5			
	Barrier protected Me	3 or 4	11	5	5			
	Barrier protected Tse	3 or 4	11	5.67	5			
	Barrier protected TSd	3 or 4	10.7	6	6			
	Barrier protected Dc	2 or 3	19.7	7.7	6			
	Barrier protected Pe	3 or 4	10	5.83	5			
	Barrier protected TSc	2 or 3	19.7	7	6.5			
	Barrier protected Db	2 or 3	18.7	8.7	7			
	Barrier protected Mc	2 or 3	19	7	7			
	Barrier protected Md	2 or 3	19	6	6			
	Barrier protected Pd	2 or 3	19	6.83	6			
	Barrier Protected TSb	2 or 3	18.7	8	7			
	Barrier Protected Pc	2 or 3	18.5	7.33	6.5			
	Barrier Protected Da	2 or 3	17.7	9.7	8			
	Barrier Protected Pb	2 or 3	18	7.83	7			
	Barrier Protected TSa	2 or 3	17.7	9	8			
	Barrier Protected Pa	2 or 3	17	8.83	8			
	Barrier Protected Mb	2 or 3	16	8	8			
	Parking protected E	2 or 3	12	8	5			
	Parking protected Ed	2 or 3	12	7.5	5			
	Parking protected C	2 or 3	11	9	6.5			
	Parking protected Cd	2 or 3	11	8.5	6.5			
	Barrier protected Ma	2 or 3	12	10	10			
	Parking protected B	2 or 3	10	10	7			
	Parking protected Bd	2 or 3	10	9.5	7			
	Parking protected A	2	9	11	8			
	Parking protected Ad	2	9	10.5	8			

One-way roadway widths

below table shows the more common widths, accounting for eighty percent of all one-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (includes all representative widths, too)	% of proposed 1-way SIR network
50 (representative roadways include those at 51', too)	Standard bicycle lane	3 or 4	14	na	6	**SW Broadway** (Burnside - Jackson) **SW 4th** (Burnside - Jackson) SW 3rd (Ash - Salmon) SW 12th (Stark - Montgomery) **NE Weidler** (MLK - Victoria)	3.8	8.6%
	Barrier protected De	3 or 4	13.7	5.7	5			
	Buffered bicycle lane	3 or 4	12	na	5			
	Barrier protected Dd	3 or 4	12.7	6.7	6.5			
	Barrier protected Me	3 or 4	13	5	5			
	Barrier protected Tse	3 or 4	13	5.67	5			
	Barrier protected TSd	3 or 4	12.7	6	6			
	Barrier protected Dc	3 or 4	11.7	7.7	6			
	Barrier protected Pe	3 or 4	12	5.83	5			
	Barrier protected TSc	3 or 4	11.7	7	6.5			
	Barrier protected Db	3 or 4	10.7	8.7	7			
	Barrier protected Mc	3 or 4	11	7	7			
	Barrier protected Md	3 or 4	11	6	6			
	Barrier protected Pd	3 or 4	11	6.83	6			
	Barrier Protected TSb	3 or 4	10.7	8	7			
	Barrier Protected Pc	3 or 4	10.5	7.33	6.5			
	Barrier Protected Da	2 or 3	19.7	9.7	8			
	Barrier Protected Pb	3 or 4	10	7.83	7			
	Barrier Protected TSa	2 or 3	19.7	9	8			
	Barrier Protected Pa	2 or 3	19	8.83	8			
	Barrier Protected Mb	2 or 3	18	8	8			
	Parking protected E	2 or 3	14	8	5			
	Parking protected Ed	2 or 3	14	7.5	5			
	Parking protected C	2 or 3	13	9	6.5			
	Parking protected Cd	2 or 3	13	8.5	6.5			
	Barrier protected Ma	2 or 3	14	10	10			
	Parking protected B	2 or 3	12	10	7			
	Parking protected Bd	2 or 3	12	9.5	7			
	Parking protected A	2 or 3	11	11	8			
	Parking protected Ad	2 or 3	11	10.5	8			

