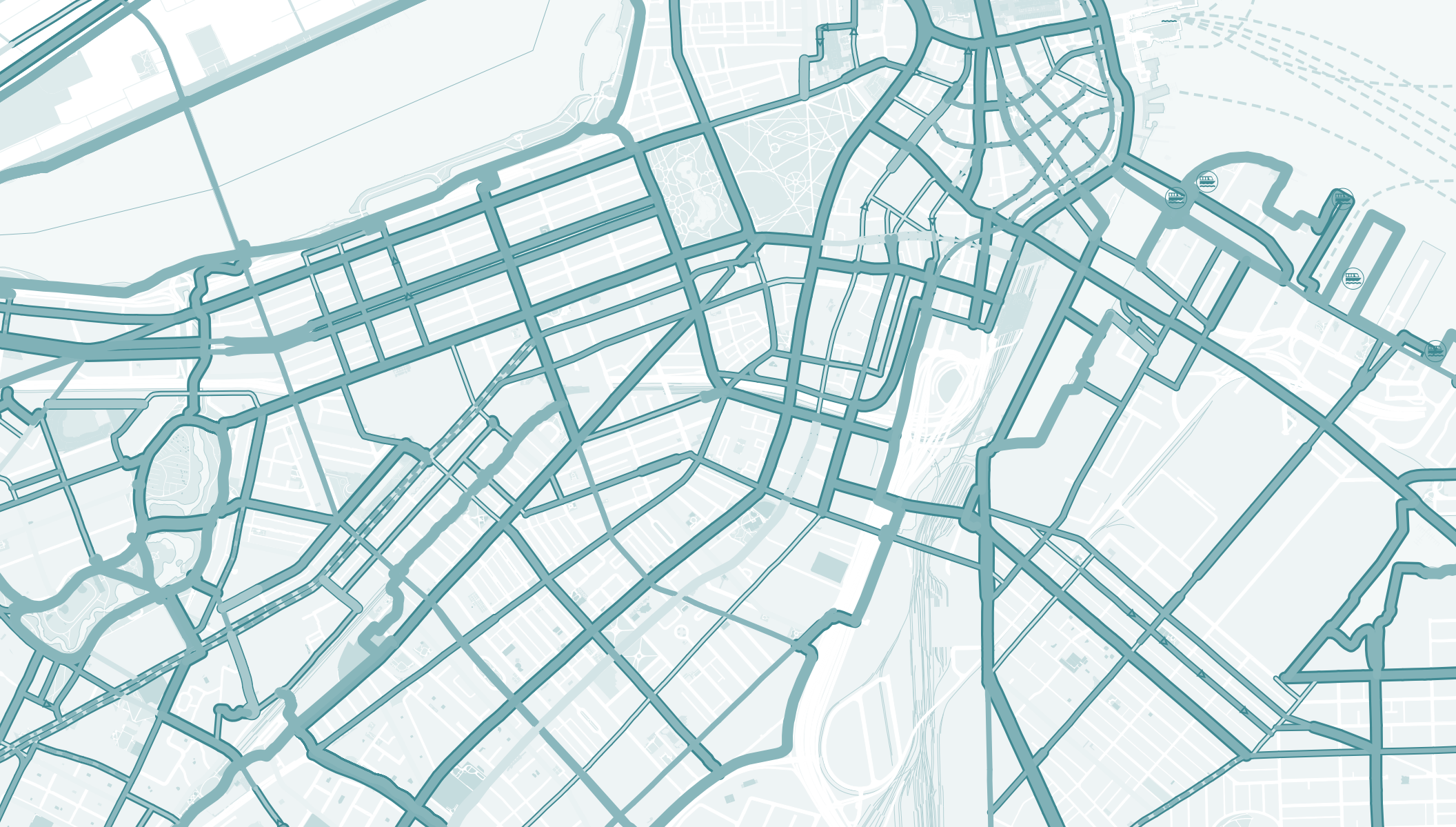




BIKE NETWORK MAPPING IDEA BOOK



U.S. Department of Transportation
Federal Highway Administration

JUNE 2016



U.S. Department of Transportation

Federal Highway Administration

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INTRODUCTION

This resource highlights ways that different communities have mapped their existing and proposed bicycle networks. It shows examples of maps at different scales, while also demonstrating a range of mapping strategies, techniques, and approaches. Facility types represented on the respective maps and legends are each different because they represent a community's unique context and needs.

It is intended to serve as a resource as communities work to identify, plan, and improve their bicycle networks.

Connected pedestrian and bicycle networks make walking, wheeling, and bicycling viable transportation choices for everyone. Networks enhance access to jobs, schools, and health care, while also promoting equity, physical activity, and health. Connected networks are comprised of a range of facility types (e.g. bike lanes, separated bike lanes, shared use paths, etc.), linked together to facilitate short trips to and from destinations and long linear connections across a city or region.

A first step to achieving connected networks is to document where bicycling infrastructure currently exists. It is also essential to establish a vision for the future network. This vision is often captured in the form of a map and it's developed as part of a local planning process that includes opportunities for public participation and input.

A community's existing and proposed bicycle network maps inform the day-to-day programming and prioritization of projects and help to ensure that all transportation improvements are enhancing the quality of the nonmotorized network and capturing opportunities to make linkages between existing and new facilities.

Network Principles

Cohesion

Directness

Accessibility

Alternatives

Safety and Security

Comfort

PRINCIPLES

This *Bike Network Mapping Idea Book* highlights a range of approaches and techniques for showing connected networks, conveying information in map form, and incorporating local context.



Connected Network

A bicycle transportation network consists of a series of interconnected facilities that enable bicyclists of all ages and abilities to safely and conveniently get where they need to go. By providing connected networks, communities are helping to facilitate all of the following types of bicycling trips:

- Access to work and school from residential areas
- Bicycling links to transit
- Recreation and physical activity opportunities
- Access to grocery stores, government buildings, health care, and other essential services

Understanding that different users have different needs, bicycle networks should be designed to provide options for continuous, safe, seamless, and convenient travel between all possible destinations.



Mapping Techniques

Various mapping conventions can help your community to convey complex information graphically in a simple and easily digestible manner. The following pages highlight some tools and techniques used to develop effective bike network maps.

Planners and designers use various computer programs to create visually compelling maps. A typical workflow consists of the following:

1. Import and organize data in a GIS-based program.
2. Export maps to Adobe Illustrator or a similar program for minimal to extensive post-production work, such as editing of colors, lineweights, patterns, and type.
3. If the map will be presented in a report or plan, compile maps in Adobe InDesign or a similar program as part of a report or plan.



Local Context

Within a planning-level bike network map, local context helps to orient users to their surroundings as well as support information the cartographer wishes to showcase.

Including local landmarks and points of interest helps users to quickly orient themselves and understand key bike network connections.

For instance, a map might display parks and open space as a background layer. This helps to clarify the connections between existing and proposed bicycle facilities and recreational destinations.

These layers may include information such as land use, community destinations, transit access points, and other important information. These vary based on the unique needs of each jurisdiction.

MAP BASICS

Common approaches for bicycle infrastructure planning maps are highlighted below. The maps that follow demonstrate these general approaches to varying degrees.

(1) COMMON INFORMATION LAYERS

BIKE NETWORK LAYERS

Specific Facility Types

- Bike path, bike lane, buffered bike lane, bike boulevard, separated bike lane, greenway, etc.

OR

Flexible Facility Types

- On-street vs. off-street bikeway systems

LOCAL CONTEXT LAYERS

- Transit lines & stations
- Bikeshare stations
- Community amenities: Schools, universities, libraries, community centers, hospitals etc.
- Building footprints
- Specific land use functions, such as commercial uses
- Study areas or corridors

BASE LAYERS

- Parks & open space
- Streets
- Waterbodies
- City boundaries
- Labels

(2) REPRESENTING DIFFERENT TYPES OF INFORMATION

PROPOSED VS. EXISTING NETWORK

- Identify ways to clearly denote what is existing and what is being proposed.

Outline	Dashed
 existing	 existing
 proposed	 proposed

COLOR SCHEME

- Consider how color will play a role in highlighting the bicycle network. Bright, saturated colors stand out against softer and more subdued tones.

LEVEL OF INFORMATION

- Carefully consider the amount of information used to tell the story. More information can help, but it can also be overwhelming if not organized in a seamless way.
- Small icons and symbols can help to identify points of interest in a less obtrusive way

(3) LEVEL OF DETAIL ON EXISTING/PROPOSED FACILITY TYPES

Providing more information about facility types requires more complex color schemes and line types.

MULTIPLE LAYERS AND INFORMATION

Example: Boston, pg. 34

This scheme helps to convey multiple facility types and specific street conditions in a clear and easily digestible manner. It can also fully integrate a series of community base layers and contextual information, including supplemental data like bicycle counts or safety information to aid decision making.

Consider a similar palette if creating a map that:

- Identifies specific facility types
- Needs a clear and concise color palette

EXISTING	PROPOSED	BASE LAYERS
 Shared-Use Path	 Shared-Use Path	 Rail Lines & Stations
 Cycle Track	 Cycle Track	 Schools
 Buffered Bicycle Lane	 Buffered Bicycle Lane	 College or University
 Bicycle Lane	 Bicycle Lane	 Bike Share Stations
 Shared Road	 Contraflow Bicycle Lane	 Waterbodies
 Bus-Bicycle Lane	 Neighborhood	 Parks & Open Space
 Shared-Lane Marking	 Shared Road	 Freeways & Arterials
	 Bus-Bicycle Lane	 Neighborhood Streets
	 Advisory Lane	
	 Priority Shared Lane	
	 Shared-Lane Marking	
	 Suggested Local Routes	

FLEXIBLE NETWORK MAPS

Example: Cedar Rapids, pg. 42

This scheme helps to convey a bicycle network that does not identify specific facility types.

Consider a similar palette if the map:

- Is not intended to identify specific facility types
- Is focused on existing & proposed routes

EXISTING	PROPOSED	BASE LAYERS
 Existing On-Street	 Proposed On-Street	 Rail Lines & Stations
 Existing Off-Street	 Proposed Off-Street	 Schools
		 College or University
		 Bike Share Stations
		 Waterbodies
		 Parks & Open Space
		 Freeways & Arterials
		 Neighborhood Streets

SUMMARY

The following chart identifies key features in each map.

DOES IT
IDENTIFY: DOES IT SHOW:

MAP	SCALE	A GENERALIZED NETWORK	SPECIFIC FACILITY TYPES	LINKAGES TO LOCAL DESTINATIONS	LINKAGES TO SURROUNDING JURISDICTIONS	BARRIERS	SPOT IMPROVEMENTS	OPPORTUNITIES TO RECONNECT COMMUNITIES	PAGE #
Arkansas	State	X		X	X			X	10
Yellowstone, WY-ID-MT	Regional	X		X			X	X	12
Albemarle Region, NC	Regional		X		X			X	14
San Francisco Area, CA	Regional	X			X			X	16
Alameda County, CA	County	X		X	X			X	18
Hennepin County	County	X			X			X	20
Idaho Falls, ID	City		X	X	X	X		X	22
Cambridge, MA	City	X		X		X		X	24
Santa Barbara, CA	City		X	X				X	26
Atlanta, GA	City		X					X	28
Austin, TX	City	X		X				X	30
Fort Collins, CO	City		X	X				X	32

**DOES IT
IDENTIFY: DOES IT SHOW:**

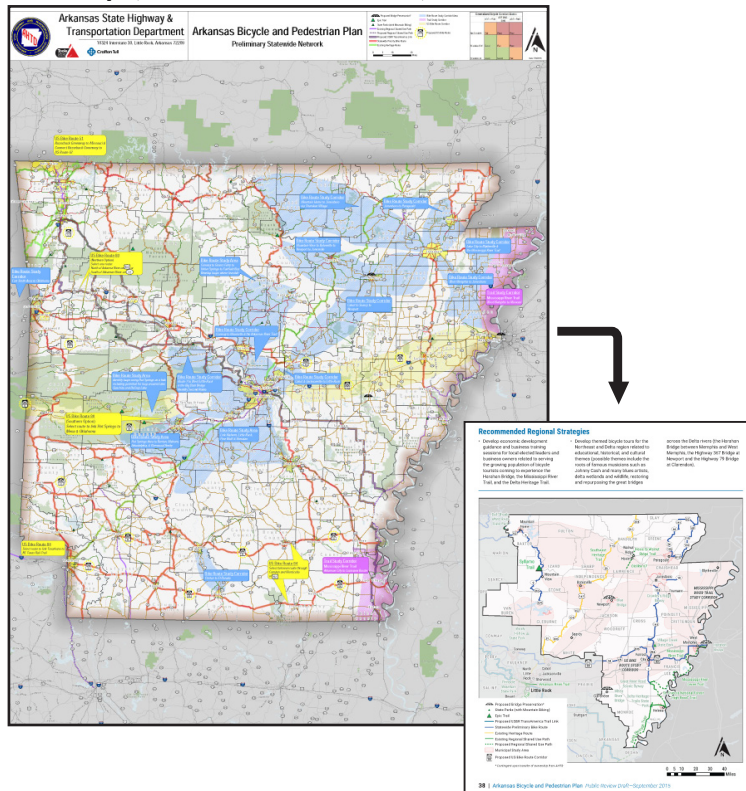
MAP	SCALE	A GENERALIZED NETWORK	SPECIFIC FACILITY TYPES	LINKAGES TO LOCAL DESTINATIONS	LINKAGES TO SURROUNDING JURISDICTIONS	BARRIERS	SPOT IMPROVEMENTS	OPPORTUNITIES TO RECONNECT COMMUNITIES	PAGE #
Portland, OR	City		X		X			X	34
Boston, MA	City		X	X	X			X	36
Salt Lake City, UT	City		X	X	X		X	X	38
Chicago, IL	City	X		X				X	40
Grafton, WI	City		X	X	X			X	42
Cedar Rapids, IA	City	X		X	X			X	44
Seattle, WA	City		X	X	X			X	46
North Santa Clara County, CA	Campus		X	X	X			X	48
Port of Portland, OR	Campus		X	X	X			X	50
Oregon State University	Campus	X			X	X		X	52
University of North Carolina	Campus		X		X			X	54

ARKANSAS

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
STATE OF ARKANSAS	2015	ARKANSAS STATE BICYCLE AND PEDESTRIAN PLAN	ARKANSAS STATE HIGHWAY AND TRANSPORTATION DEPARTMENT

KEY MAP FEATURES

Full Map (Click to view full size)



Region-specific maps are identified in the plan with more detail provided



Calls out study corridors/areas



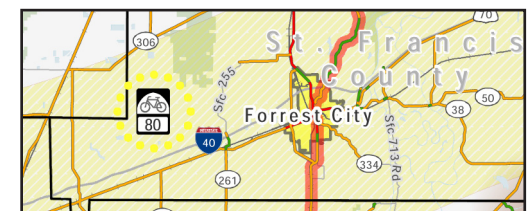
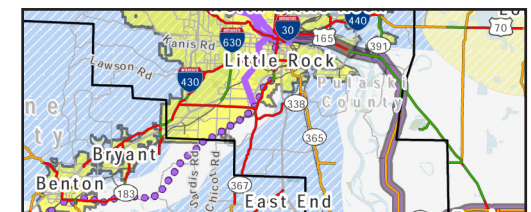
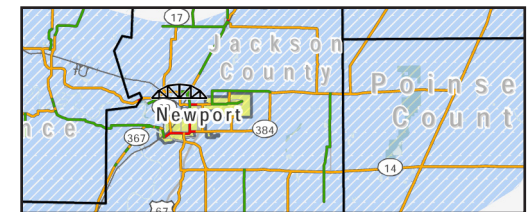
Features State-specific landmarks; shown here are proposed bridge preservation projects

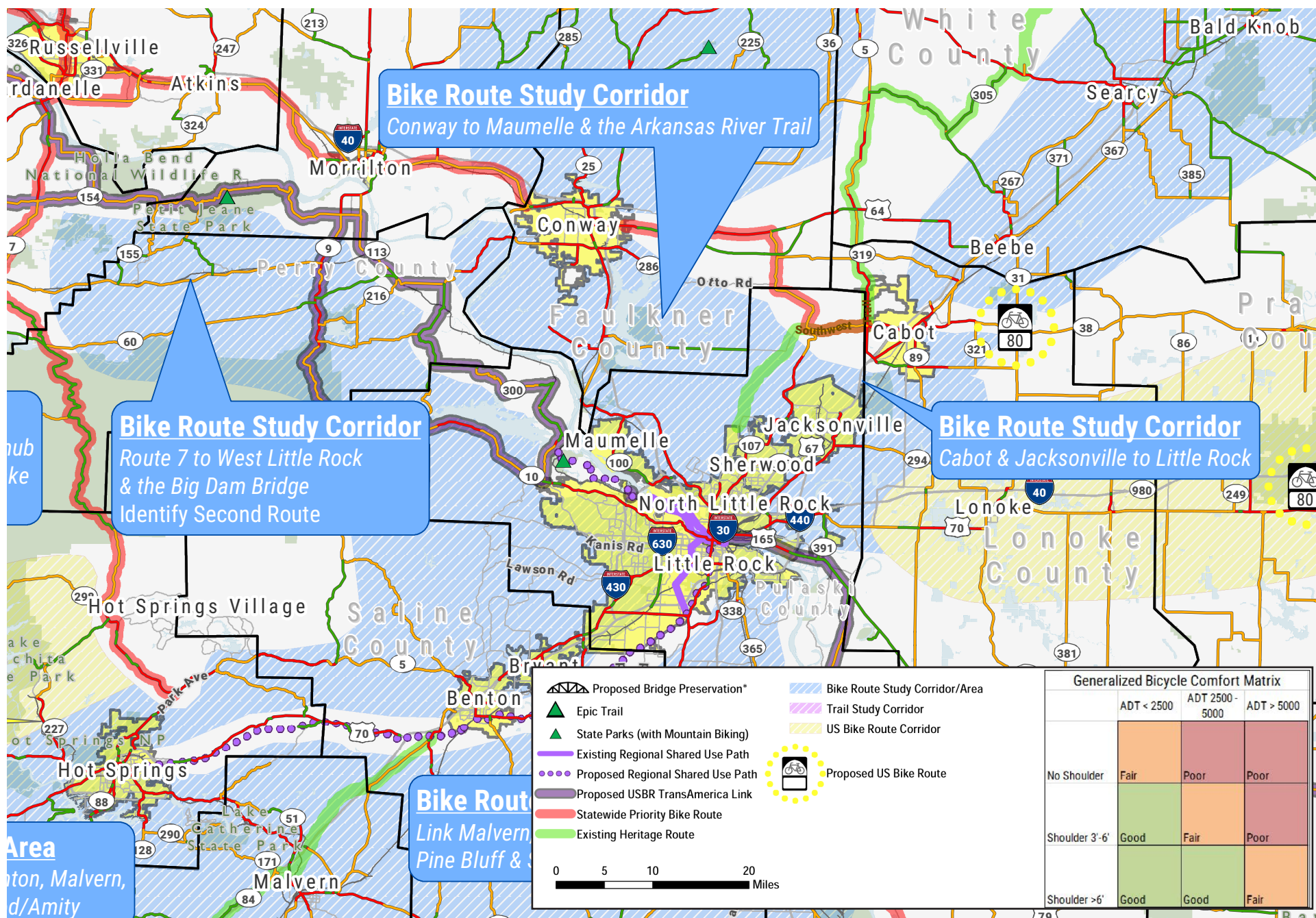


Highlights regional connections to cities



Identifies proposed U.S. bike routes

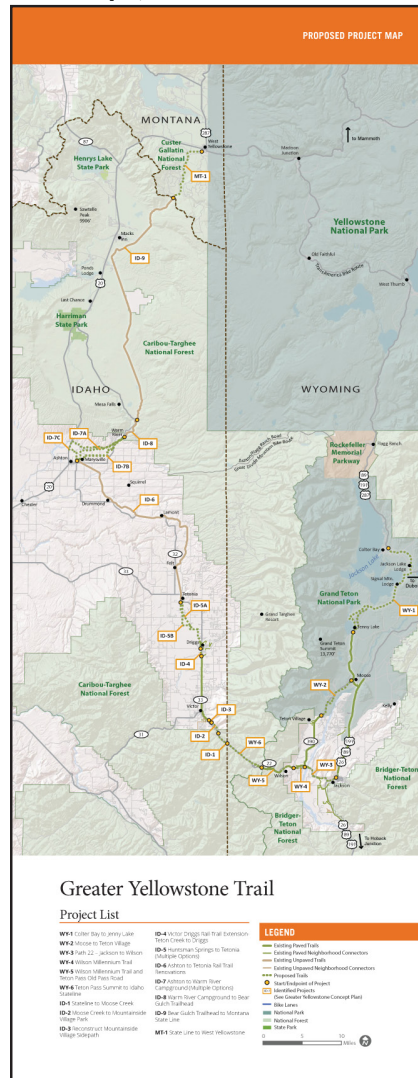




YELLOWSTONE, WY-ID-MT

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
YELLOWSTONE REGION	2015	GREATER YELLOWSTONE TRAIL CONCEPT PLAN	WYOMING PATHWAYS (NONPROFIT)

