

Prioritizing Bicyclist Safety and Mobility: Which Guidance Do I Use?

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About the Pacific Southwest Region University Transportation Center

The Pacific Southwest Region University Transportation Center (UTC) is the Region 9 University Transportation Center funded under the US Department of Transportation's University Transportation Centers Program. Established in 2016, the Pacific Southwest Region UTC (PSR) is led by the University of Southern California and includes seven partners: Long Beach State University; University of California, Davis; University of California, Irvine; University of California, Los Angeles; University of Hawaii; Northern Arizona University; Pima Community College.

The Pacific Southwest Region UTC conducts an integrated, multidisciplinary program of research, education and technology transfer aimed at *improving the mobility of people and goods throughout the region*. Our program is organized around four themes: 1) technology to address transportation problems and improve mobility; 2) improving mobility for vulnerable populations; 3) Improving resilience and protecting the environment; and 4) managing mobility in high growth areas.

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Edward J. Smaglik (Principal Investigator) and Brendan J. Russo (Co-Principal Investigator) conducted this research titled, "Prioritizing Bicyclist Safety and Mobility: Which Guidance Do I Use?" at Northern Arizona University. The research took place from August 15th, 2022 to August 14th, 2023 and was funded by a grant from the Pacific Southwest Region University Transportation Center in the amount of \$24,997. The research was conducted as part of the Pacific Southwest Region University Transportation Center research program.

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Abstract

Historically bicyclists may have been an afterthought and expected to share space with motor vehicles, however, this is outdated attitude is giving way to new approaches found in various bicycle infrastructure design guidance documents. This study used a multi-staged approach to investigate the usage of these guides by state and local agencies. A literature review synthesized literature and published guides on bicycle infrastructure design and was followed by a survey of bicycle / pedestrian coordinators to gather information from practitioners about their use of these design guides. Data collected were analyzed to identify trends, relationships, and gaps in the knowledge about bicycle infrastructure design guidance. From this, it was found that the two federally published guidance documents (the Manual on Uniform Traffic Control Devices (MUTCD) and the Guide for the Development of Bicycle Facilities (GDBF)) were the most frequently utilized by these survey respondents and were noted to be held as the standard for bicyclist infrastructure planning and design by some, however they are sparsely updated and tend not to align with contemporary community expectations. Additionally, states tended to rely on the MUTCD and GDBF while cities utilized a larger variety of guidance documents such as those published by NACTO.

Prioritizing Bicyclist Safety and Mobility: Which Guidance Do I Use?

Executive Summary

This research aims to understand how decision-makers for bicyclist infrastructure design navigate the various guidance documents available and how the documents are utilized in various transportation scenarios. With the availability of information from various sources, challenges can arise for planners and practitioners such as which guidance document may be the most desirable (for different operational objectives), which may be updated the most regularly, which may offer the strongest liability protection (or the converse, which may offer the greatest risk), which is in line with community expectations, and more. These questions are left to individual agencies to solve, and little standardization exists to assist in making these decisions. To achieve this, a comprehensive literature review of guidance documents used to aid bicyclist infrastructure design as well as a review of previously conducted research that utilized a survey instrument directed toward pedestrian/bicyclist coordinators was conducted to inform the development and dissemination of a survey on the same topic. State Department of Transportation (DOT) practitioners in all 50 states of the United States, including the District of Columbia, as well as practitioners from the top 25 most populous cities, were sent a survey to answer questions such as which documents they use for specific bicyclist design scenarios and their reasons for using those documents. Those results were then synthesized to make various comparisons between state and city agency responses.

The survey instrument used in this research project asked respondents questions about how bicycle infrastructure is managed within their agency, presented a sliding scale to gauge use of different guidance documents under specific design scenarios, and questions inquiring why specific guidance documents may not be used. The guidance documents included in the survey were the Manual on Uniform Traffic Control Devices, the American Association of State Highway and Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities, the National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide, the Federal Highway Administration (FHWA) Separated Bike Lane Planning and Design Guide, the NACTO Urban Streets Design Guide, and supplemental state or municipality documents. Using these guidance document options, respondents were asked questions for the following scenarios: on-street bike lanes, separated bike lanes, shared-use pathways, the mitigation of user conflicts at intersections, and bicycle signals.

The results of this research reveal a wide range of strategies for bicycle infrastructure planning across DOT agencies in the United States. A total of 44 unique survey responses were received and overall revealed that cities often utilize a wider array of guidance to make decisions and place a higher priority on making improvements to bicyclist infrastructure. Some select findings from this study, which can inform practitioners and future research related to navigating the various guidance documents, are listed below.

- While two federally published guidance documents (Manual on Uniform Traffic Control Devices and Guide for the Development for Bicycle Facilities) are the most frequently referenced and are held as the standard for bicyclist infrastructure planning and design by some, they both are

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sparsely updated and may not align with community expectations. However, numerous respondents noted that the Guide for the Development for Bicycle Facilities will be receiving an update soon, and it will include important considerations from modern guidance documents and allow for greater flexibility in planning design.