One-way roadway widths

below table shows the more common widths, accounting for eighty percent of all one-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (includes all representative widths, too)	% of proposed 1-way SIR network
52 (representative roadways include those at 53' and 54', too)	Standard bicycle lane	3 or 4	16	na	6	**NE Broadway** (Williams - Grand; 10th - 17th) **NE Weidler** (8th - 16th)) **SE Hawthorne** (Grand-12th)	4.5	2.0%
	Barrier protected De	3 or 4	15.7	5.7	5			
	Buffered bicycle lane	3 or 4	14	na	5			
	Barrier protected Dd	3 or 4	14.7	6.7	6.5			
	Barrier protected Me	3 or 4	15	5	5			
	Barrier protected Tse	3 or 4	15	5.67	5			
	Barrier protected TSd	3 or 4	14.7	6	6			
	Barrier protected Dc	3 or 4	13.7	7.7	6			
	Barrier protected Pe	3 or 4	14	5.83	5			
	Barrier protected TSc	3 or 4	13.7	7	6.5			
	Barrier protected Db	3 or 4	12.7	8.7	7			
	Barrier protected Mc	3 or 4	13	7	7			
	Barrier protected Md	3 or 4	13	6	6			
	Barrier protected Pd	3 or 4	13	6.83	6			
	Barrier Protected TSb	3 or 4	12.7	8	7			
	Barrier Protected Pc	3 or 4	12.5	7.33	6.5			
	Barrier Protected Da	3 or 4	11.7	9.7	8			
	Barrier Protected Pb	3 or 4	12	7.83	7			
	Barrier Protected TSa	3 or 4	11.7	9	8			
	Barrier Protected Pa	3 or 4	11	8.83	8			
	Barrier Protected Mb	3 or 4	10	8	8			
	Parking protected E	2 or 3	16	8	5			
	Parking protected Ed	2 or 3	16	7.5	5			
	Parking protected C	2 or 3	15	9	6.5			
	Parking protected Cd	2 or 3	15	8.5	6.5			
	Barrier protected Ma	2 or 3	16	10	10			
	Parking protected B	2 or 3	14	10	7			
	Parking protected Bd	2 or 3	14	9.5	7			
	Parking protected A	2 or 3	13	11	8			
	Parking protected Ad	2 or 3	13	10.5	8			

One-way roadway widths

below table shows the more common widths, accounting for eighty percent of all one-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (includes all representative widths, too)	% of proposed 1-way SIR network
56 (representative roadways include those at 55', 57' and 58', too)	Standard bicycle lane	4 or 5	10	na	6	**NE Broadway** (segments east of Grand; 17th - 24th) Martin Luther King Jr. Blvd (multiple segments Lincoln - Hancock) Grand Avenue (multiple segments s of Holladay) **E Burnside** (Couch - 11th)	3.8	8.6%
	Barrier protected De	3 or 4	19.7	5.7	5			
	Buffered bicycle lane	3 or 4	18	na	5			
	Barrier protected Dd	3 or 4	18.7	6.7	6.5			
	Barrier protected Me	3 or 4	19	5	5			
	Barrier protected Tse	3 or 4	19	5.67	5			
	Barrier protected TSd	3 or 4	18.7	6	6			
	Barrier protected Dc	3 or 4	17.7	7.7	6			
	Barrier protected Pe	3 or 4	18	5.83	5			
	Barrier protected TSc	3 or 4	17.7	7	6.5			
	Barrier protected Db	3 or 4	16.7	8.7	7			
	Barrier protected Mc	3 or 4	17	7	7			
	Barrier protected Md	3 or 4	17	6	6			
	Barrier protected Pd	3 or 4	17	6.83	6			
	Barrier Protected TSb	3 or 4	16.7	8	7			
	Barrier Protected Pc	3 or 4	16.5	7.33	6.5			
	Barrier Protected Da	3 or 4	15.7	9.7	8			
	Barrier Protected Pb	3 or 4	16	7.83	7			
	Barrier Protected TSa	3 or 4	15.7	9	8			
	Barrier Protected Pa	3 or 4	15	8.83	8			
	Barrier Protected Mb	3 or 4	14	8	8			
	Parking protected E	3 or 4	10	8	5			
	Parking protected Ed	3 or 4	10	7.5	5			
	Parking protected C	2 or 3	19	9	6.5			
	Parking protected Cd	2 or 3	19	8.5	6.5			
	Barrier protected Ma	3 or 4	10	10	10			
	Parking protected B	2 or 3	18	10	7			
	Parking protected Bd	2 or 3	18	9.5	7			
	Parking protected A	2 or 3	17	11	8			
	Parking protected Ad	2 or 3	17	10.5	8			