Full Map (Click to view full size)



KEY MAP FEATURES



Shows the beginning and end points of projects and identifies project areas



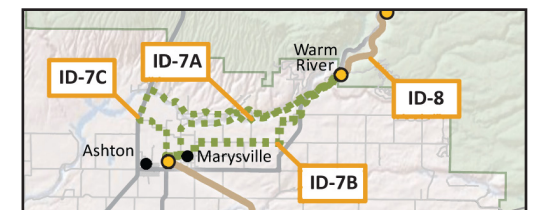
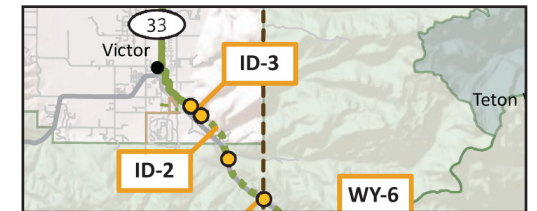
Highlights connections to State and Federal lands

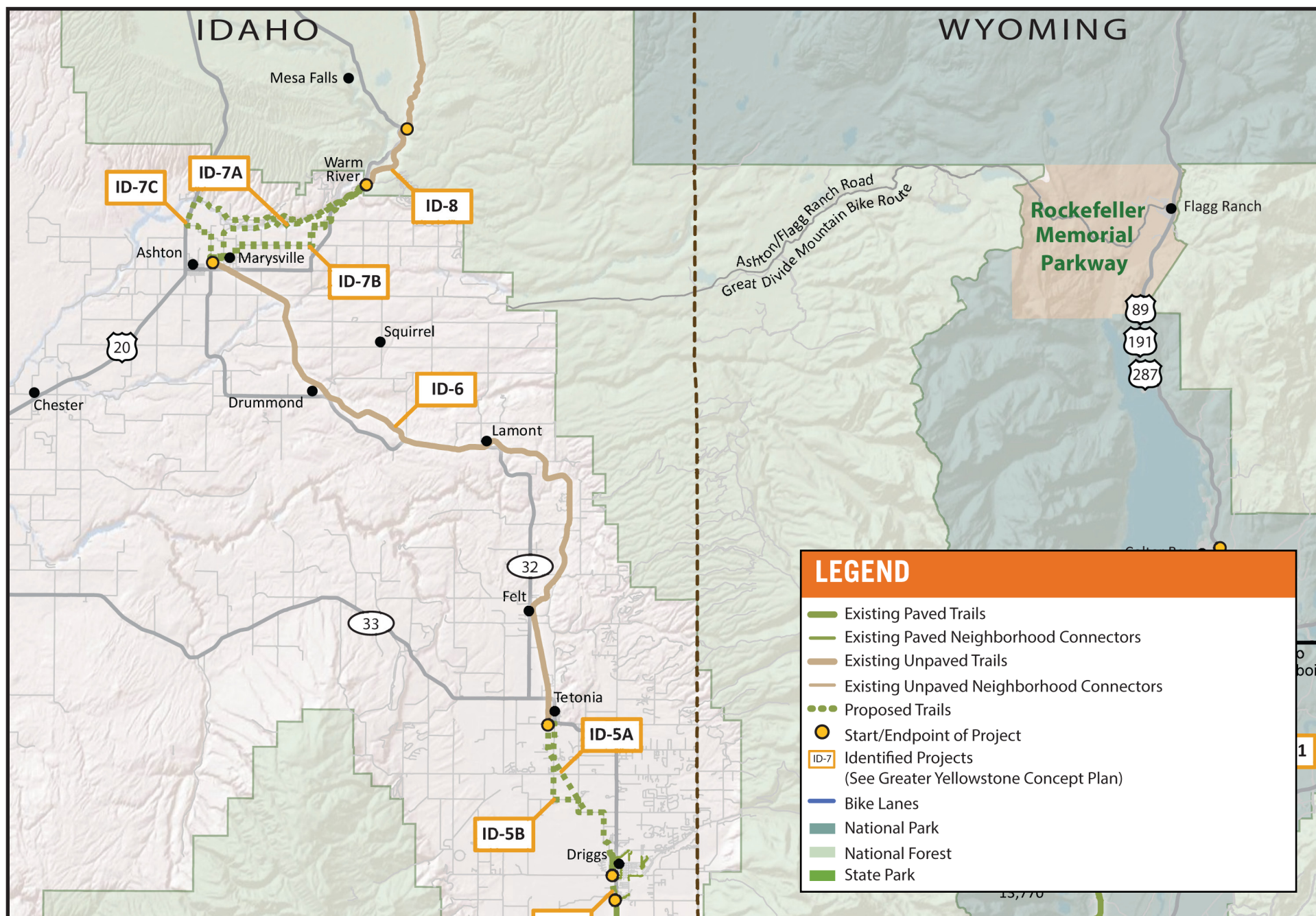


Legend highlights paved, unpaved, and proposed connections



Legend includes a numbered list of projects

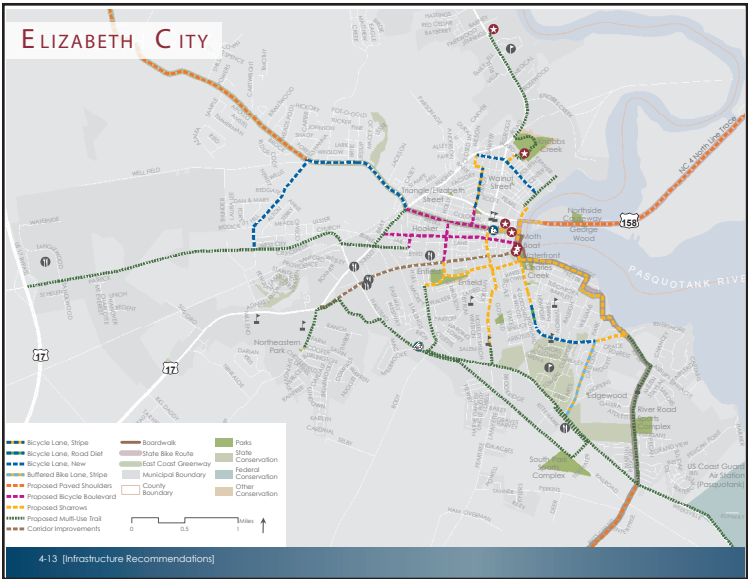




ALBEMARLE REGION, NC

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
ALBEMARLE REGION, NC	2013	ALBEMARLE REGIONAL BICYCLE PLAN	ALBEMARLE RURAL PLANNING ORGANIZATION

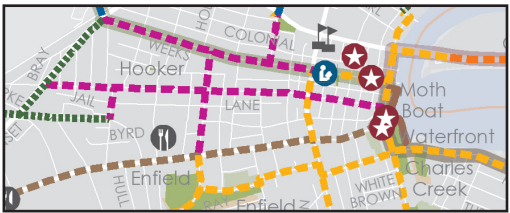
One of a series of additional local maps
(Click to view full size)



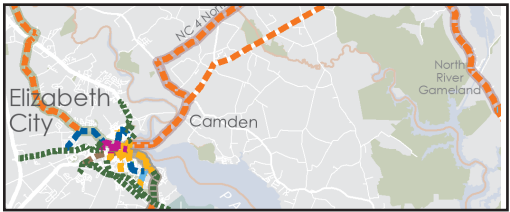
KEY MAP FEATURES



Nighborhood maps show connections to community destinations

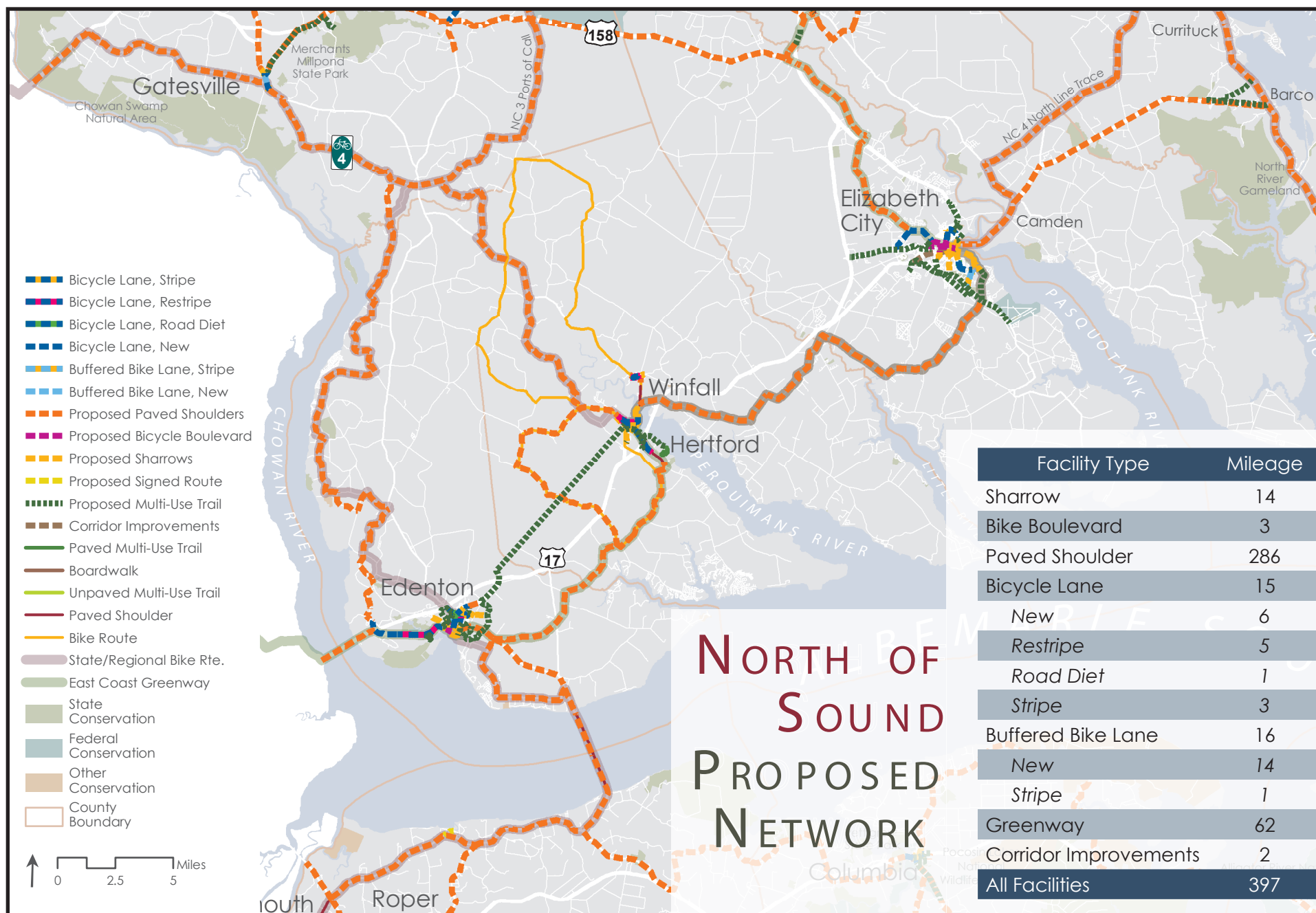


Highlights connections to State and Federal conservation lands



Includes the amount of mileage of each type of bike facility

Facility Type	Mileage
Sharrow	14
Bike Boulevard	3
Paved Shoulder	286
Bicycle Lane	15

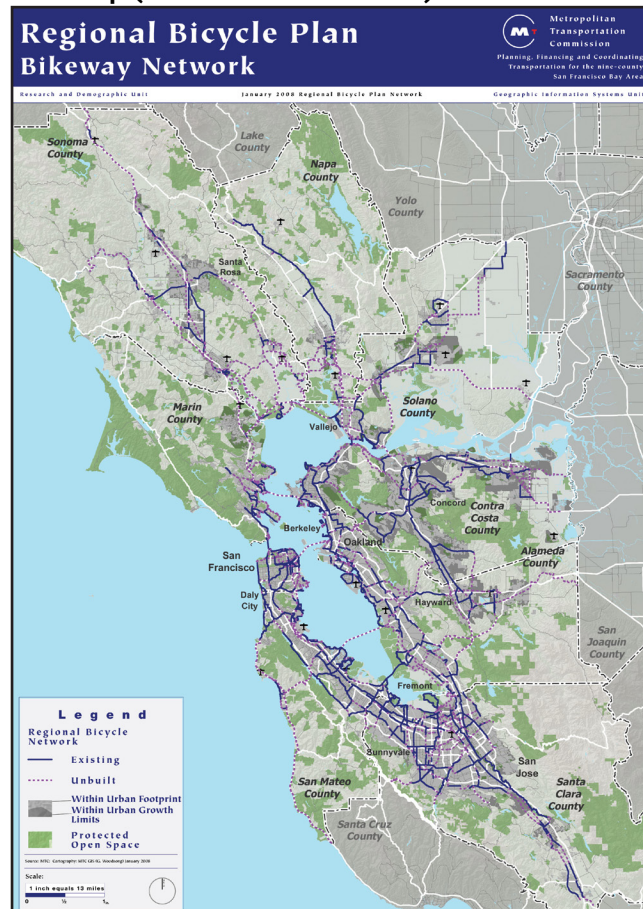


SAN FRANCISCO AREA, CA

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
SAN FRANCISCO BAY AREA	2008	REGIONAL BICYCLE PLAN NETWORK	METROPOLITAN TRANSPORTATION COMMISSION

KEY MAP FEATURES

Full Map (Click to view full size)



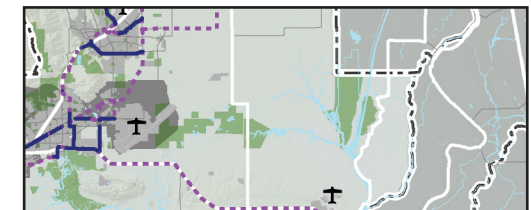
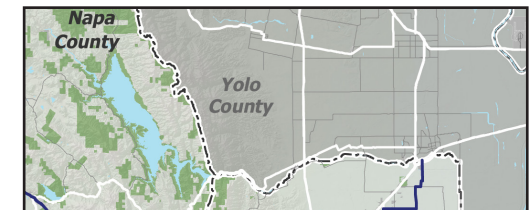
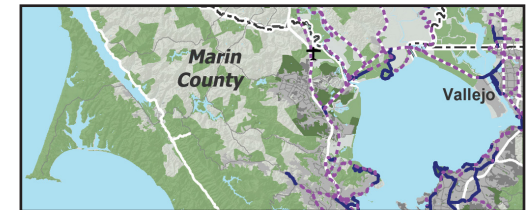
Identifies existing and planned connections to protected open space

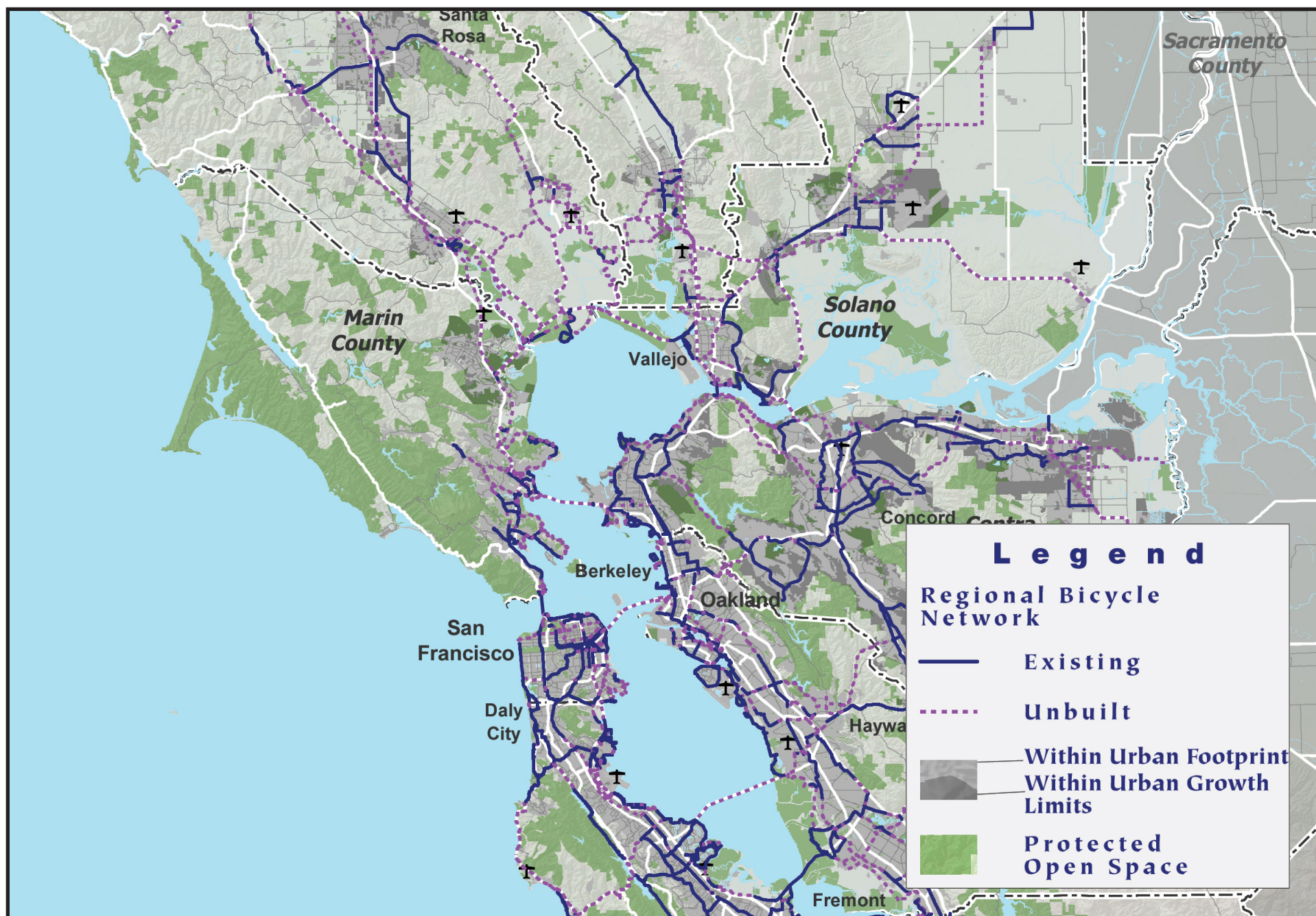


Differentiates between inside and outside the jurisdiction



Identifies Urban Growth Limits, an important regional land use concept



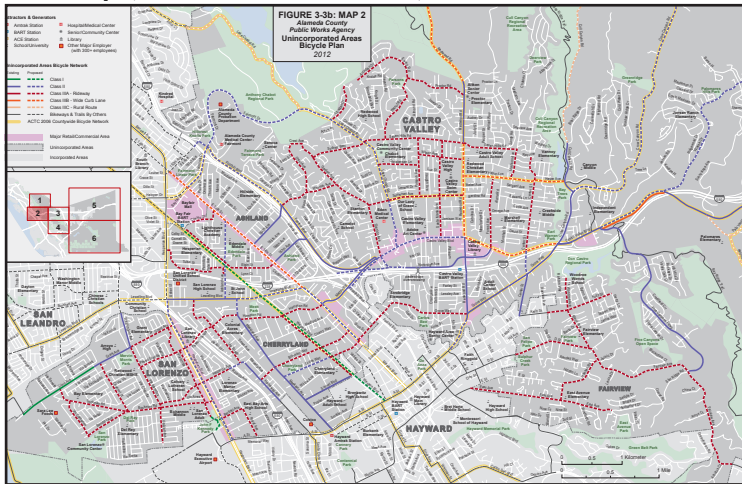


ALAMEDA COUNTY, CA

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
ALAMEDA COUNTY, CA	2012	BICYCLE AND PEDESTRIAN MASTER PLAN FOR UNINCORPORATED AREAS	ALAMEDA COUNTY PUBLIC WORKS AGENCY

KEY MAP FEATURES

Full Map (Click to view full size)