- Cities and state agencies prioritize guidance document usage differently related to the different design scenarios discussed.
 - State agencies rely largely on the Manual on Uniform Traffic Control Devices and Guide for the Development for Bicycle Facilities.
 - City agencies seem to utilize a greater range of guidance, including guidance from NACTO. This may be because city agencies require more detailed guidance to address the complicated situations that arise in cities.
 - Many state agencies may not engage in the planning and design of bicycle infrastructure within their agency since it is outside their scope and instead turn to outside contractors for these considerations.

Based on the results of this survey, there is potential for agencies to reference where other practitioners are turning for their information on specific scenarios as well as which documents others believe are most aligned with community expectations and the state of practice. It is also clear that the use of supplemental documents within an agency is common and these are likely to possess a wealth of information that would not be available to others outside the agency. The results from this study reveal several areas that may benefit from future work in this area:

- Expanding the survey group to reach more practitioners from different agencies around the United States,
- Review survey results for geographical differences, the impact of urban vs. rural communities, and the impact of climate/weather,
- Compare the supplemental guidance documents which both state and city agencies rely on for informing decisions about many different scenarios, including research about how frequently they are updated compared to the recognized guidance documents discussed in this study,
- Identifying the types of content contained in supplemental guidance documents to determine if they might contain unique content (which might represent research needs within this domain) and, if not, understand why there is reliance on internal documents when content may be available in nationally recognized documents, and
- Follow up with respondents to conduct interviews with respondents and acquire a deeper understanding of the decision-making process around traffic design scenarios.

Introduction

Background

To achieve balanced transportation in urban areas by serving multiple travel modes efficiently and safely, bicycling should be promoted as a viable method of transportation. Cycling has the potential to improve environmental health in urban areas as well as contribute to a healthy lifestyle for its users. It also serves as a method to possibly reduce congestion on motorized facilities by moving travelers out of vehicles. However, considerations for the mobility and safety of vulnerable roadway users (e.g. pedestrians and bicyclists) are critical issues, especially in the United States. For example, of 938 bicyclist fatalities in 2020, 79% occurred in an urban environment (1). While bicyclists may have been considered an afterthought to motorized travel in some jurisdictions in the United States, with the expectation to share roadways with vehicles, newer approaches to making travel space in urban areas more equitable are developing. However, this process is uneven across urban environments in the United States, and the need for communication between agencies regarding the development of bicyclist facilities with improvements to safety and mobility is evident.

As a result of these issues, modern design standards and guidance documents have taken on a rekindled importance in an effort to improve safety and mobility through the implementation of various bicycle-focused treatments. The Manual on Uniform Traffic Control Devices (MUTCD) published by the Federal Highway Administration (FHWA) has long been the standard for operational treatments in the United States. However, it can fall short in covering all situations and is challenged by a slow updating process (2). Because of this, other agencies, such as the National Association of City Transportation Officials (NACTO), have formulated their own guidance documents to provide additional information on bicycle facility design treatments (3). Additionally, the American Association of State Highway Transportation Officials (AASHTO) publish the Guide for the Development of Bicycle Facilities (GDBF) for decisions related to bicyclist infrastructure (4). Combined with numerous design guides from different states and municipalities across the United States, a wealth of information regarding bicyclist facility design is available for practitioners.

Motivation and Study Goals

With the availability of information from various sources, challenges can quickly arise for planners and practitioners. With so many guidance documents available, many considerations must be accounted for – questions like which guidance document may be the most desirable (for different operational objectives), which may be updated the most regularly, which may offer the strongest liability protection (or the converse, which may offer the greatest risk), which documents are most in line with community expectations, and more are left to individual agencies to uncover and little standardization exists to make these decisions.

This manuscript documents a study comprised of the following key components which were aimed to address these issues:

- A comprehensive literature review of guidance documents used to aid bicyclist infrastructure design and traffic safety strategies and review of previously conducted research which utilized a survey instrument directed towards Pedestrian/Bicyclist Coordinators from around the United States to develop standards for vulnerable roadway users,

- A survey of Pedestrian/Bicycle Coordinators from state and city Departments of Transportation (DOTs) to answer questions such as which documents they utilize for specific bicyclist design scenarios and why, and
- A synthesis of results acquired from the conducted survey, including a comparison of how state and city agency respondents make decisions on the various topics included in the survey and a summary of additional information offered by these practitioners.

This research aims to understand how decision-makers for bicyclist infrastructure design navigate the various guidance documents available for reference on the subject and how the documents are utilized in various traffic scenarios. By administering the survey to DOT employees across the United States, this work has the potential to discover themes for how decisions are made on these scenarios as well as recognize potential weaknesses, areas for improvement, and future research. Dissemination of the results of this survey will provide insight for practitioners regarding how others in similar roles are utilizing these resources for bicycle infrastructure implementation.