One-way roadway widths

below table shows the more common widths, accounting for eighty percent of all one-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (includes all representative widths, too)	% of proposed 1-way SIR network
60 (representative roadways include those at 59', 61', 62', 63' and 64', too)	Standard bicycle lane	4 or 5	14	na	6	SE Woodstock/Foster (within I-205 interchange) SE Morrison (Grand to 12th)	1.2	2.8%
	Barrier protected De	4 or 5	13.7	5.7	5			
	Buffered bicycle lane	4 or 5	12	na	5			
	Barrier protected Dd	4 or 5	12.7	6.7	6.5			
	Barrier protected Me	4 or 5	13	5	5			
	Barrier protected Tse	4 or 5	13	5.67	5			
	Barrier protected TSd	4 or 5	12.7	6	6			
	Barrier protected Dc	4 or 5	11.7	7.7	6			
	Barrier protected Pe	4 or 5	12	5.83	5			
	Barrier protected TSc	4 or 5	11.7	7	6.5			
	Barrier protected Db	4 or 5	10.7	8.7	7			
	Barrier protected Mc	4 or 5	11	7	7			
	Barrier protected Md	4 or 5	11	6	6			
	Barrier protected Pd	4 or 5	11	6.83	6			
	Barrier Protected TSb	4 or 5	10.7	8	7			
	Barrier Protected Pc	4 or 5	10.5	7.33	6.5			
	Barrier Protected Da	3 or 4	19.7	9.7	8			
	Barrier Protected Pb	4 or 5	10	7.83	7			
	Barrier Protected TSa	3 or 4	19.7	9	8			
	Barrier Protected Pa	3 or 4	19	8.83	8			
	Barrier Protected Mb	3 or 4	18	8	8			
	Parking protected E	3 or 4	14	8	5			
	Parking protected Ed	3 or 4	14	7.5	5			
	Parking protected C	3 or 4	13	9	6.5			
	Parking protected Cd	3 or 4	13	8.5	6.5			
	Barrier protected Ma	3 or 4	14	10	10			
	Parking protected B	3 or 4	12	10	7			
	Parking protected Bd	3 or 4	12	9.5	7			
	Parking protected A	3 or 4	11	11	8			
	Parking protected Ad	3 or 4	11	10.5	8			

One-way roadway widths

below table shows the more common widths, accounting for eighty percent of all one-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (includes all representative widths, too)	% of proposed 1-way SIR network
66 (representative roadways include those at 65' and greater than 66', too)	Standard bicycle lane	5 or 6	10	na	6	SE Stark Street (93rd - 106th)	1.2	2.6%
	Barrier protected De	4 or 5	19.7	5.7	5			
	Buffered bicycle lane	4 or 5	18	na	5			
	Barrier protected Dd	4 or 5	18.7	6.7	6.5			
	Barrier protected Me	4 or 5	19	5	5			
	Barrier protected Tse	4 or 5	19	5.67	5			
	Barrier protected TSd	4 or 5	18.7	6	6			
	Barrier protected Dc	4 or 5	17.7	7.7	6			
	Barrier protected Pe	4 or 5	18	5.83	5			
	Barrier protected TSc	4 or 5	17.7	7	6.5			
	Barrier protected Db	4 or 5	16.7	8.7	7			
	Barrier protected Mc	4 or 5	17	7	7			
	Barrier protected Md	4 or 5	17	6	6			
	Barrier protected Pd	4 or 5	17	6.83	6			
	Barrier Protected TSb	4 or 5	16.7	8	7			
	Barrier Protected Pc	4 or 5	16.5	7.33	6.5			
	Barrier Protected Da	4 or 5	15.7	9.7	8			
	Barrier Protected Pb	4 or 5	16	7.83	7			
	Barrier Protected TSa	4 or 5	15.7	9	8			
	Barrier Protected Pa	4 or 5	15	8.83	8			
	Barrier Protected Mb	4 or 5	14	8	8			
	Parking protected E	4 or 5	10	8	5			
	Parking protected Ed	4 or 5	10	7.5	5			
	Parking protected C	3 or 4	19	9	6.5			
	Parking protected Cd	3 or 4	19	8.5	6.5			
	Barrier protected Ma	4 or 5	10	10	10			
	Parking protected B	3 or 4	18	10	7			
	Parking protected Bd	3 or 4	18	9.5	7			
	Parking protected A	3 or 4	17	11	8			
	Parking protected Ad	3 or 4	17	10.5	8			