Highlights major employers, community centers, libraries, and hospitals



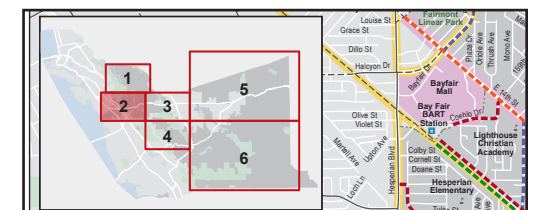
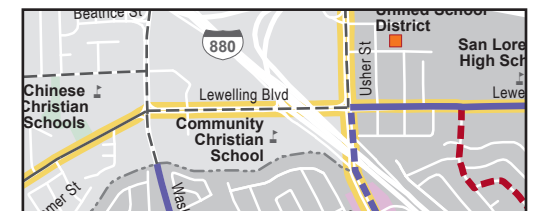
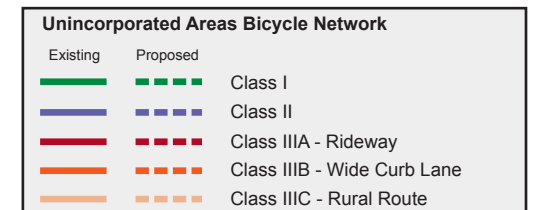
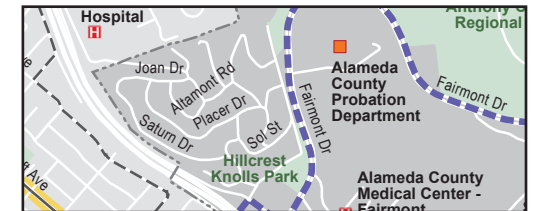
Streamlined legend labels

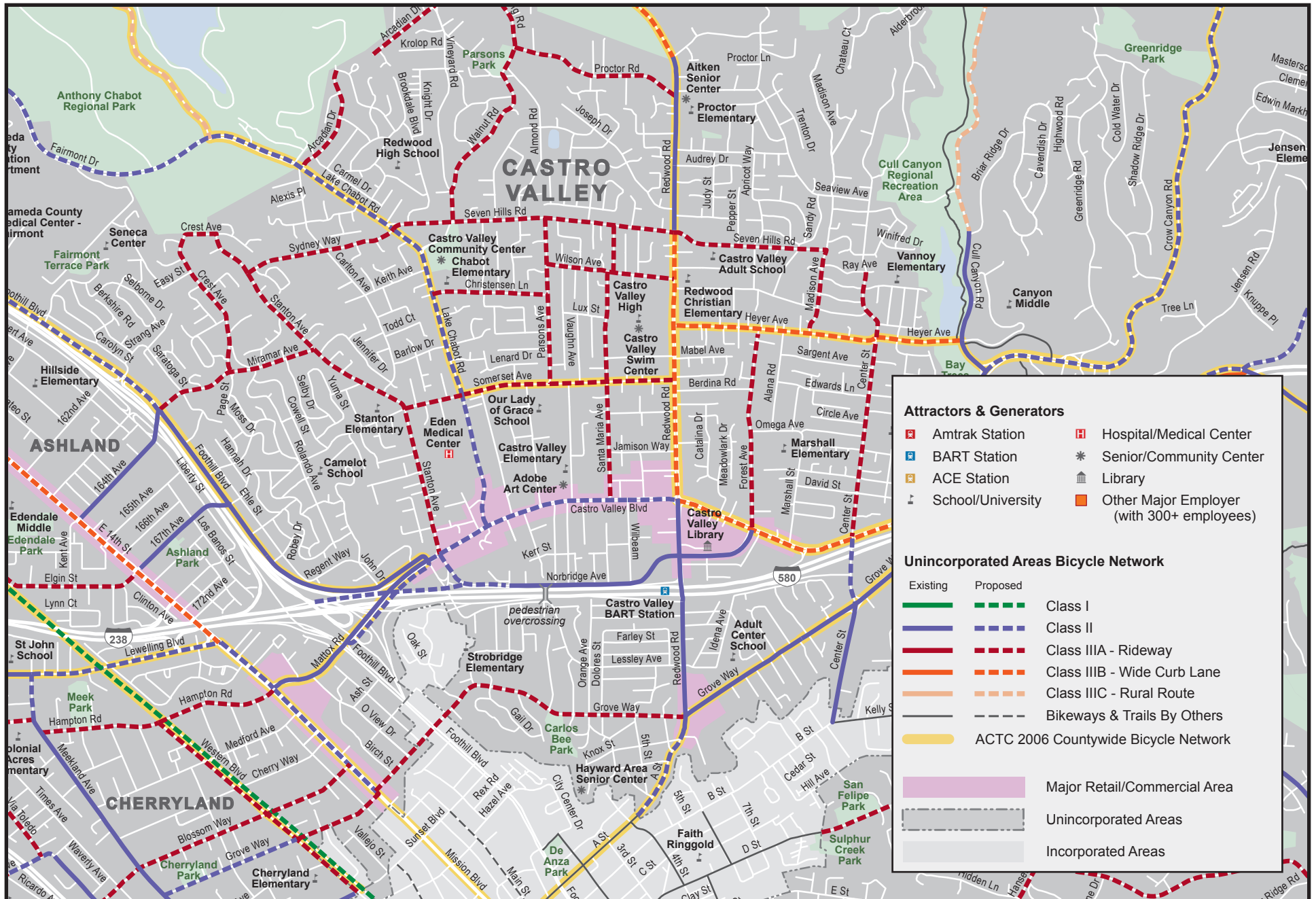


Identifies areas inside and outside the planning jurisdiction



Includes a key to each neighborhood map



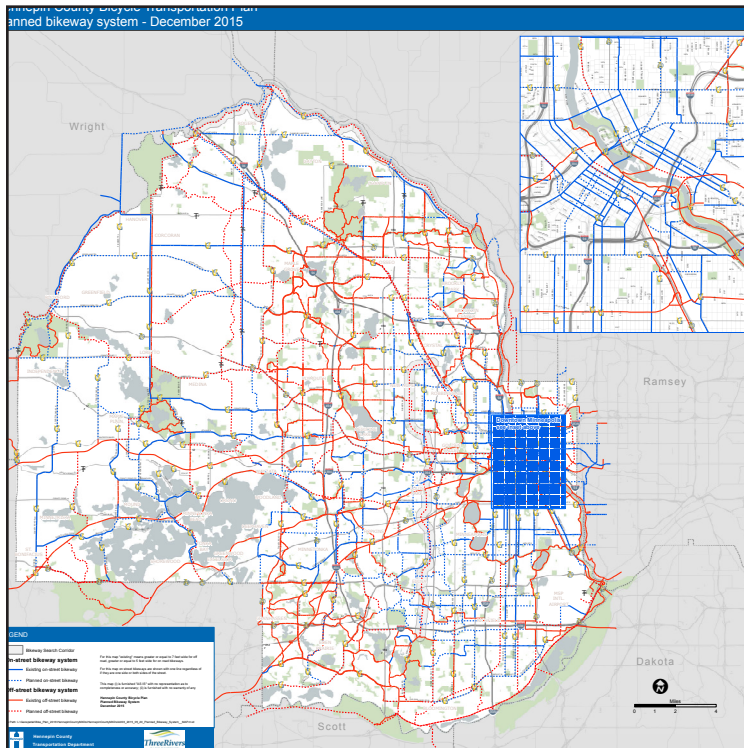


HENNEPIN COUNTY, MN

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
HENNEPIN COUNTY, MN	2015	HENNEPIN COUNTY BIKE PLAN	HENNEPIN COUNTY

KEY MAP FEATURES

Full Map (Click to view full size)



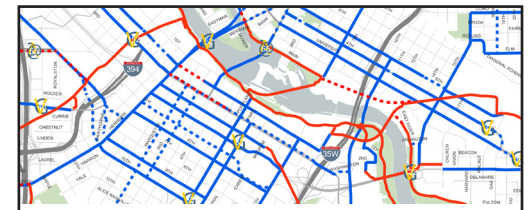
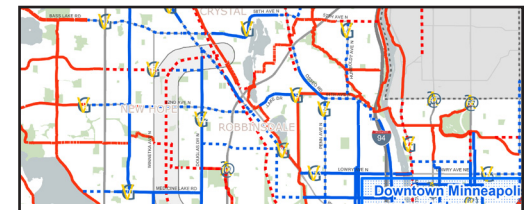
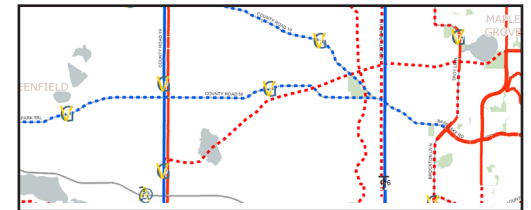
Simple symbology - Two colors and two line types

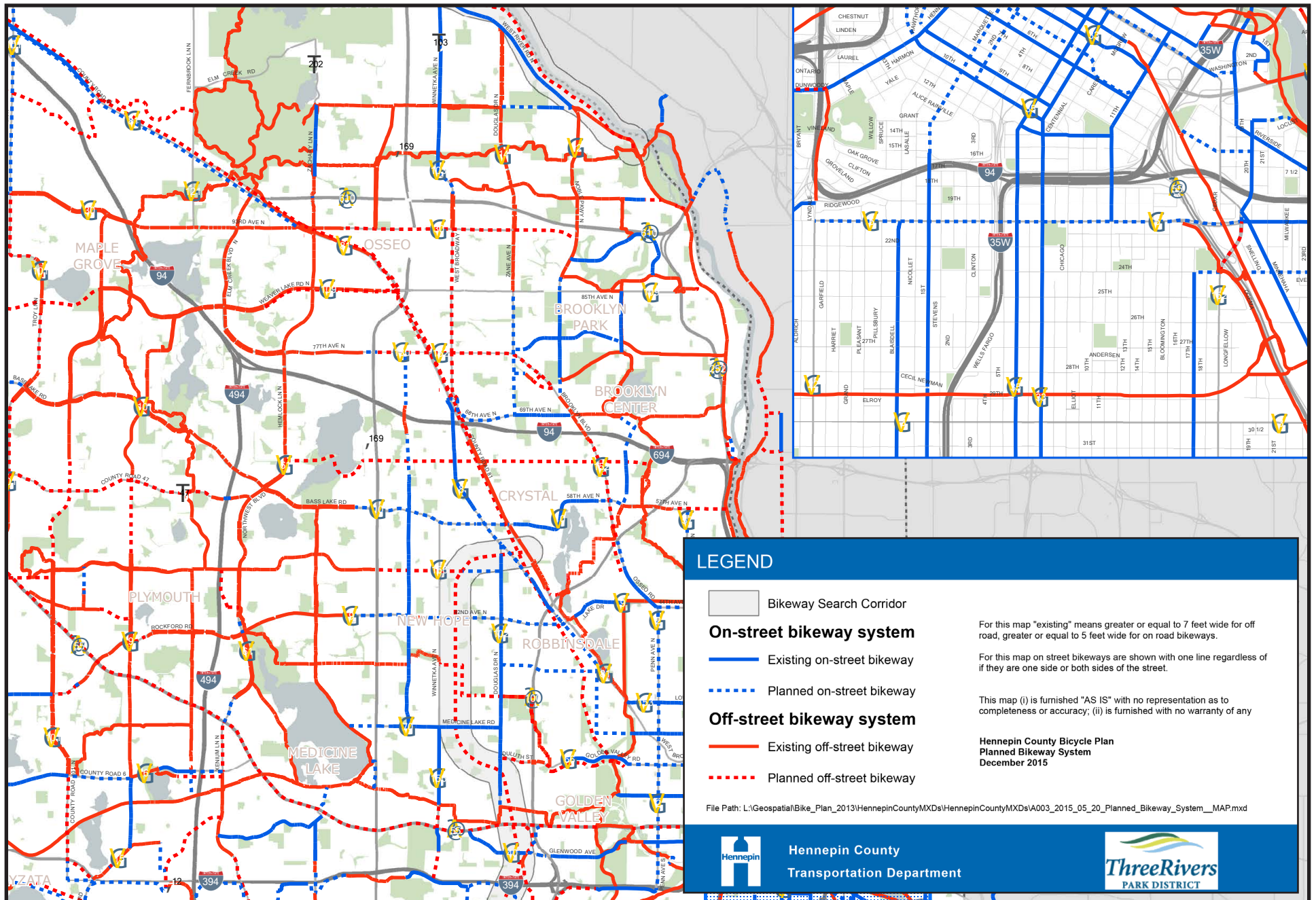


Map focuses on county and state roads. Local roads not shown to improve legibility.



Downtown area is shown in more detail for closer inspection



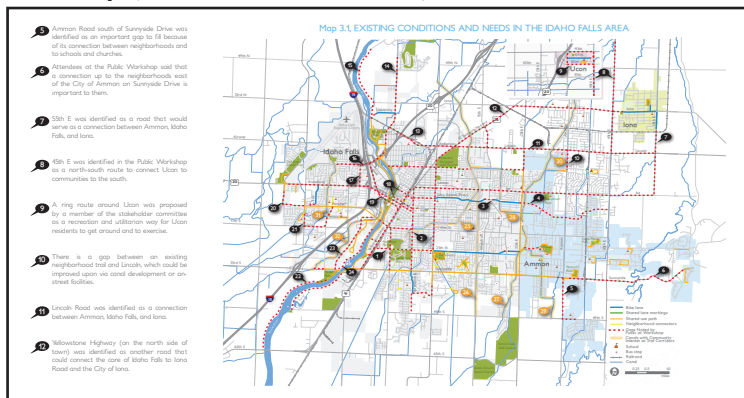


IDAHO FALLS, ID

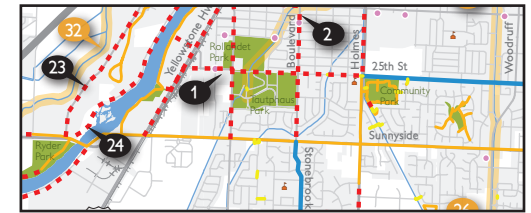
LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
IDAHO FALLS, ID	2014	CONNECTING OUR COMMUNITY	IDAHO FALLS PARKS AND RECREATION DIVISION AND THE BONNEVILLE METROPOLITAN PLANNING ORGANIZATION

KEY MAP FEATURES

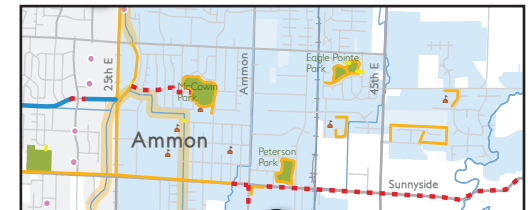
Full Map (Click to view full size)



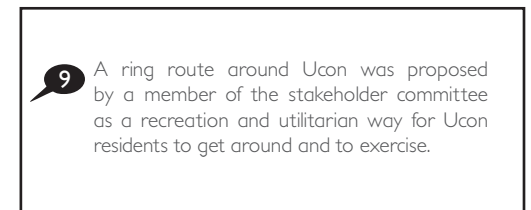
Incorporates community feedback gathered from a range of public workshops and committees



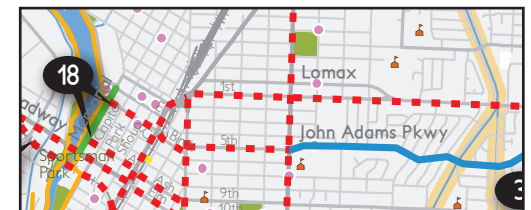
Highlights connections to nearby jurisdictions

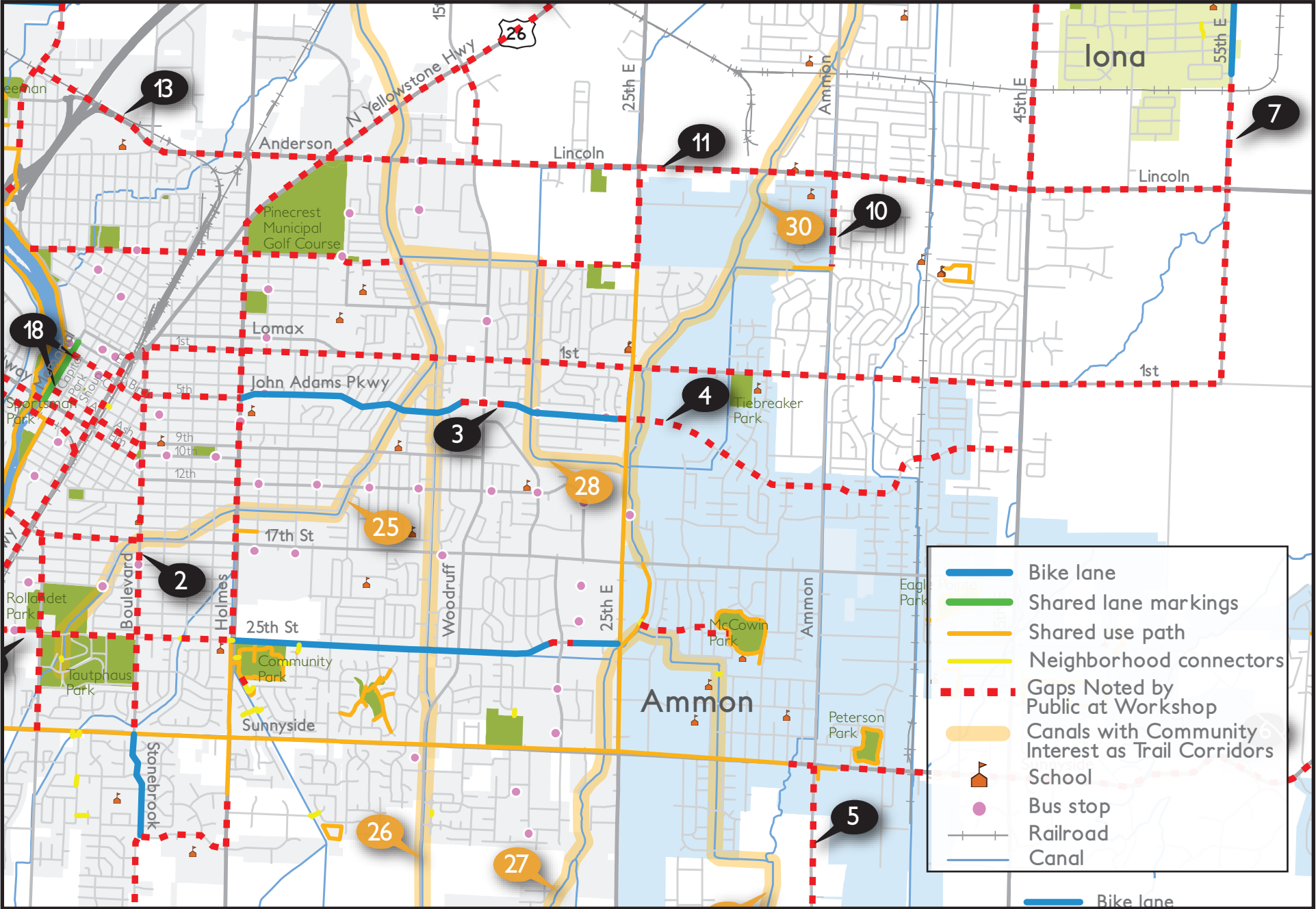


Community comment sidebar included



Notes gaps in the bikeway network



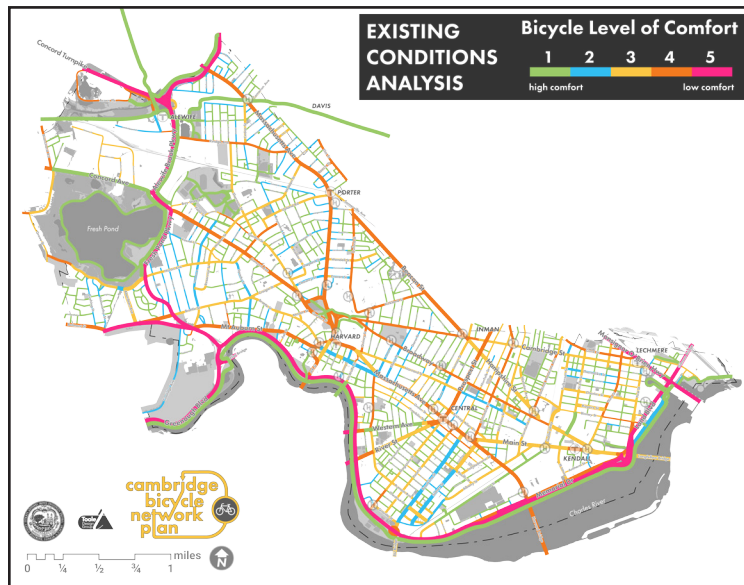


CAMBRIDGE, MA

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
CAMBRIDGE, MA	2015	INTERNAL PLANNING MAP	CITY OF CAMBRIDGE

KEY MAP FEATURES

Full Map (Click to view full size)



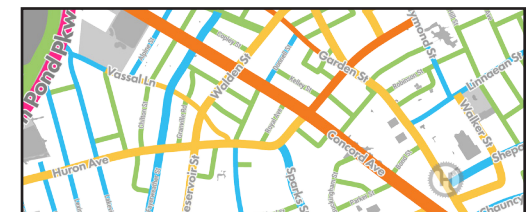
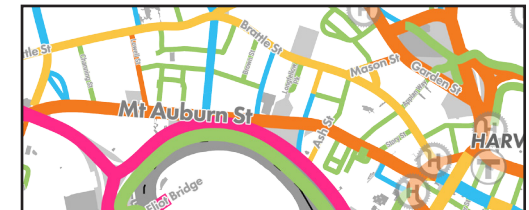
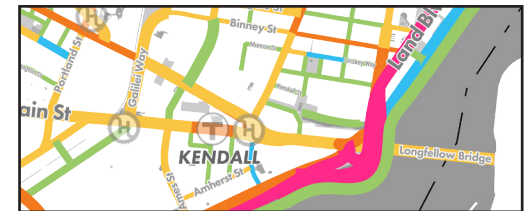
Identifies access points to transit hubs

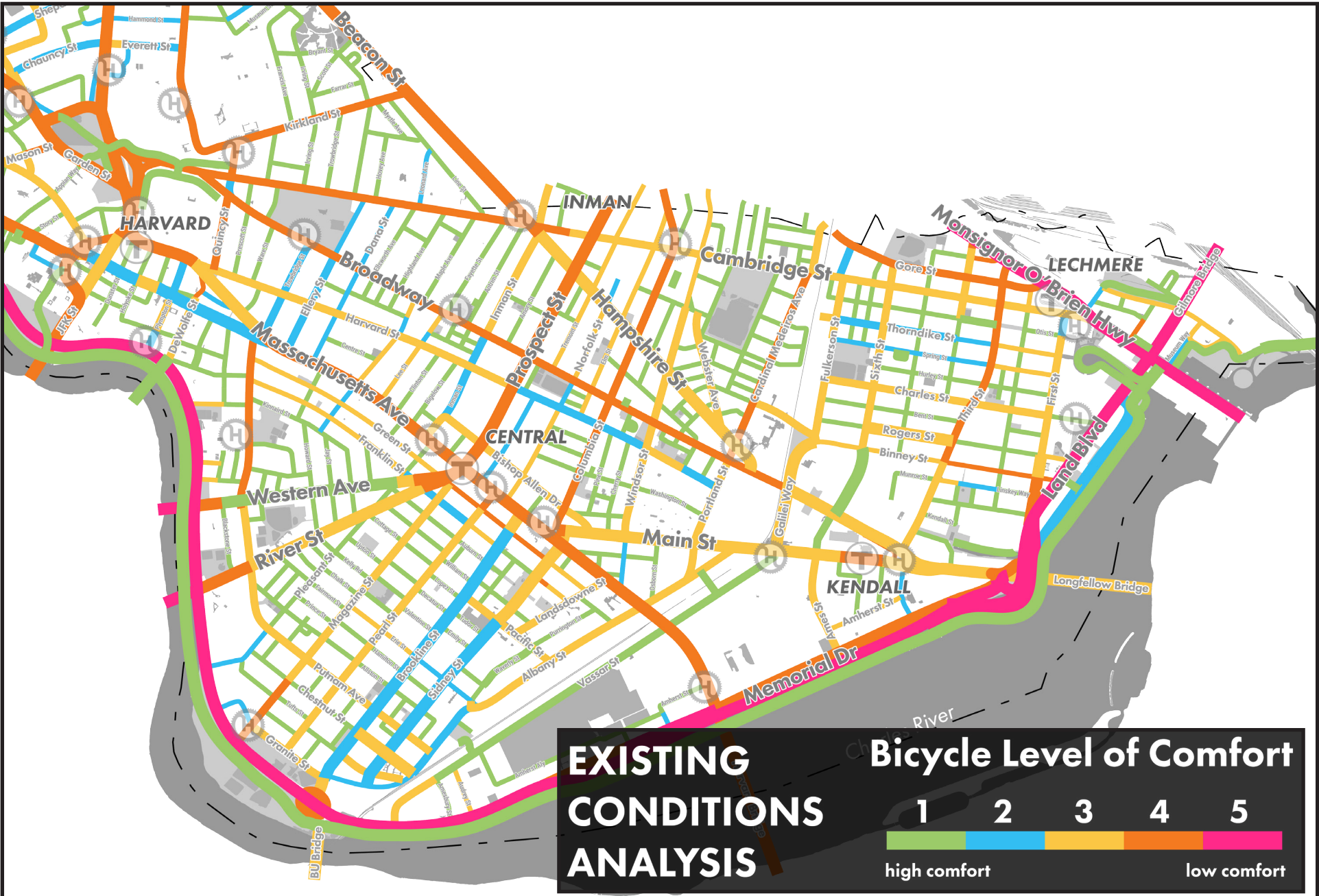


Bright and easily understandable color scheme



Highlights how low and high stress networks connect



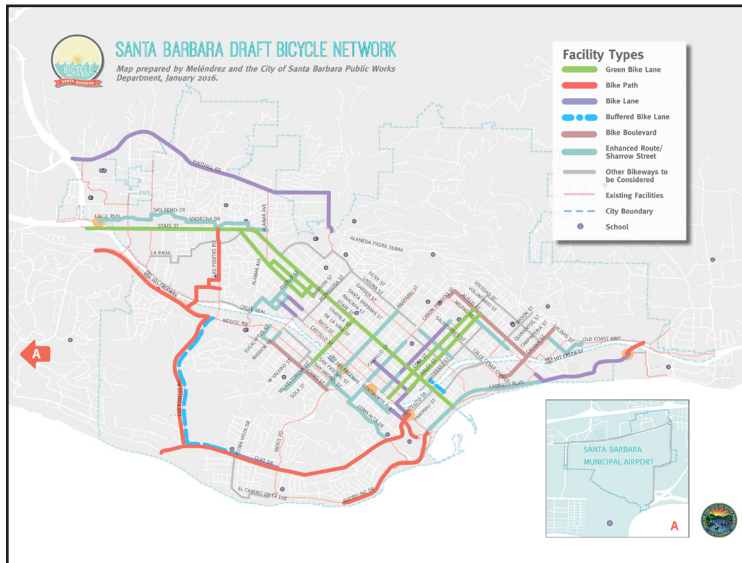


SANTA BARBARA, CA

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
SANTA BARBARA, CA	DRAFT 2016	SANTA BARBARA BICYCLE MASTER PLAN	CITY OF SANTA BARBARA

KEY MAP FEATURES

Full Map (Click to view full size)



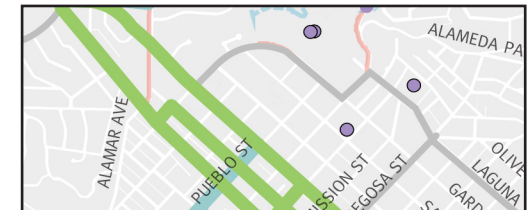
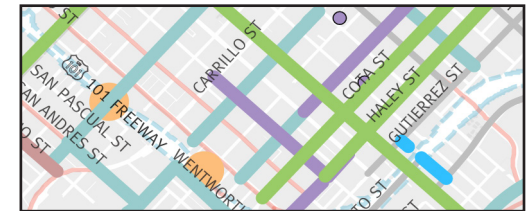
Vibrant color palette while maintaining legibility

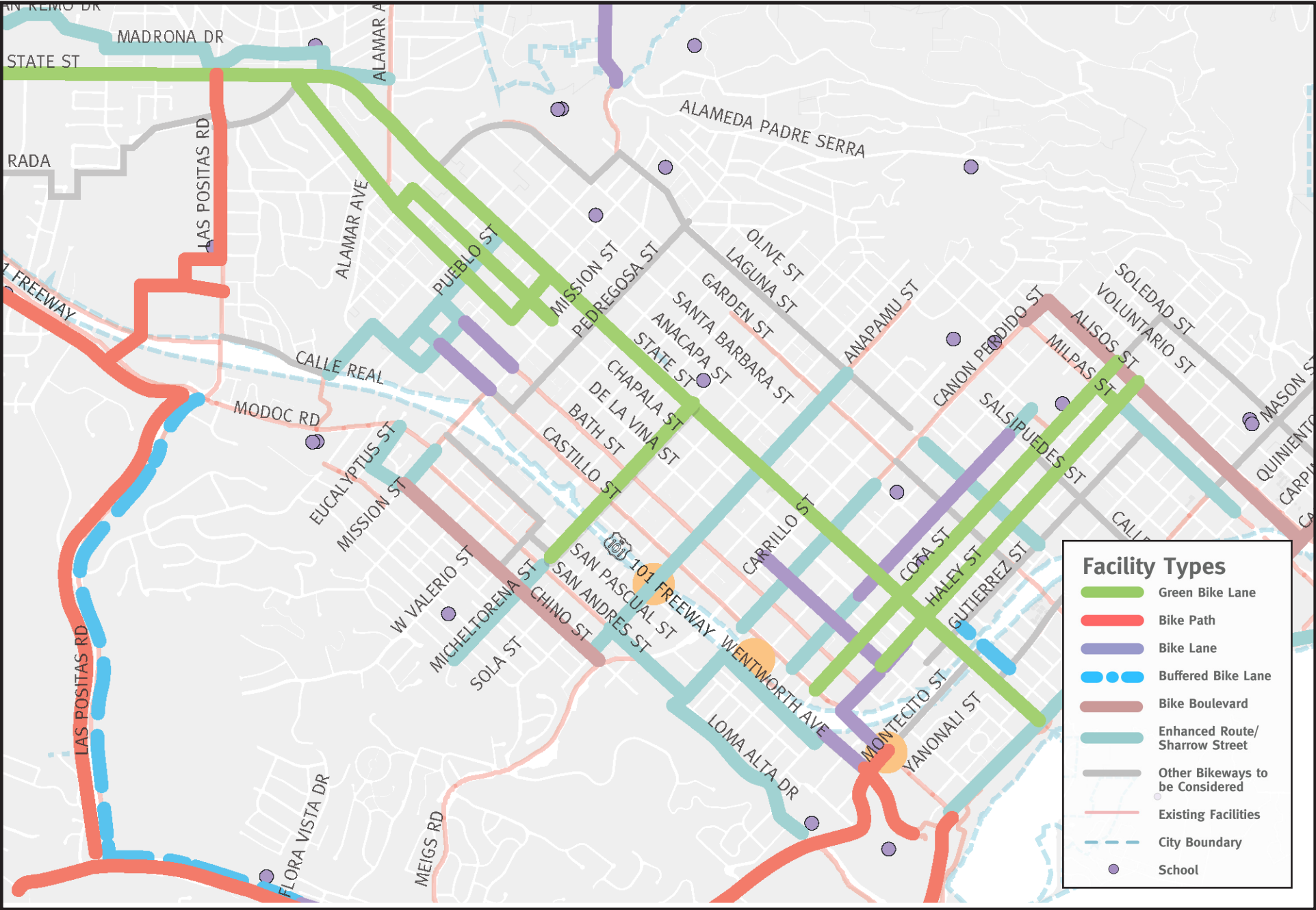


Shows alternate bikeways that were considered



Clearly symbolizes two facilities on the same road



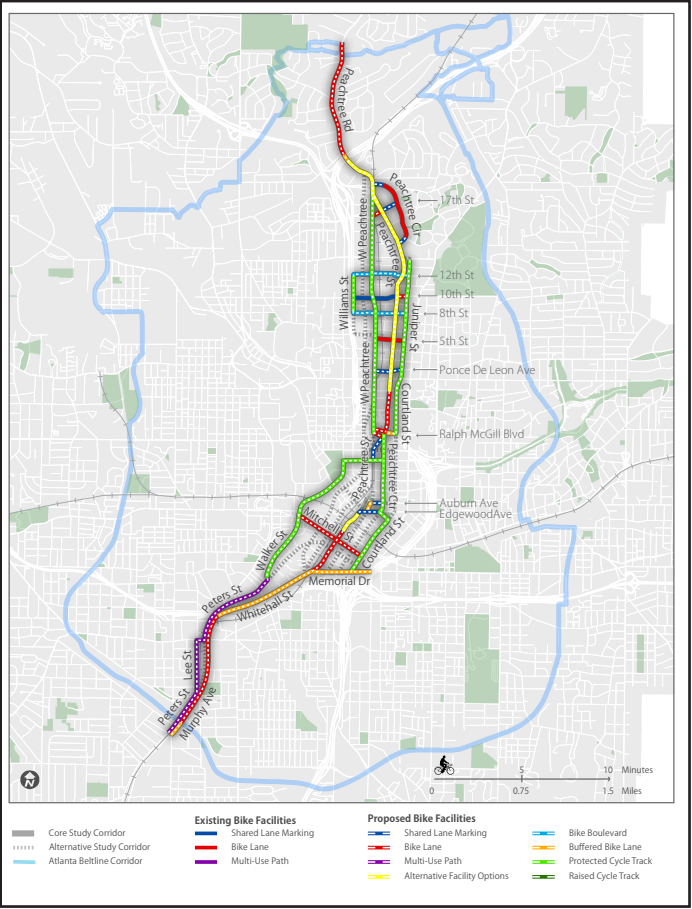


ATLANTA, GA

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
ATLANTA, GA	2015	COMPREHENSIVE TRANSPORTATION PLAN - CONNECT ATLANTA	CITY OF ATLANTA

KEY MAP FEATURES

Full Map (Click to view full size)



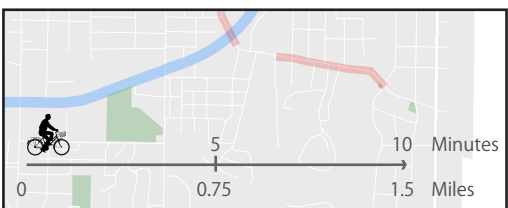
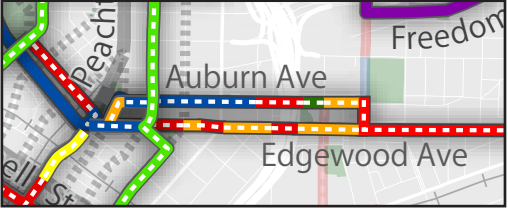
Highlights corridors and transitions between facility types

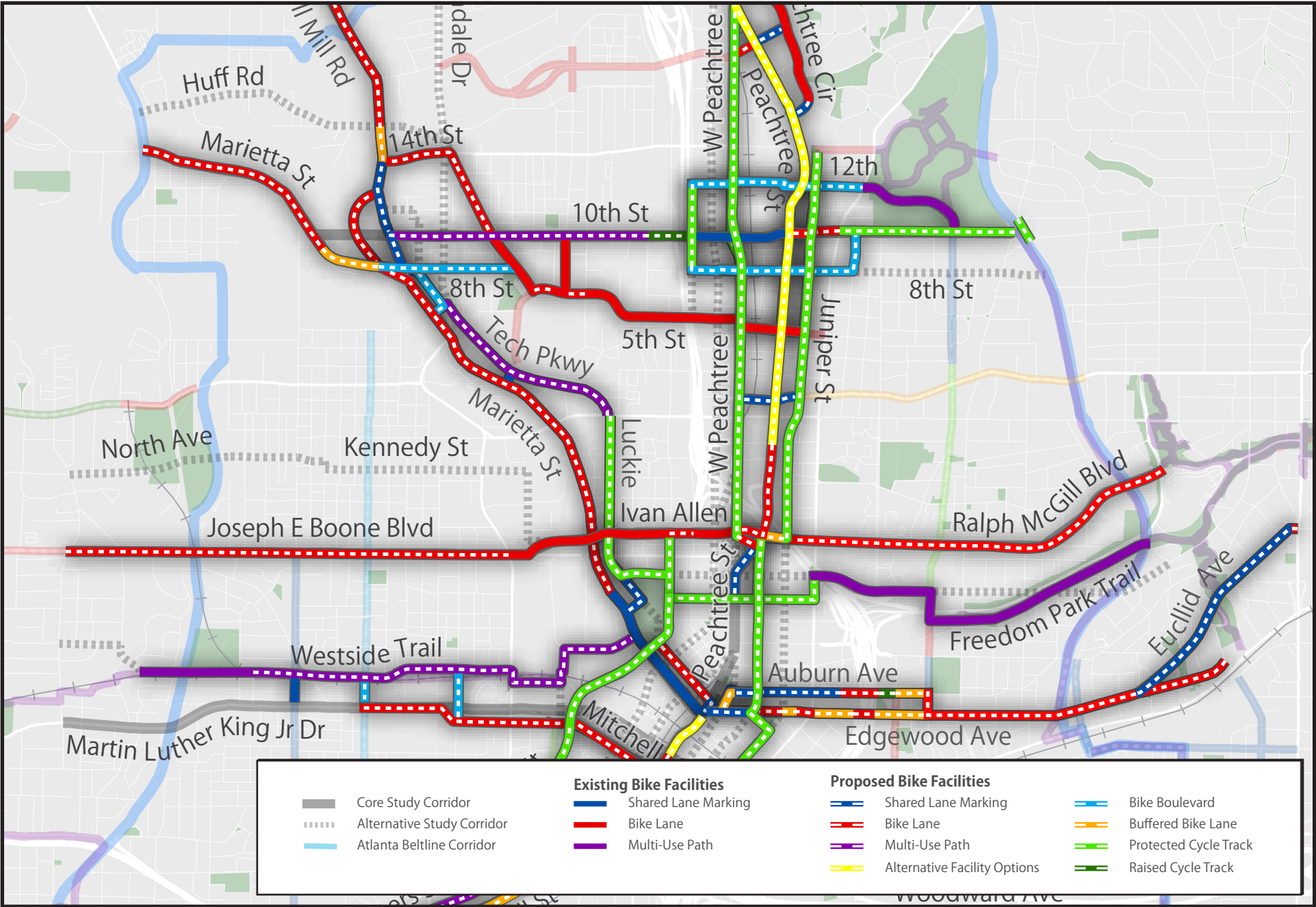


Unique line convention for proposed facilities



Scale communicates to user how long travel will take



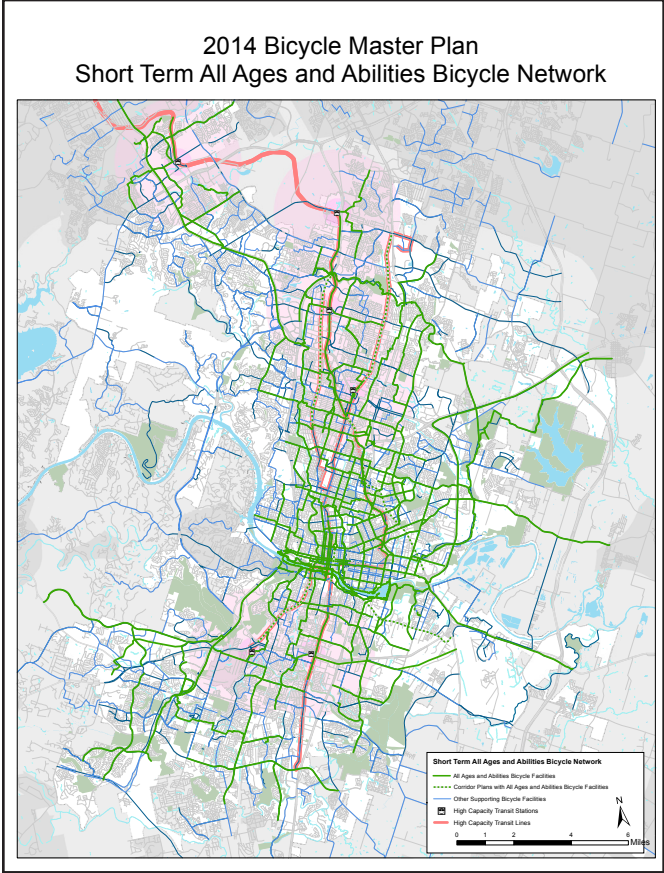


AUSTIN, TX

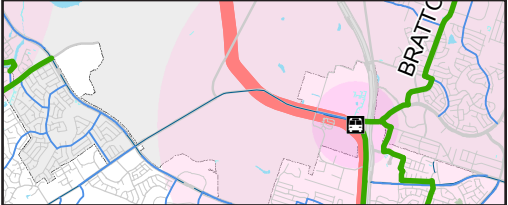
LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
AUSTIN, TX	2014	AUSTIN BICYCLE MASTER PLAN	CITY OF AUSTIN