Two-way roadway widths

The table below shows the more common widths, accounting for slightly more than one-half of all two-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (Also includes all representative widths)	% of proposed 2-way SIR network
36' (representative roadways include those at 34', 35', 37' and 38', too)	Standard bicycle lane	2	4	na	6	NW 9th Ave NE 15th Ave NW Thurman Street NE Knott Street N Ida Ave N Willamette (east of Ida) N Lagoon SE Belmont SE Holgate NE Halsey NE Fremont **SW Multnomah** (w of 56th)	73	18%
	Barrier-protected De	2	2	5.7	5			
	Buffered bicycle lane	2	0	na	5			
	Barrier protected Dd	2	0	6.7	6.5			
	Barrier protected Me	2	0	5	5			
40' (representative roadways include those at 39', 41' and 42', too)	Standard bicycle lane	2	8	na	6	**SE 41st/42nd** SE 52nd Ave SE 72nd Ave SE 92nd Ave NE Fremont (EPDX) **NE Tillamook** (62nd - 82nd) **N Willamette** (along the bluff and west) **SE Market** **SE Millmain** SE Steele N Mississippi N Ainsworth N Vancouver	35	8.4%
	Barrier protected De	2	6	5.7	5			
	Buffered bicycle lane	2	4	na	5			
	Barrier protected Dd	2	4	6.7	6.5			
	Barrier protected Me	2	4	5	5			
	Barrier protected Tse	2	3.3	5.67	5			
	Barrier protected TSd	2	2	6	6			
	Barrier protected Dc	2	2	7.7	6			
	Barrier protected Pe	2	1.3	5.83	5			
	Barrier protected TSc	2	0	7	6.5			
	Barrier protected Db	2	0	8.7	7			
	Barrier protected Mc	2	0	7	7			
	Barrier protected Md	2	0	6	6			
	Barrier protected Pd	2	0	6.83	6			
44' (representative roadways include those at 43' and 45', too)	Standard bicycle lane	2 or 3	12	na	6	SE Flavel SE Duke SE Woodstock (w of 72nd) SE 45th SE Steele SE Division (60th to 79th) **E Burnside** (e of 78th) SE 92nd **SW Capitol/Vermont** (30th - Bertha) **N Basin** SE Cherry Blossom/112th **NE Prescott** (81st - I-205)	27	6.6%
	Barrier protected De	2 or 3	10	5.7	5			
	Buffered bicycle lane	2	8	na	5			
	Barrier protected Dd	2	8	6.7	6.5			
	Barrier protected Me	2	8	5	5			
	Barrier protected Tse	2	8	5.67	5			
	Barrier protected TSd	2	7.3	6	6			
	Barrier protected Dc	2	6	7.7	6			
	Barrier protected Pe	2	6	5.83	5			
	Barrier protected TSc	2	5.3	7	6.5			
	Barrier protected Db	2	4	8.7	7			
	Barrier protected Mc	2	4	7	7			
	Barrier protected Md	2	4	6	6			
	Barrier protected Pd	2	4	6.83	6			
	Barrier Protected TSb	2	3.3	8	7			
	Barrier Protected Pc	2	3	7.33	6.5			
	Barrier Protected Da	2	2	9.7	8			
	Barrier Protected Pb	2	2	7.83	7			
	Barrier Protected TSa	2	1.3	9	8			
	Barrier Protected Pa	2	0	8.83	8			