KEY MAP FEATURES

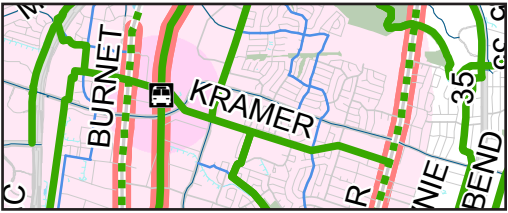
Full Map (Click to view full size)



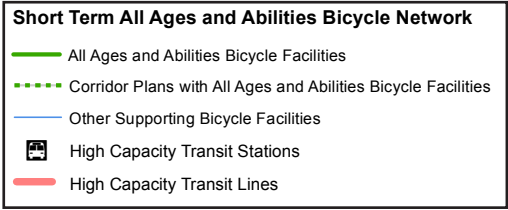
Highlights connections to high capacity transit stations and lines

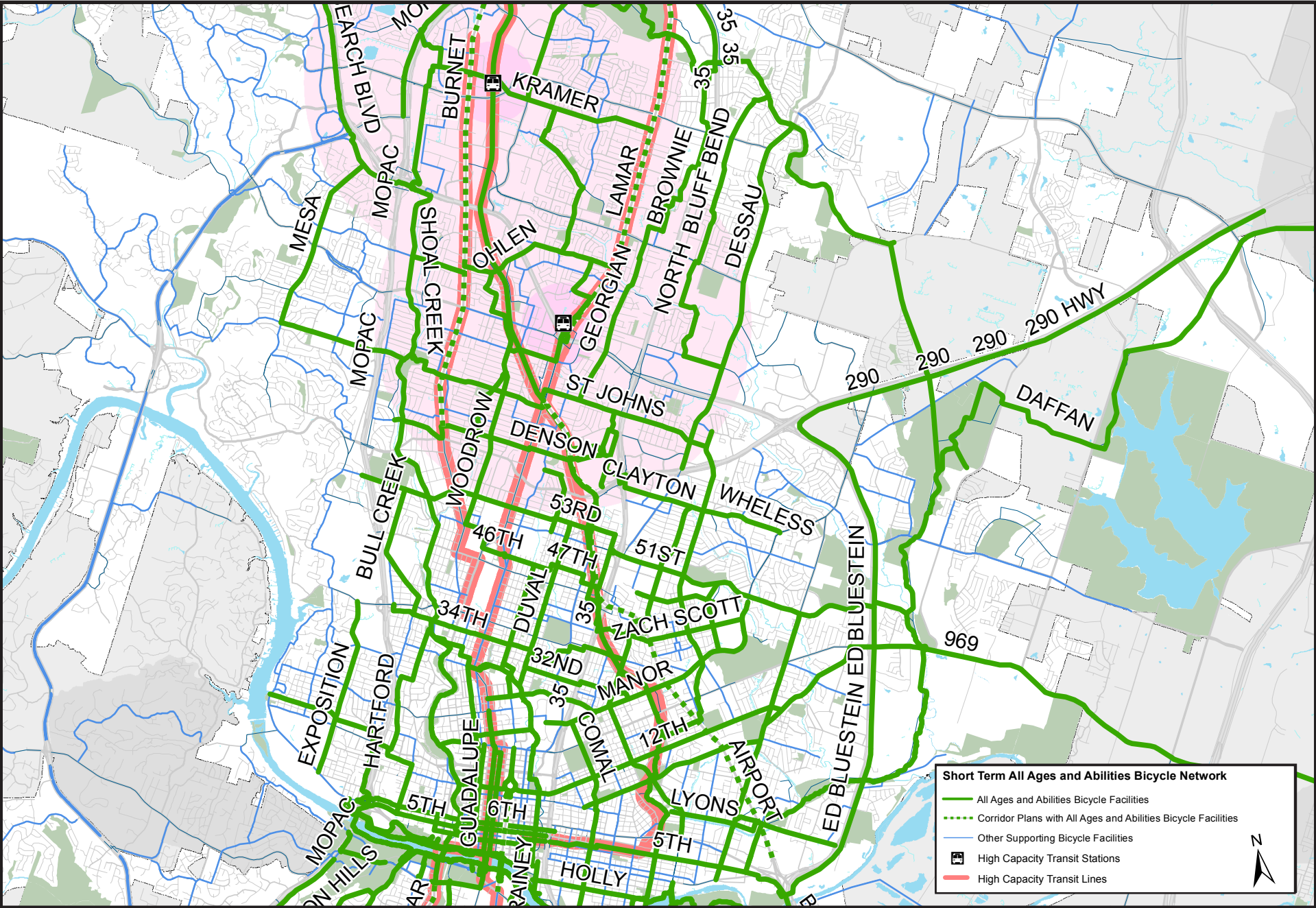


Highlights 'all ages and abilities' network



Denotes facilities from corridor plans



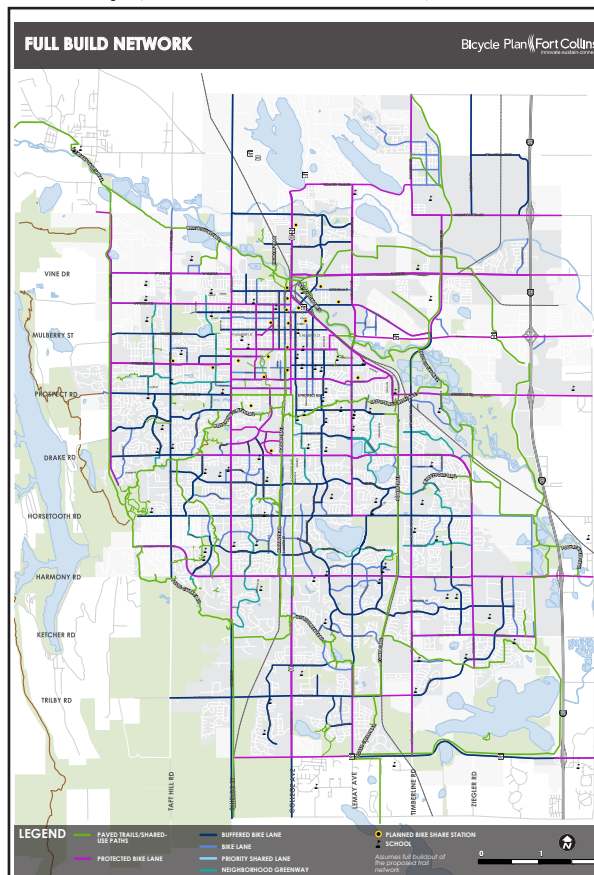


FORT COLLINS, CO

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
FORT COLLINS, CO	2014	CITY OF FORT COLLINS BIKE PLAN	CITY OF FORT COLLINS

KEY MAP FEATURES

Full Map (Click to view full size)



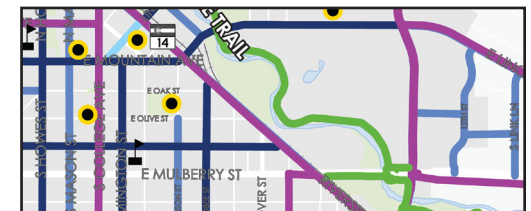
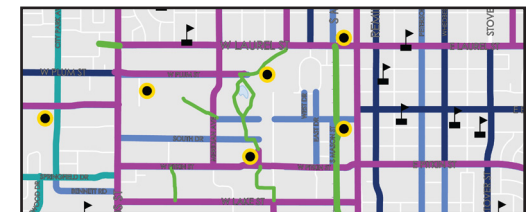
Simple symbology and color scheme

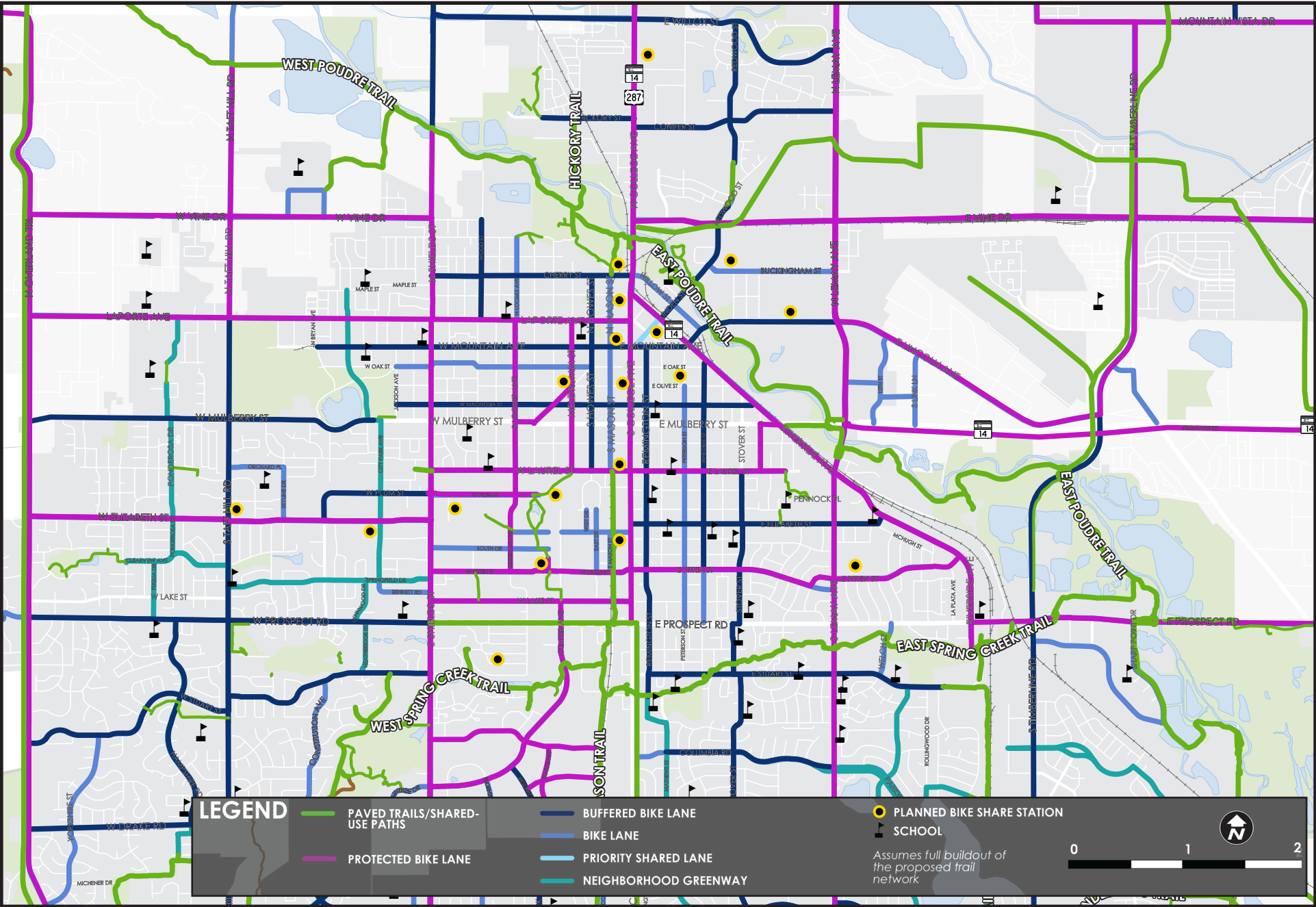


Shows planned bike share stations



Lower stress facilities more visible



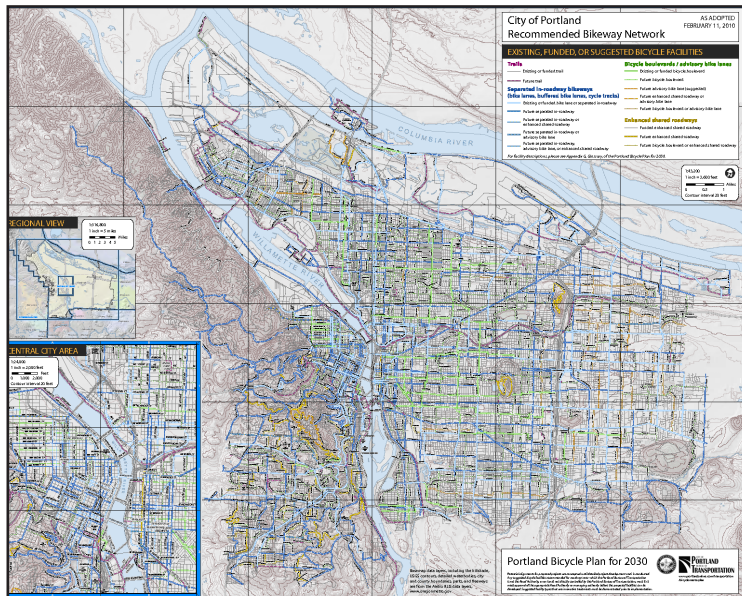


PORTLAND, OR

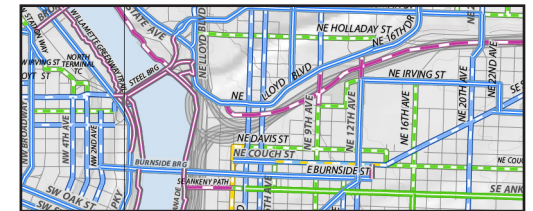
LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
PORTLAND, OR	2010	CITY OF PORTLAND BICYCLE PLAN FOR 2030	CITY OF PORTLAND

KEY MAP FEATURES

Full Map (Click to view full size)



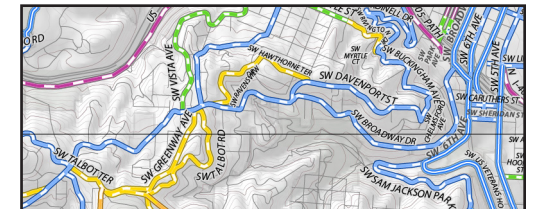
Highlights connections to regional trails and parks

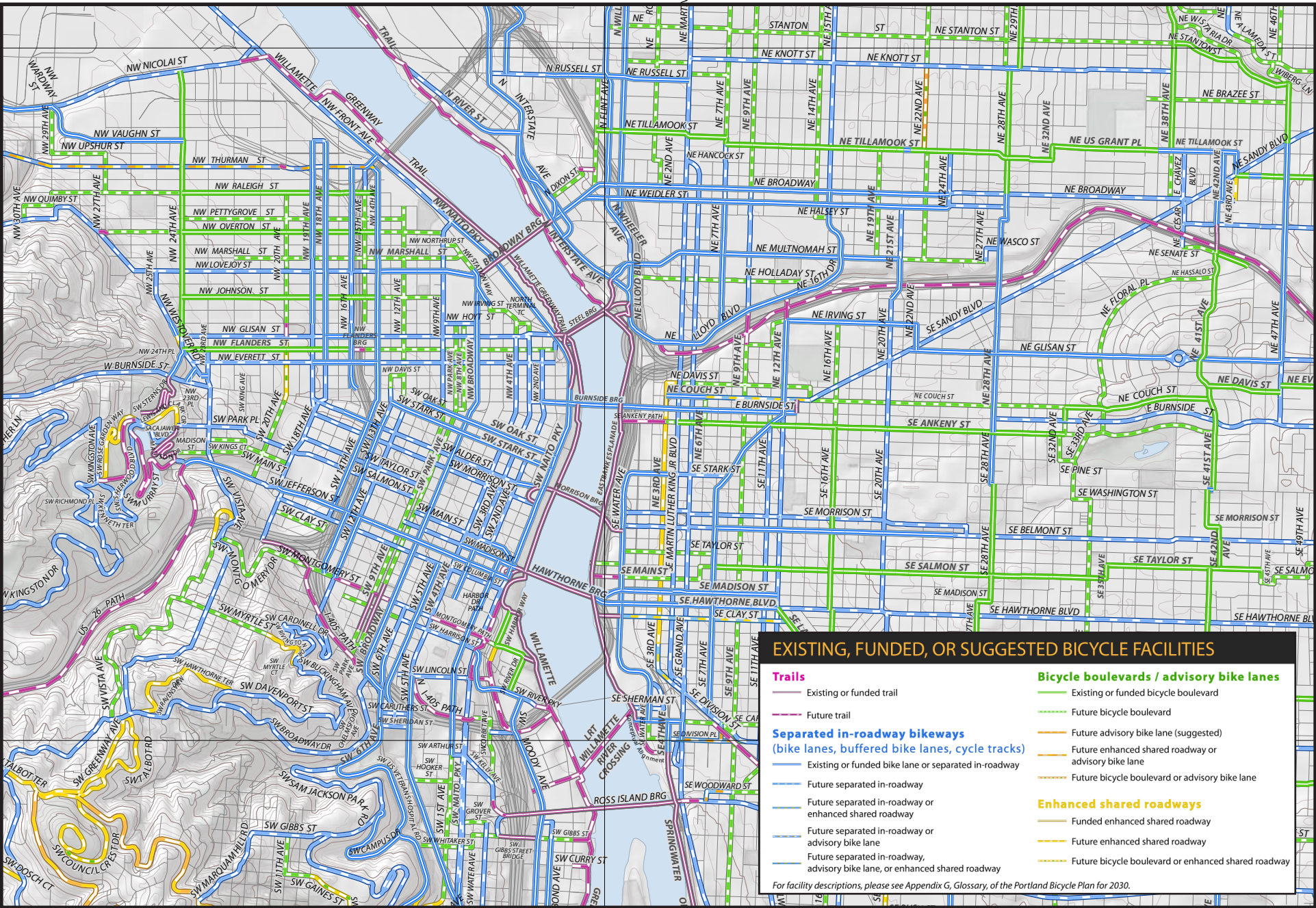


Identifies both 'existing and funded' and 'planned' bike routes



Shows elevation change



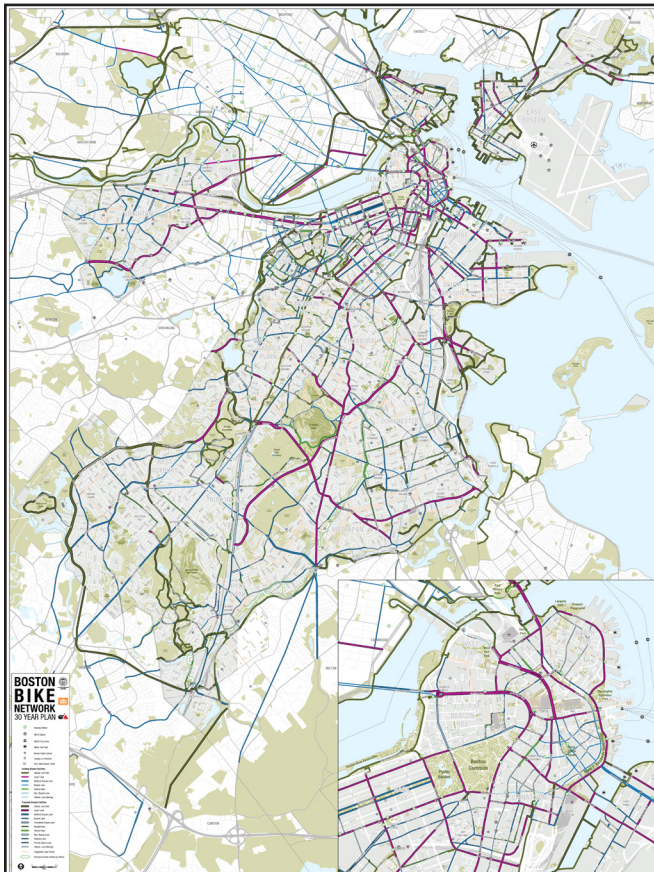


BOSTON, MA

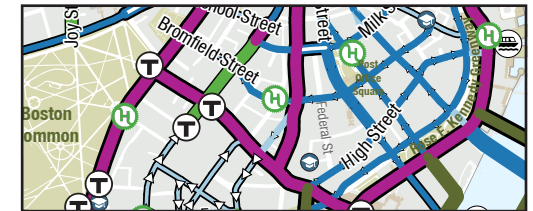
LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
BOSTON, MA	2015	BOSTON BIKE NETWORK PLAN	BOSTON DEPARTMENT OF TRANSPORTATION

KEY MAP FEATURES

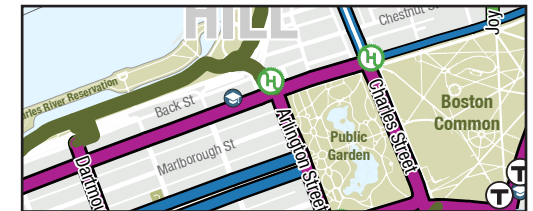
Full Map (Click to view full size)



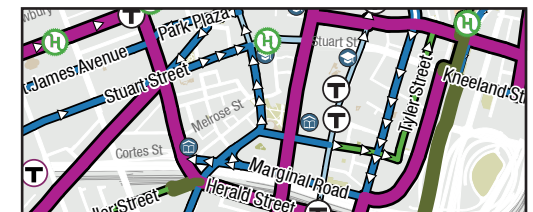
Shows connections between bike network and transportation hubs including rail and bike share stations



Shared use paths is similar to the color used for parks to indicate low-stress

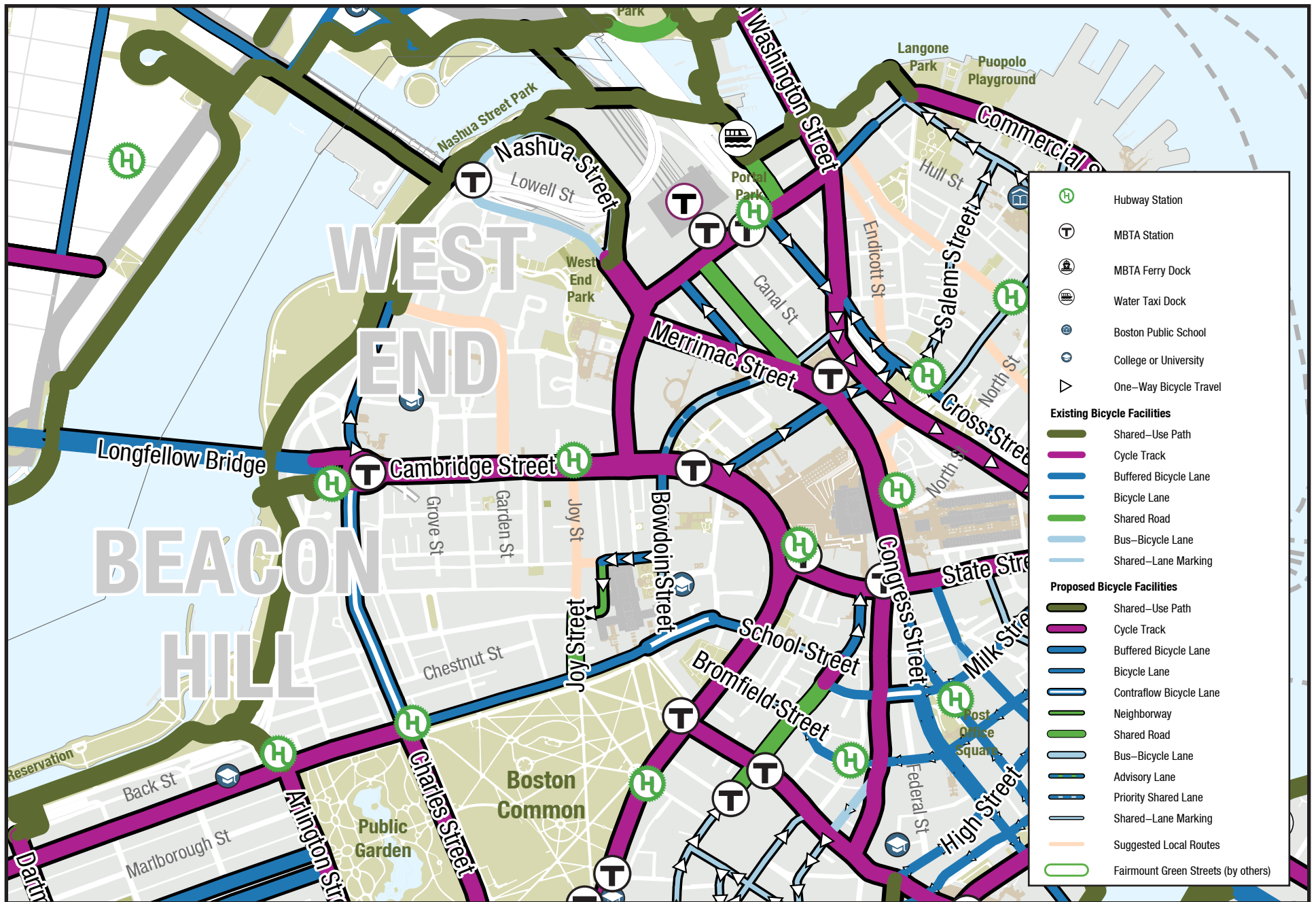


A dominant color is used for cycle tracks, emphasizing the high comfort level this facility type provides



Neighborhood scale maps are included within the plan for more specific details



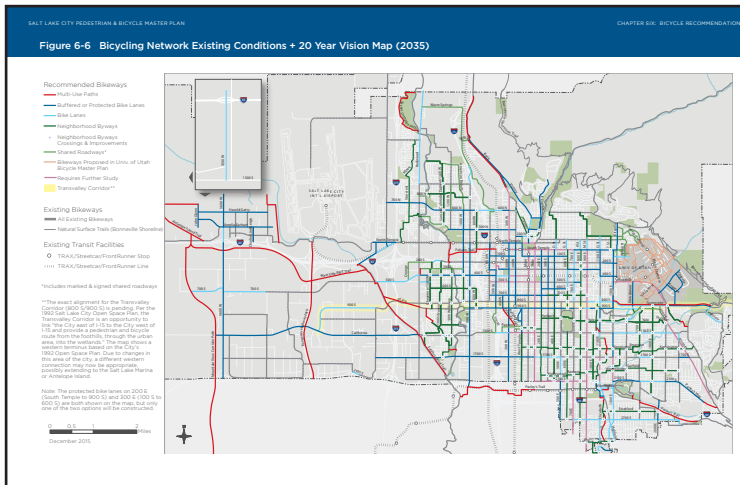


SALT LAKE CITY, UT

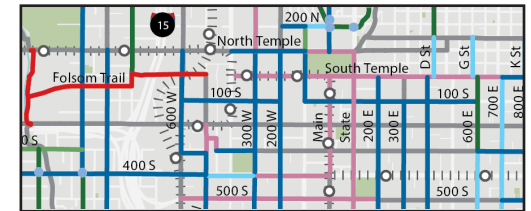
LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
SALT LAKE CITY, UT	2015	SALT LAKE CITY PEDESTRIAN AND BICYCLE MASTER PLAN	SALT LAKE CITY

KEY MAP FEATURES

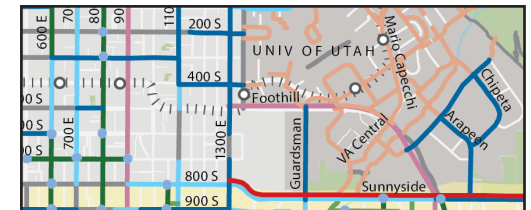
Full Map (Click to view full size)



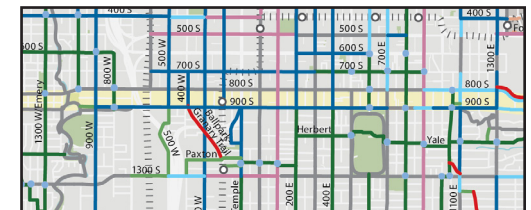
Shows connections to transit lines and stops

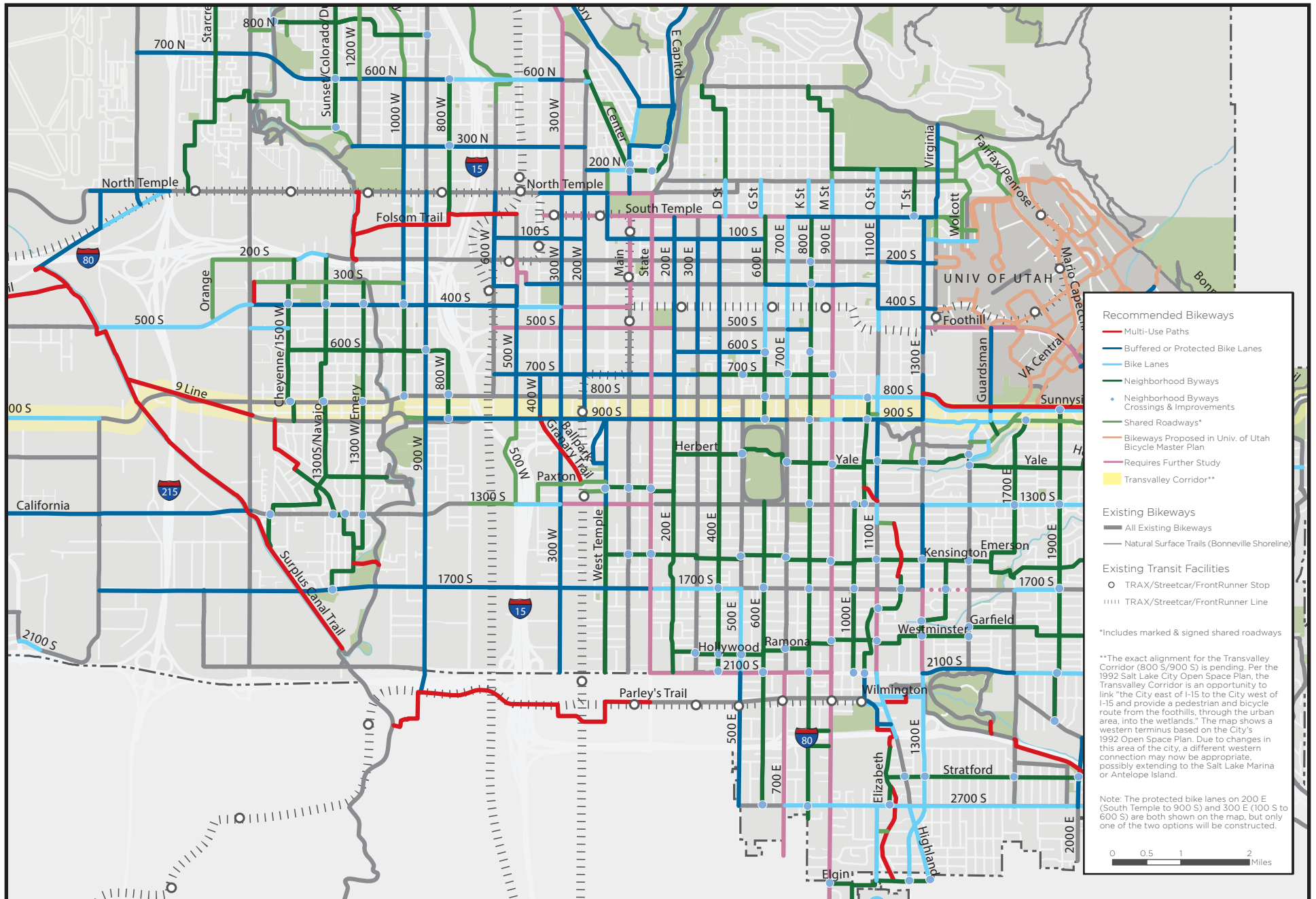


Highlights a university campus master plan



Highlights the Transvalley corridor, a planned future investment



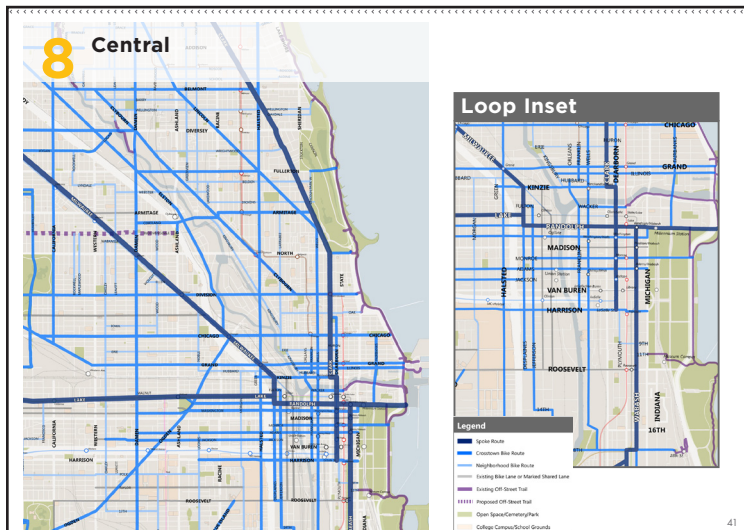


CHICAGO, IL

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
CHICAGO, IL	2012	CHICAGO STREETS FOR CYCLING 2020	CITY OF CHICAGO

KEY MAP FEATURES

Full Map (Click to view full size)



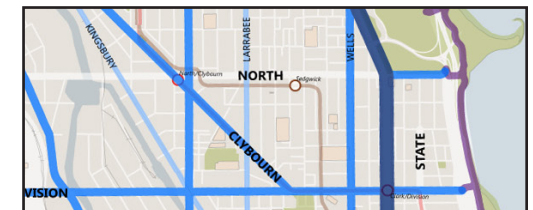
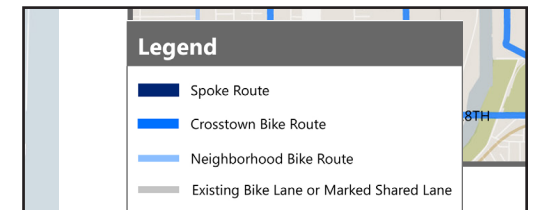
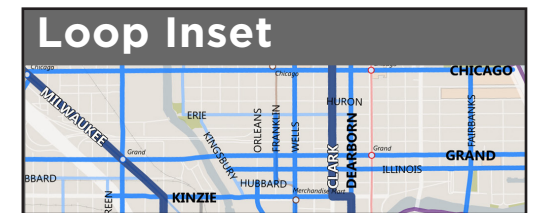
Inset map provides additional information about important area

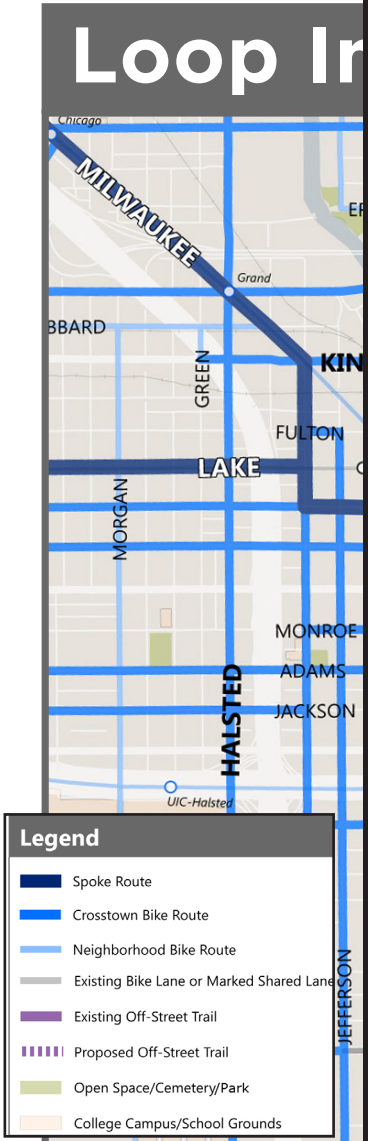
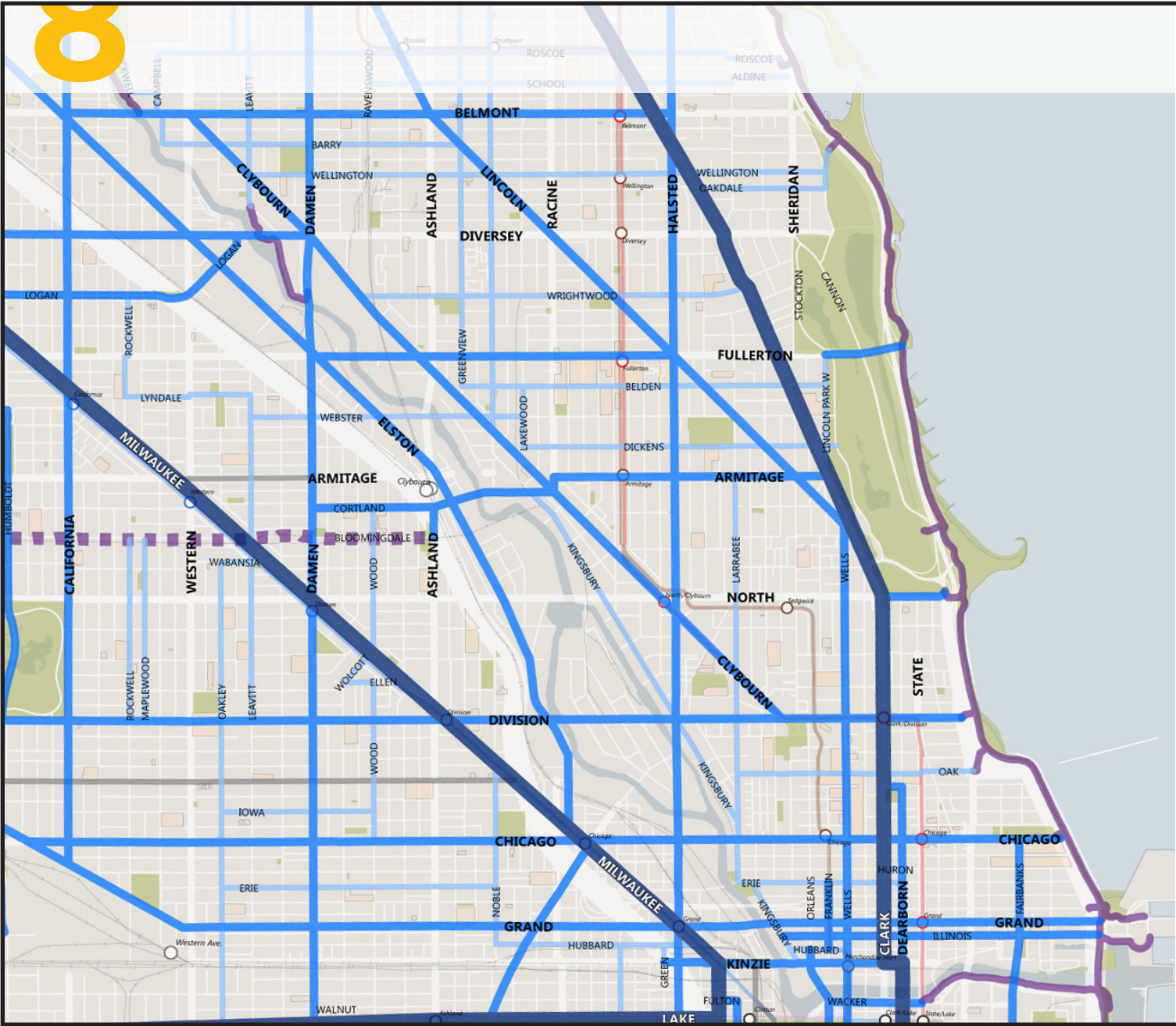


Route hierarchy shown using line thickness and color saturation



Shows connections to network of off-street trails



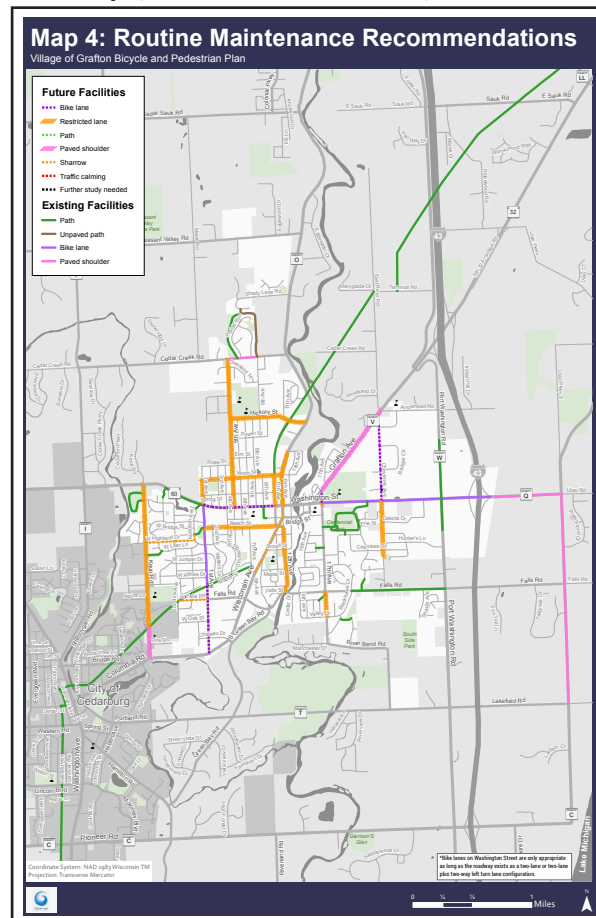


GRAFTON, WI

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
GRAFTON, WI	2015	VILLAGE OF GRAFTON BICYCLE AND PEDESTRIAN PLAN	VILLAGE OF GRAFTON