Two-way roadway widths

The table below shows the more common widths, accounting for slightly more than one-half of all two-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (Also includes all representative widths)	% of proposed 2-way SIR network
46' (representative roadways include those at 47', too)	Standard bicycle lane	2 or 3	14	na	6	**N Lombard** (at the cut) NW Front Ave N Albina **NE 7th Ave** **SW Bertha** NE Cully SE Harold SE Holgate	11	2.6%
	Barrier protected De	2 or 3	12	5.7	5			
	Buffered bicycle lane	2 or 3	10	na	5			
	Barrier protected Dd	2 or 3	10	6.7	6.5			
	Barrier protected Me	2 or 3	10	5	5			
	Barrier protected Tse	2 or 3	10	5.67	5			
	Barrier protected TSd	2	9.3	6	6			
	Barrier protected Dc	2	8	7.7	6			
	Barrier protected Pe	2	8	5.83	5			
	Barrier protected TSc	2	7.3	7	6.5			
	Barrier protected Db	2	6	8.7	7			
	Barrier protected Mc	2	6	7	7			
	Barrier protected Md	2	6	6	6			
	Barrier protected Pd	2	6	6.83	6			
	Barrier Protected TSb	2	5.3	8	7			
	Barrier Protected Pc	2	5	7.33	6.5			
	Barrier Protected Da	2	4	9.7	8			
	Barrier Protected Pb	2	4	7.83	7			
	Barrier Protected TSa	2	3.3	9	8			
	Barrier Protected Pa	2	2	8.83	8			
	Barrier Protected Mb	2	0	8	8			
50' (representative roadways include those at 48', 49', 51', 52' and 53', too)	Standard bicycle lane	2 or 3	18	na	6	**NW Broadway** (Hoyt - Burnside) N Portsmouth N Lombard N Fessenden **N Denver** E Burnside (32nd - 52nd) NE Glisan (47th to 82nd) SE Gladstone SE Foster (west of 75th) SE Woodstock (41st - 70th) SE 41st SE 52nd Ave (s of Duke) SE Hawthorne (12th - 53rd) SW 26th (Marigold - Dolph)	29	7.1%
	Barrier protected De	2 or 3	16	5.7	5			
	Buffered bicycle lane	2 or 3	14	na	5			
	Barrier protected Dd	2 or 3	14	6.7	6.5			
	Barrier protected Me	2 or 3	14	5	5			
	Barrier protected Tse	2 or 3	14	5.67	5			
	Barrier protected TSd	2 or 3	13.3	6	6			
	Barrier protected Dc	2 or 3	12	7.7	6			
	Barrier protected Pe	2 or 3	12	5.83	5			
	Barrier protected TSc	2 or 3	11.3	7	6.5			
	Barrier protected Db	2 or 3	10	8.7	7			
	Barrier protected Mc	2 or 3	10	7	7			
	Barrier protected Md	2 or 3	10	6	6			
	Barrier protected Pd	2 or 3	10	6.83	6			
	Barrier Protected TSb	2	9.3	8	7			
	Barrier Protected Pc	2	9	7.33	6.5			
	Barrier Protected Da	2	8	9.7	8			
	Barrier Protected Pb	2	8	7.83	7			
	Barrier Protected TSa	2	7.3	9	8			
	Barrier Protected Pa	2	6	8.83	8			
	Barrier Protected Mb	2	4	8	8			