KEY MAP FEATURES

Full Map (Click to view full size)



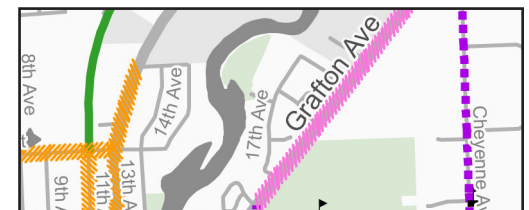
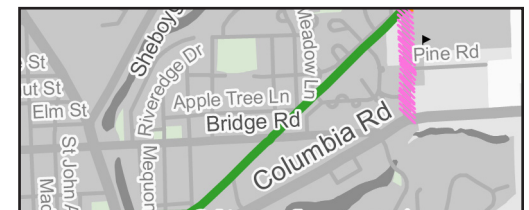
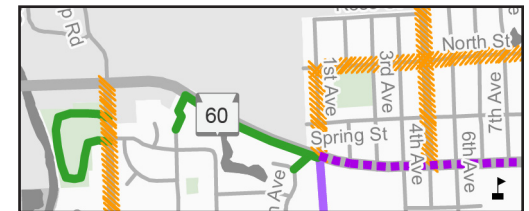
Shows 'restricted lanes,' a unique facility where bicyclists share a lane with parking and right-turning vehicles

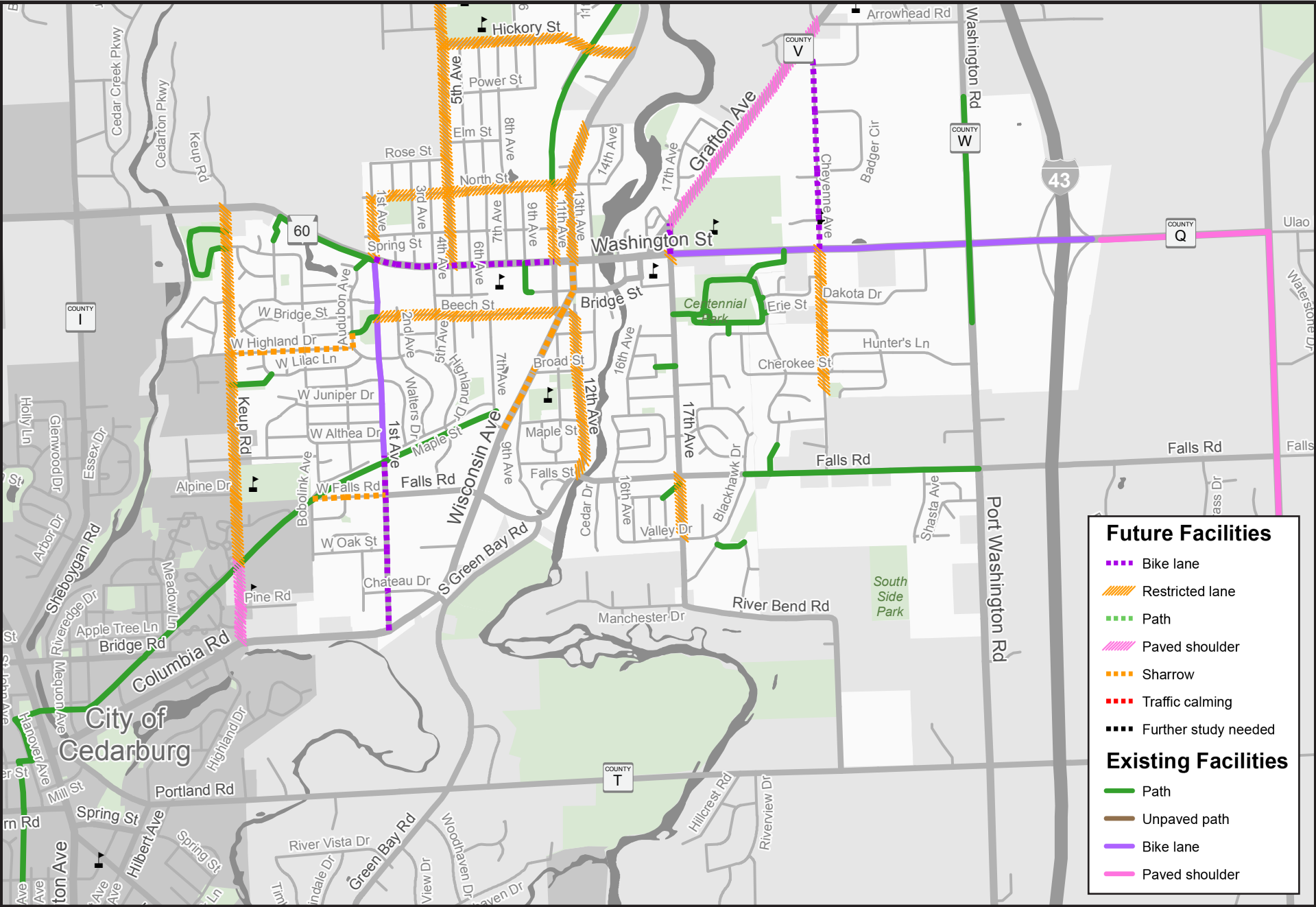


Highlights future and existing paved shoulders, an important bike facility in more rural communities



Highlights streets keyed for future traffic calming



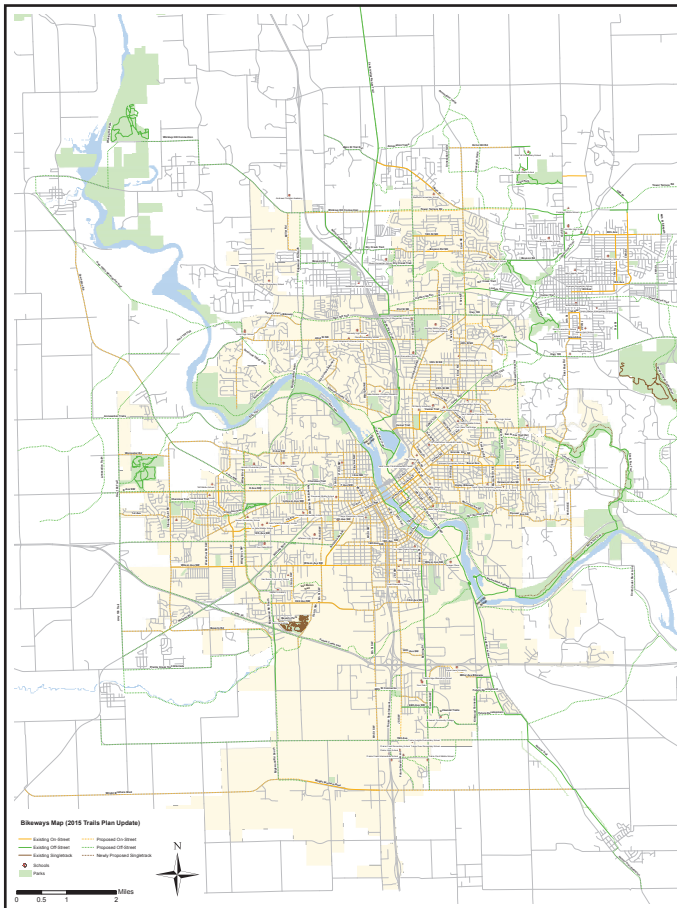


CEDAR RAPIDS, IA

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
CEDAR RAPIDS, IA	2015	CEDAR RAPIDS COMPREHENSIVE TRAILS PLAN	CORRIDOR METROPOLITAN PLANNING ORGANIZATION

KEY MAP FEATURES

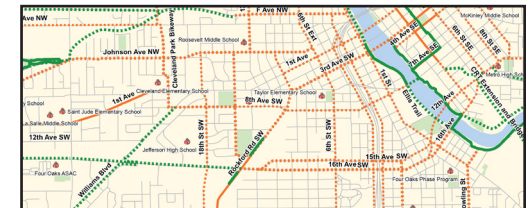
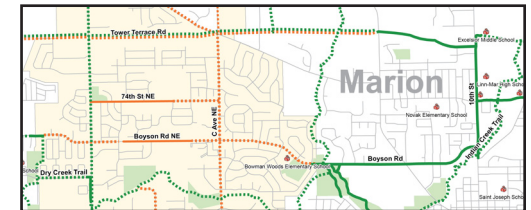
Full Map (Click to view full size)



Highlights nearby jurisdictions



Includes flexible facility typologies



SEATTLE, WA

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
SEATTLE,WA	2015	SEATTLE BICYCLE MASTER PLAN UPDATE	SEATTLE DEPARTMENT OF TRANSPORTATION

KEY MAP FEATURES

Full Map (Click to view full size)



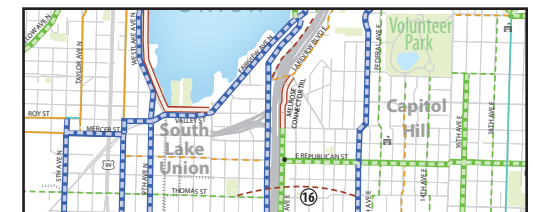
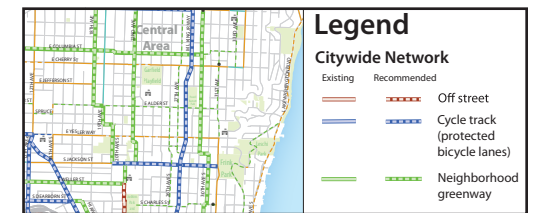
Unique symbology for proposed facilities

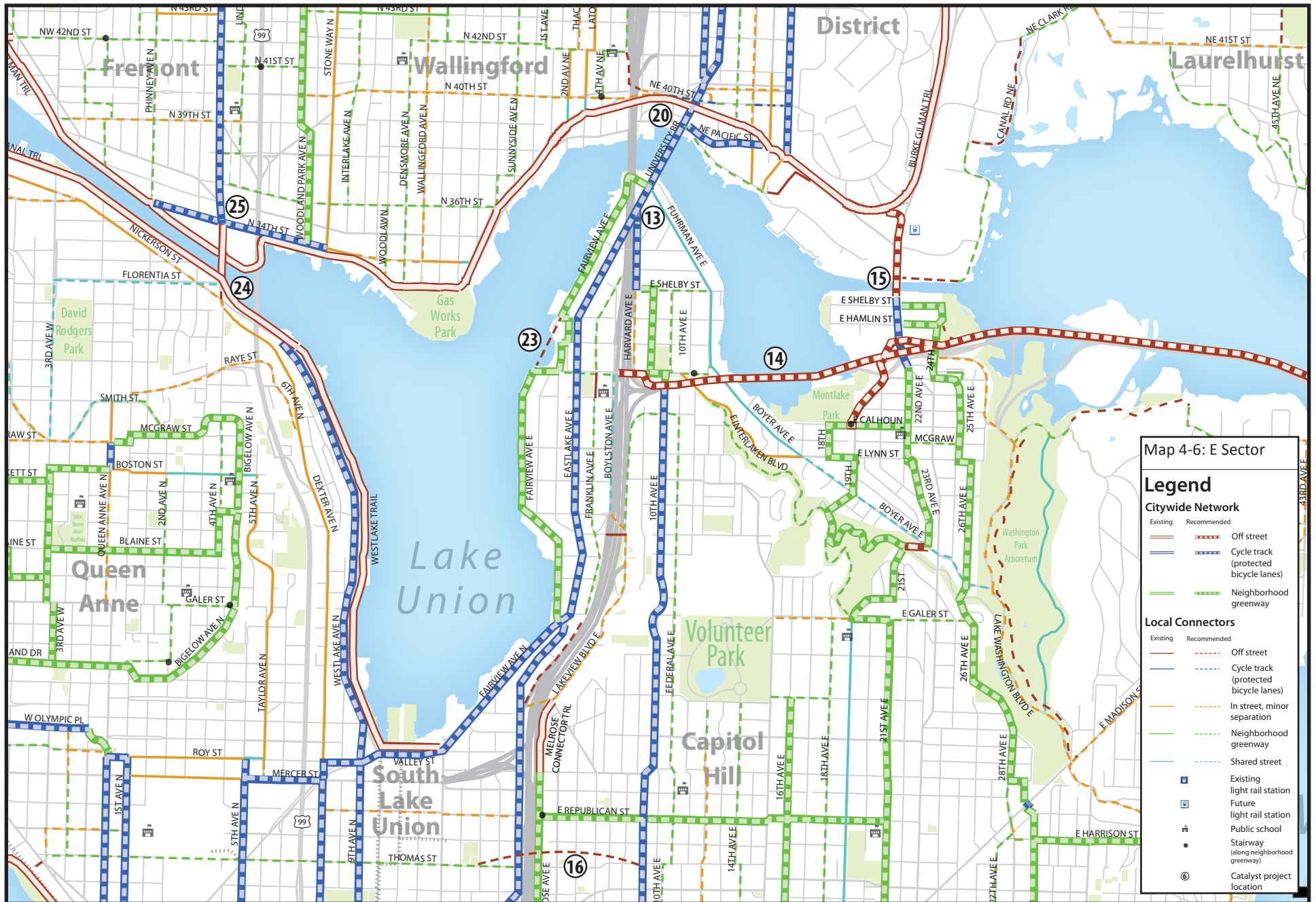


Recommendation hierarchy delineated by line weight



Neighborhood names highlighted to orient users



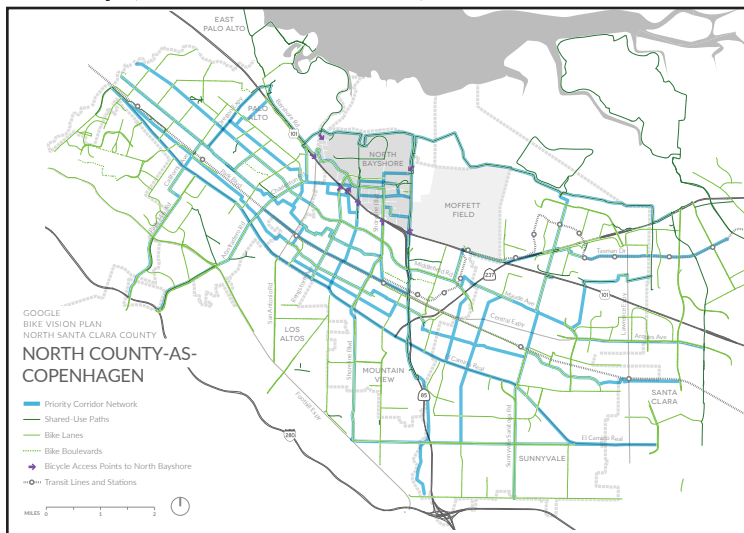


NORTH SANTA CLARA COUNTY, CA

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
NORTH SANTA CLARA COUNTY, CA	2015	GOOGLE BIKE VISION PLAN	GOOGLE

KEY MAP FEATURES

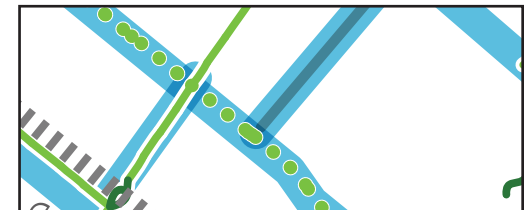
Full Map (Click to view full size)



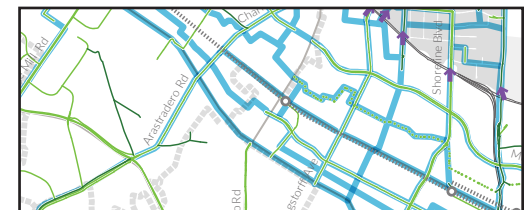
Identifies bike access points to Google's North Bayshore campus

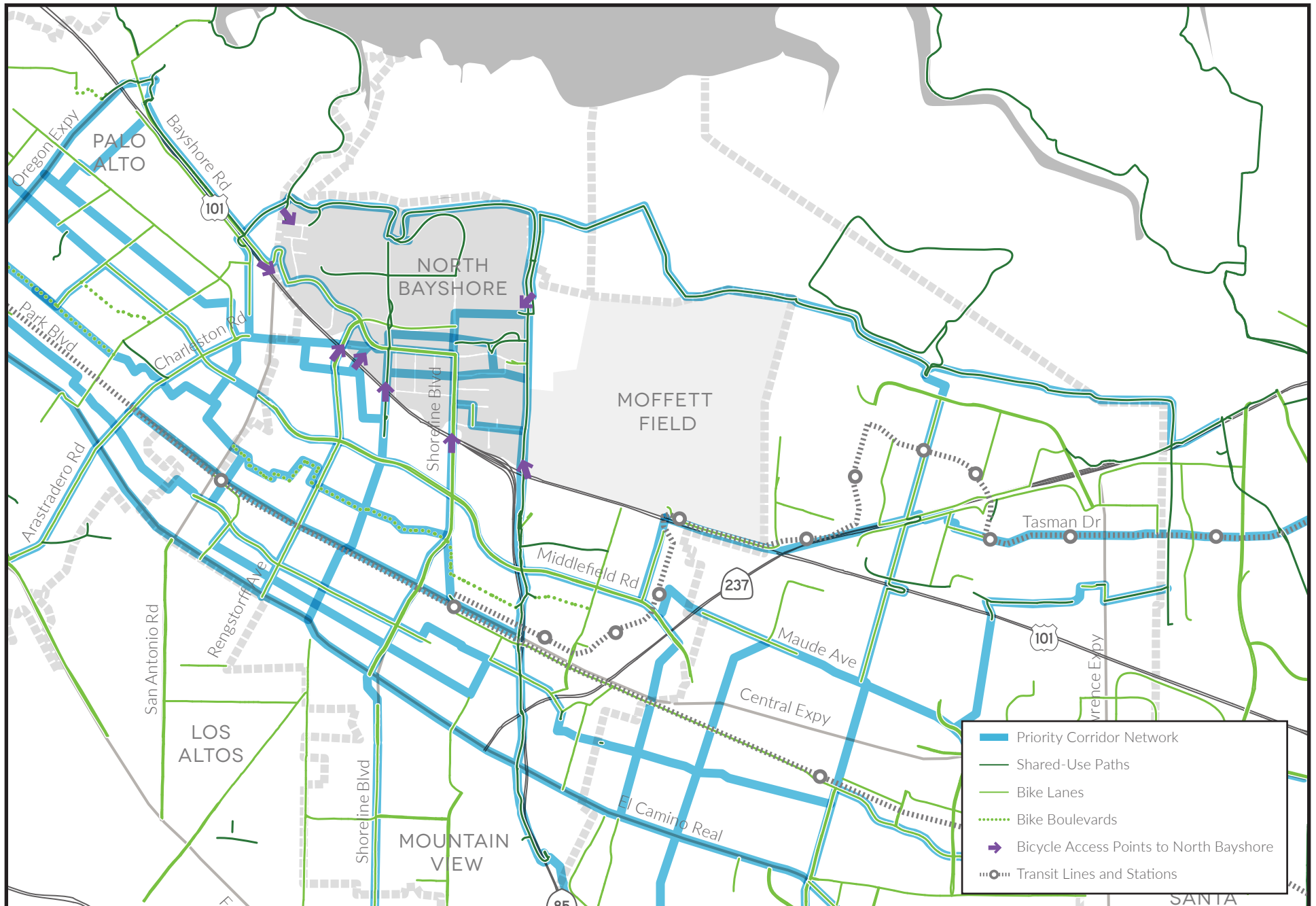


Different line weights allow for layered information



Clear color scheme and organization



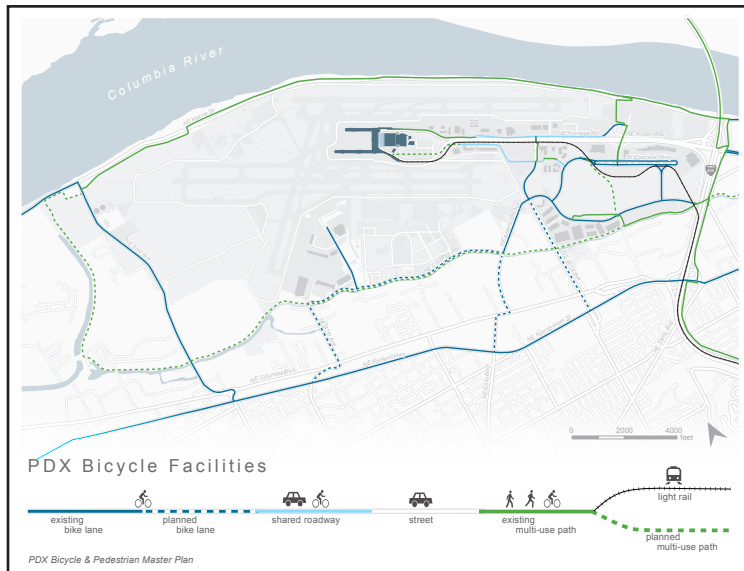


PORT OF PORTLAND, OR

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
PORTLAND, OR	2014	PORTLAND INTERNATIONAL AIRPORT BICYCLE AND PEDESTRIAN MASTER PLAN	PORT OF PORTLAND

KEY MAP FEATURES

Full Map (Click to view full size)



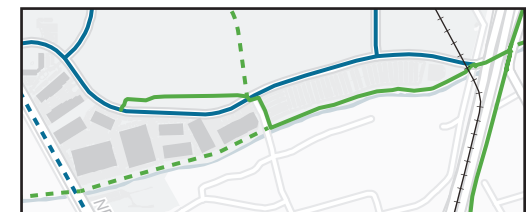
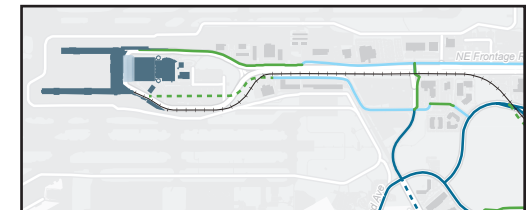
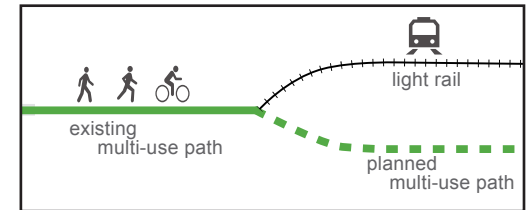
Legend integrates facility types with user types

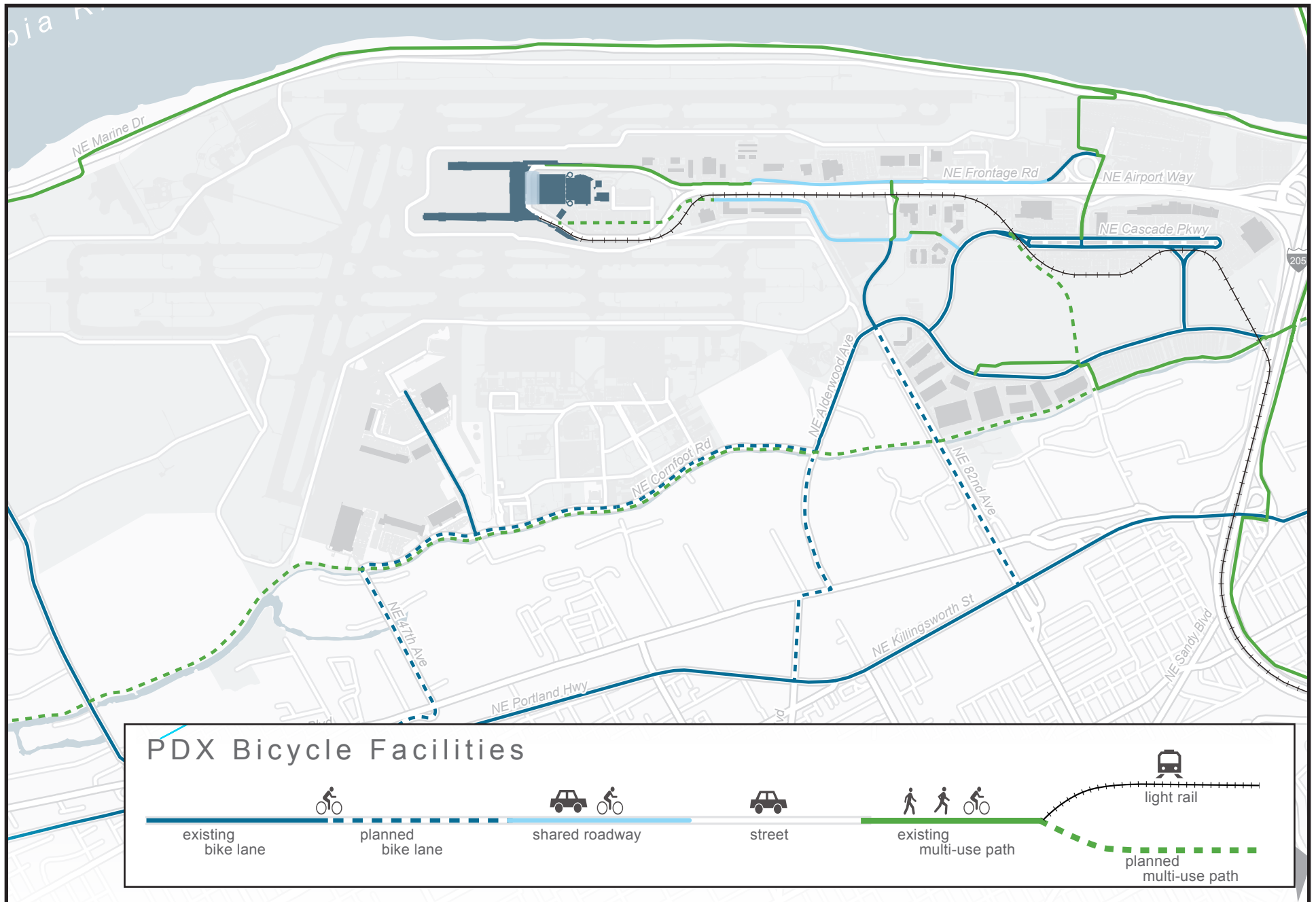


Simple color palette and contextual background layers including buildings and waterways



Highlights connections to citywide bike network and other multimodal options



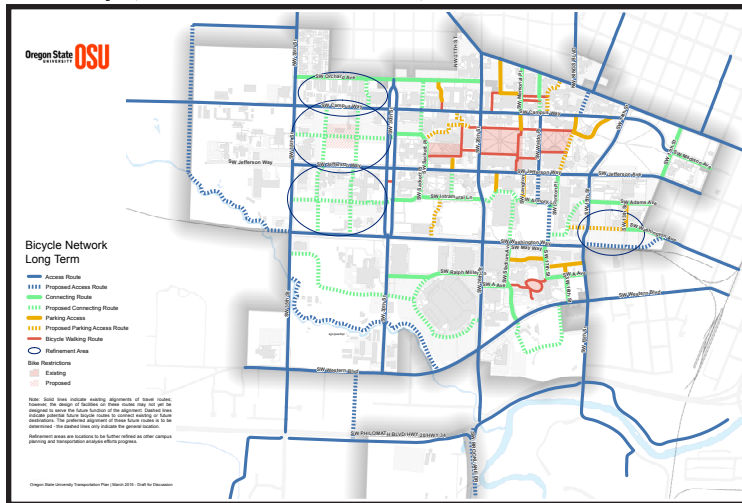


OREGON STATE UNIVERSITY

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
CORVALLIS, OR	2015	OREGON STATE UNIVERSITY TRANSPORTATION PLAN	OREGON STATE UNIVERSITY

KEY MAP FEATURES

Full Map (Click to view full size)



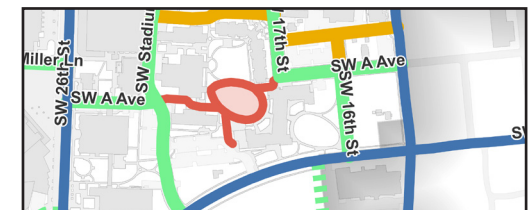
Highlights dismount zones



Identifies areas for further refinement



Highlights bicycle parking access routes



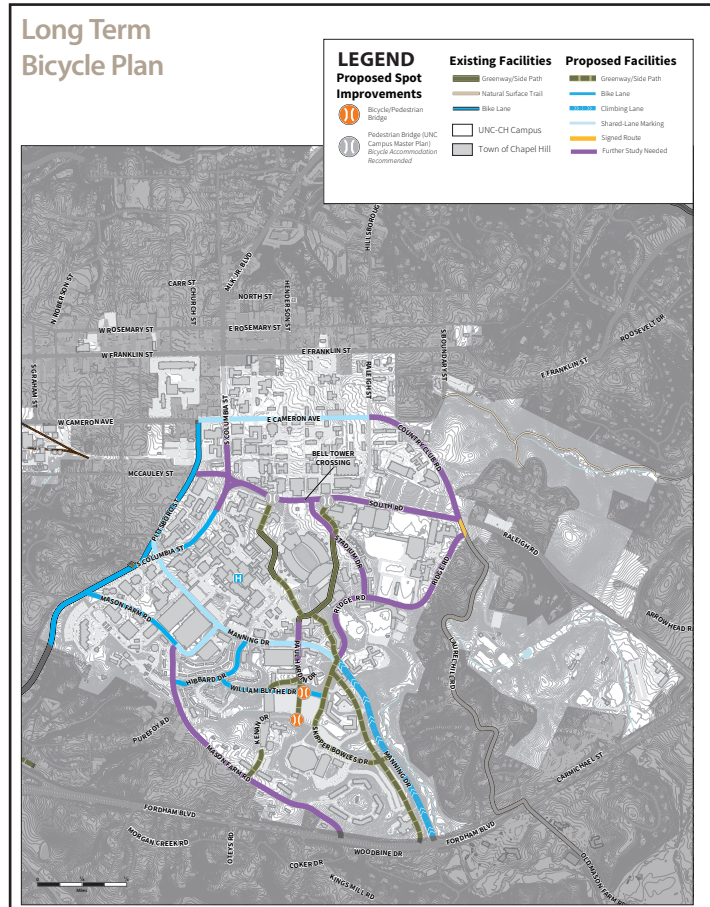


UNIVERSITY OF NORTH CAROLINA

LOCATION	YEAR	PUBLICATION	RESPONSIBLE AGENCY
CHAPEL HILL, NC	2014	UNC CHAPEL HILL BIKE MASTER PLAN	UNIVERSITY OF NORTH CAROLINA

KEY MAP FEATURES

Full Map (Click to view full size)



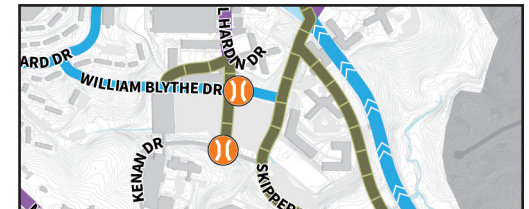
Shows recommended bridges with clean icons

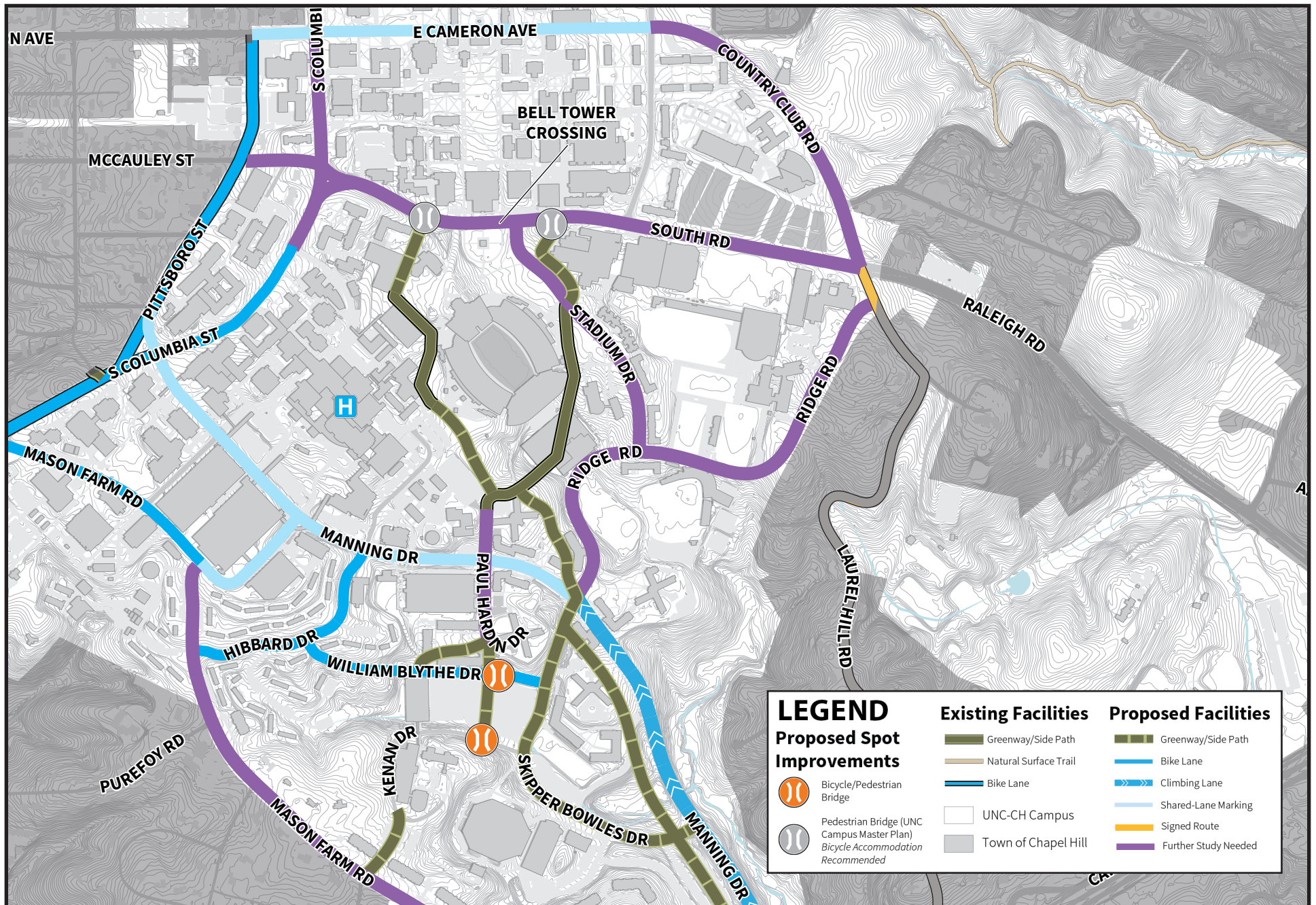


Clever symbology for climbing lanes



Shows greenways





NEXT STEPS

This resource highlights different approaches and techniques for mapping existing and proposed bicycle networks.

As demonstrated by the best practices highlighted here, there have been significant positive advances in this area in recent years.

To build on this progress, it will be important to institutionalize these techniques so that they become standard practice across jurisdictions and at all scales.

The following next steps are offered to inform the continued development of this national capacity and they will involve partners and stakeholders at all levels.

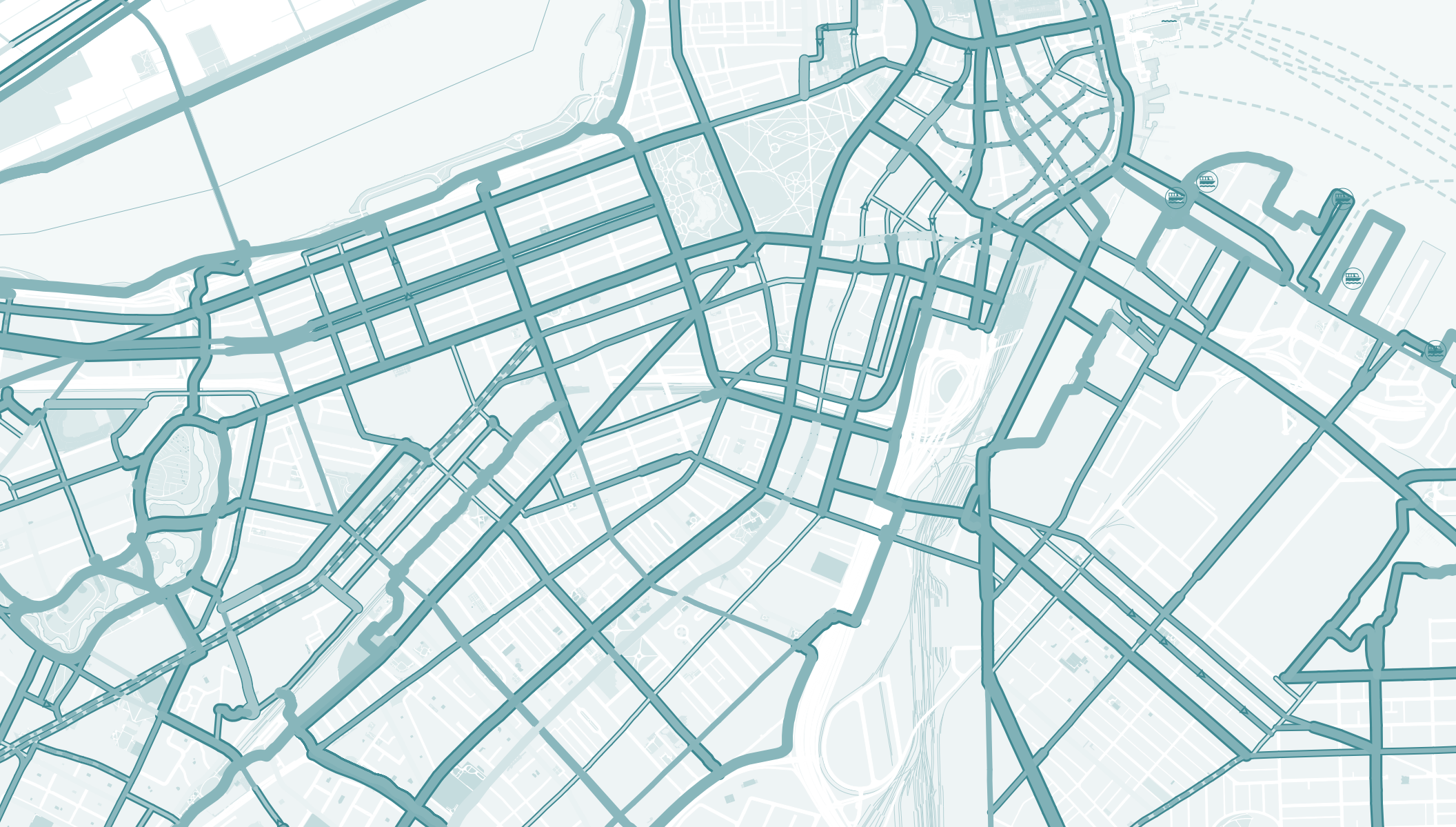
1. Identify a consistent set of bicycle facility types and community destinations that can serve as a baseline for bicycle network planning efforts across jurisdictions and geographic locations. The tables below are intended to inform this conversation.
2. Undertake a significant national push to research, apply, and document methodologies for measuring bicycle network connectivity and tracking change in connectivity over time.
3. Examine ways to integrate bicycle network infrastructure data into national infrastructure databases and data management systems.
4. Continue to identify and promote strategies for integrating bicycle network planning into ongoing planning processes at the local, MPO, and State level (e.g. resurfacing, TIP and STIP, Highway Safety Improvement Program, project design and development, MPO certification review).

BICYCLE FACILITY TYPES

- Bike Lane
- Buffered Bike Lane
- Climbing Lane (i.e., bike lane on uphill side only)
- Separated Bike Lane or Protected Bike Lane or Cycle Track
- Bike Boulevard
- Shared Use Path
- Other (such as shared lane marking and paved shoulder)

COMMUNITY DESTINATIONS

- | | | |
|----------------------------|----------------------------------|--|
| • Bike share stations | • Major retail and entertainment | • Government offices |
| • Bus stops | • Parks | • Universities or colleges |
| • Community centers | • Places of worship | • Major tourist destinations |
| • Community colleges | • Public libraries | • Hospitals and other health care facilities |
| • Community service center | • Retirement homes | • Transit centers |
| • High density residential | • Schools | |



U.S. Department of Transportation
Federal Highway Administration

For More Information Visit: http://www.fhwa.dot.gov/environment/bicycle_pedestrian
Publication Number: FHWA-HEP-16-054