Two-way roadway widths

The table below shows the more common widths, accounting for slightly more than one-half of all two-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (Also includes all representative widths)	% of proposed 2-way SIR network
56' (representative roadways include those at 54', 55' and 57', too)	Standard bicycle lane	3 or 4	14	na	8	82nd Ave SE 7th/Sandy **NE 12th Ave** (I-84-Burnside) N Basin NE Glisan (22nd - 33rd) **N Greeley** N Smith	17	4.1%
	Barrier protected De	3 or 4	12	5.7	8			
	Buffered bicycle lane	3 or 4	10	na	5			
	Barrier protected Dd	3 or 4	10	6.7	6.5			
	Barrier protected Me	3 or 4	10	5	5			
	Barrier protected Tse	3 or 4	10	5.67	5			
	Barrier protected TSd	2 or 3	19.3	6	6			
	Barrier protected Dc	2 or 3	18	7.7	6			
	Barrier protected Pe	2 or 3	18	5.83	5			
	Barrier protected TSc	2 or 3	17.3	7	6.5			
	Barrier protected Db	2 or 3	16	8.7	7			
	Barrier protected Mc	2 or 3	16	7	7			
	Barrier protected Md	2 or 3	16	6	6			
	Barrier protected Pd	2 or 3	16	6.83	6			
	Barrier Protected TSb	2 or 3	15.3	8	7			
	Barrier Protected Pc	2 or 3	15	7.33	6.5			
	Barrier Protected Da	2 or 3	14	9.7	8			
	Barrier Protected Pb	2 or 3	14	7.83	7			
	Barrier Protected TSa	2 or 3	13.3	9	8			
	Barrier Protected Pa	2 or 3	12	8.83	8			
	Barrier Protected Mb	2 or 3	10	8	8			
	Parking protected E	2	4	8	5			
	Parking protected Ed	2	4	7.5	5			
	Parking protected C	2	2	9	6.5			
	Parking protected Cd	2	2	8.5	6.5			
	Barrier protected Ma	2	2	10	10			
	Parking protected B	2	0	10	7			
	Parking protected Bd	2	0	9.5	7			

Two-way roadway widths

The table below shows the more common widths, accounting for slightly more than one-half of all two-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (Also includes all representative widths)	% of proposed 2-way SIR network
60' (representative roadways include those at 58', 59', 61' and 62', too)	Standard bicycle lane	3 or 4	18	na	8	NE Lloyd NE Multnomah NE Sandy Blvd (12th - I-205) NE Martin Luther King Jr SW Terwilliger SW Barbur (inner) SW Capitol (southern) N Lombard (n of St. Johns) **N Rosa Parks** N Denver NE 82nd Ave (Fremont - Killingsworth) SE 82nd Ave (Burnside - Springwater (with gaps) SE Powell Blvd (west of 90th) SE Foster (w of 72nd) SE McLoughlin Blvd (Tacoma - Tolman) SW Capitol Hwy (Hillsdale District) SW Barbur (through the curves; n of Naito) SW River Parkway	33	8.0%
	Barrier protected De	3 or 4	16	5.7	8			
	Buffered bicycle lane	3 or 4	14	na	5			
	Barrier protected Dd	3 or 4	14	6.7	6.5			
	Barrier protected Me	3 or 4	14	5	5			
	Barrier protected Tse	3 or 4	14	5.67	5			
	Barrier protected TSd	3 or 4	13.3	6	6			
	Barrier protected Dc	3 or 4	12	7.7	6			
	Barrier protected Pe	3 or 4	12	5.83	5			
	Barrier protected TSc	3 or 4	11.3	7	6.5			
	Barrier protected Db	3 or 4	10	8.7	7			
	Barrier protected Mc	3 or 4	10	7	7			
	Barrier protected Md	3 or 4	10	6	6			
	Barrier protected Pd	3 or 4	10	6.83	6			
	Barrier Protected TSb	2 or 3	19.3	8	7			
	Barrier Protected Pc	2 or 3	19	7.33	6.5			
	Barrier Protected Da	2 or 3	18	9.7	8			
	Barrier Protected Pb	2 or 3	18	7.83	7			
	Barrier Protected TSa	2 or 3	17.3	9	8			
	Barrier Protected Pa	2 or 3	16	8.83	8			
	Barrier Protected Mb	2 or 3	14	8	8			
	Parking protected E	2	8	8	5			
	Parking protected Ed	2	8	7.5	5			
	Parking protected C	2	6	9	6.5			
	Parking protected Cd	2	6	8.5	6.5			
	Barrier protected Ma	2	6	10	10			
	Parking protected B	2	4	10	7			
	Parking protected Bd	2	4	9.5	7			
	Parking protected A	2	2	11	8			
	Parking protected Ad	2	2	10.5	8			

Two-way roadway widths

The table below shows the more common widths, accounting for slightly more than one-half of all two-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (Also includes all representative widths)	% of proposed 2-way SIR network
66' (representative roadways include those at 63', 64', 65' and 67', too)	Standard bicycle lane	4 or 5	14	na	8	**SE Halsey** (east of 135th) NE Glisan (w of 139th) NE 148th (s of Division; Glisan - I-84) SE Stark (e of 109th) 102nd (Halsey - Pine) SE Holgate (96th - 122nd) SE 92nd (Franklin - Lincoln) NE Killingsworth (w of 47th) NE Cully (Failing to Prescott) N Columbia (Lombard - MLK)	24	5.7%
	Barrier protected De	4 or 5	12	5.7	8			
	Buffered bicycle lane	4 or 5	10	na	5			
	Barrier protected Dd	4 or 5	10	6.7	6.5			
	Barrier protected Me	4 or 5	10	5	5			
	Barrier protected Tse	4 or 5	10	5.67	5			
	Barrier protected TSd	3 or 4	19.3	6	6			
	Barrier protected Dc	3 or 4	18	7.7	6			
	Barrier protected Pe	3 or 4	18	5.83	5			
	Barrier protected TSc	3 or 4	17.3	7	6.5			
	Barrier protected Db	3 or 4	16	8.7	7			
	Barrier protected Mc	3 or 4	16	7	7			
	Barrier protected Md	3 or 4	16	6	6			
	Barrier protected Pd	3 or 4	16	6.83	6			
	Barrier Protected TSb	3 or 4	15.3	8	7			
	Barrier Protected Pc	3 or 4	15	7.33	6.5			
	Barrier Protected Da	3 or 4	14	9.7	8			
	Barrier Protected Pb	3 or 4	14	7.83	7			
	Barrier Protected TSa	3 or 4	13.3	9	8			
	Barrier Protected Pa	3 or 4	12	8.83	8			
	Barrier Protected Mb	3 or 4	10	8	8			
	Parking protected E	2 or 3	14	8	5			
	Parking protected Ed	2 or 3	14	7.5	5			
	Parking protected C	2 or 3	12	9	6.5			
	Parking protected Cd	2 or 3	12	8.5	6.5			
	Barrier protected Ma	2 or 3	12	10	10			
	Parking protected B	2 or 3	10	10	7			
	Parking protected Bd	2 or 3	10	9.5	7			
	Parking protected A	2	8	11	8			
	Parking protected Ad	2	8	10.5	8			

Two-way roadway widths

The table below shows the more common widths, accounting for slightly more than one-half of all two-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (Also includes all representative widths)	% of proposed 2-way SIR network
72' (representative roadways include those at 68', 69', 70', 71' and 73', too)	Standard bicycle lane	5 or 6	10	na	8	NW St. Helens Rd (112th - 3700' s of St Johns Bridge) NE Lombard (12th - Cully) **NE Going** (Interstate - Greeley ramps) NE Killingsworth (Cully - 92nd) NE 102nd (Prescott - Weidler) NE Glisan (100th - 133rd) SE 162nd (Division - Powell) SW Beaverton-Hillsdale Hwy (Capitol - City Limit)	25	6.0%
	Barrier protected De	4 or 5	18	5.7	8			
	Buffered bicycle lane	4 or 5	16	na	5			
	Barrier protected Dd	4 or 5	16	6.7	6.5			
	Barrier protected Me	4 or 5	16	5	5			
	Barrier protected Tse	4 or 5	16	5.67	5			
	Barrier protected TSd	4 or 5	15.3	6	6			
	Barrier protected Dc	4 or 5	14	7.7	6			
	Barrier protected Pe	4 or 5	14	5.83	5			
	Barrier protected TSc	4 or 5	13.3	7	6.5			
	Barrier protected Db	4 or 5	12	8.7	7			
	Barrier protected Mc	4 or 5	12	7	7			
	Barrier protected Md	4 or 5	12	6	6			
	Barrier protected Pd	4 or 5	12	6.83	6			
	Barrier Protected TSb	4 or 5	11.3	8	7			
	Barrier Protected Pc	4 or 5	11	7.33	6.5			
	Barrier Protected Da	4 or 5	10	9.7	8			
	Barrier Protected Pb	4 or 5	10	7.83	7			
	Barrier Protected TSa	3 or 4	19.3	9	8			
	Barrier Protected Pa	3 or 4	18	8.83	8			
	Barrier Protected Mb	3 or 4	16	8	8			
	Parking protected E	3 or 4	10	8	5			
	Parking protected Ed	3 or 4	10	7.5	5			
	Parking protected C	2 or 3	18	9	6.5			
	Parking protected Cd	2 or 3	18	8.5	6.5			
	Barrier protected Ma	2 or 3	18	10	10			
	Parking protected B	2 or 3	16	10	7			
	Parking protected Bd	2 or 3	16	9.5	7			
	Parking protected A	2 or 3	14	11	8			
	Parking protected Ad	2 or 3	14	10.5	8			

Two-way roadway widths

The table below shows the more common widths, accounting for slightly more than one-half of all two-way roadways identified for SIR treatment. Roadways widths falling between those listed below can be similarly designed for protected lanes.

Curb to curb width	Acceptable designs	# travel lanes	Width remaining (assuming lower # of travel lanes)	Sweeping Width	Cycling width	Representative Roadways (Major City Bikeway roadways shown in BOLD)	Miles of this width (Also includes all representative widths)	% of proposed 2-way SIR network
76' (representative roadways include those at 74', 75' and all wider than 76', too)	Standard bicycle lane	5 or 6	14	na	8	NW St Helens Rd (city limit - 107th) NW Front Ave (Nicolai - 26th) **SW Barbur** (segments) SE McLoughlin (Ross Island Br - Knight) SE Division (78th - City limit) SE 162nd **122nd Avenue** **NE Halsey** (114th to 136th)	31	7.4%
	Barrier protected De	5 or 6	12	5.7	8			
	Buffered bicycle lane	5 or 6	10	na	5			
	Barrier protected Dd	5 or 6	10	6.7	6.5			
	Barrier protected Me	5 or 6	10	5	5			
	Barrier protected Tse	5 or 6	10	5.67	5			
	Barrier protected TSd	4 or 5	19.3	6	6			
	Barrier protected Dc	4 or 5	18	7.7	6			
	Barrier protected Pe	4 or 5	18	5.83	5			
	Barrier protected TSc	4 or 5	17.3	7	6.5			
	Barrier protected Db	4 or 5	16	8.7	7			
	Barrier protected Mc	4 or 5	16	7	7			
	Barrier protected Md	4 or 5	16	6	6			
	Barrier protected Pd	4 or 5	16	6.83	6			
	Barrier Protected TSb	4 or 5	15.3	8	7			
	Barrier Protected Pc	4 or 5	15	7.33	6.5			
	Barrier Protected Da	4 or 5	14	9.7	8			
	Barrier Protected Pb	4 or 5	14	7.83	7			
	Barrier Protected TSa	4 or 5	13.3	9	8			
	Barrier Protected Pa	4 or 5	12	8.83	8			
	Barrier Protected Mb	4 or 5	10	8	8			
	Parking protected E	3 or 4	14	8	5			
	Parking protected Ed	3 or 4	14	7.5	5			
	Parking protected C	3 or 4	12	9	6.5			
	Parking protected Cd	3 or 4	12	8.5	6.5			
	Barrier protected Ma	3 or 4	12	10	10			
	Parking protected B	3 or 4	10	10	7			
	Parking protected Bd	3 or 4	10	9.5	7			
	Parking protected A	2 or 3	18	11	8			
	Parking protected Ad	2 or 3	18	10.5	8			

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