Literature Review

A comprehensive literature review of relevant research was undertaken to establish a baseline understanding of what topics each guidance document specifically focused on prior to administering the survey to Bicycle/Pedestrian Coordinators from State and City DOTs. Further review was conducted on synthesis reports published by the National Cooperative Highway Research Program (NCHRP) which utilized a methodology similar to that employed in this work, in conducting a survey of this same group of transportation design decision-makers (5–7). The specific guidance documents were accessed directly through their publishers' website and other research reports or articles were accessed through the following databases:

- National Transportation Library
- TRB's Transport Research International Documentation database
- Google Scholar

Guidance Document Background Information

The guidance documents considered in this research each have a unique timeline and purpose of development. First, the MUTCD is known as the national standard for traffic control devices installed on any street, highway, bikeway, or private roadway available for public use. It establishes uniformity of traffic control devices in the United States by implementing appropriate policies and procedures from the FHWA. The MUTCD was published initially through joint efforts from AASHTO and the National Conference on Street and Highway Safety (NCSHS) in 1935 and was taken over by the FHWA prior to the 1971 edition. Its current edition was released in 2009 which received revisions in May 2012 and July 2022 (2). Next, the GDBF was published by AASHTO originally in 1999 to address issues related to bicyclists, bicycle infrastructure, and the elements needed to make cycling a more comfortable and convenient option for transportation. The current 4th edition was released in 2012 (and is the most current, although an update is in development) and is intended for use by facility designers in the local context. Its contents are based on research of cities and their approaches to different traffic scenarios (4).

NACTO published the Urban Bikeway Design Guide (UBDG) as an attempt to provide cities with modern solutions to create functioning streets in which bicyclists could safely operate. This research-based guidance document evaluates case studies of various traffic treatments in cities around the United States. NACTO began the project in 2009, and the current edition was released in 2012, with revisions occurring throughout 2022 and 2023 (3). NACTO also released the Urban Streets Design Guide (USDG) in October of 2013, a document designed to chart the principles and practices used by the most relevant planners, designers, and engineers in cities around the United States (8).

An additional guidance document related to bicyclist infrastructure design is the Separated Bike Lane Planning and Design Guide (SBLPDG), published by the FHWA in 2015. This document is designed to outline considerations specifically for separated bike lanes and offer treatment strategies for numerous one- and two-way scenarios. The SBLPDG was developed by the consolidation of practitioner design strategies and implementation for separated bike lanes throughout the United States (9). Each of the documents discussed above serves as an example of the wide array of guidance that organizations have developed to enhance bicyclist infrastructure planning and help protect vulnerable roadway users, in addition to numerous agency-developed guidance documents as well.

Review of Synthesis Articles

Other similar projects have utilized a survey specifically designed for pedestrian/bicycle coordinators of State DOTs to gather information about how infrastructure design topics are handled across the United States. One such synthesis project aimed to document and summarize how different state DOTs select pedestrian and bicyclist projects to be implemented in their communities. By identifying the guiding policies these jurisdictions use for decision-making, comparisons can be made to identify similarities and differences. The results of their research showed that an array of methods were utilized by different DOTs to make these decisions, from quantitative modeling to qualitative assessments, as well as the inclusion of non-DOT stakeholders who had influence in the community (10). Another synthesis study aimed to document current DOT practices for storing, collecting, and sharing pedestrian infrastructure data from their jurisdictions. A literature review conducted by the researchers revealed that the most robust data were maintained for road shoulders and sidewalks while crossing and signalization data were collected with the lowest frequency. Survey results also indicated there was no conclusive definition of what pedestrian infrastructure includes or how its data should be collected or stored. Further research was conducted through case example interviews of five state DOTs whose responses demonstrated diverse approaches. The results of this project demonstrate how development of a questionnaire for Pedestrian/Bicyclist Coordinators can be used to create more consistent and effective planning and management strategies for data related to vulnerable roadway users (5). An additional synthesis study surveyed these same departments from state DOTs and conducted an extensive literature review to understand different street and highway crossing treatments for pedestrians. Review of literature revealed a prioritization of implementing Vision Zero and Complete Streets design methods to improve pedestrian safety and mobility over motorized mobility. Results of the survey indicated that these decision-makers frequently utilized guidance produced by NACTO and AASHTO for pedestrian crossing applications. It was also shown that a vast majority (over 90%) over jurisdictions turned to pedestrian median crossing islands and curb extensions to improve the safety of pedestrian roadway users (6).

Based on this literature review, it is noted that some guidance documents may be better suited for specific design applications than others and therefore use of multiple documents may be necessary to allow planners and engineers access to relevant information regarding a diverse set of design scenarios. It is also shown that administering a survey for Pedestrian/Bicyclist Coordinators across city and state DOT agencies is an effective method for analyzing how decisions are made across agencies regarding infrastructure for vulnerable roadway users. While research related to these topics is available, little has been done to use these tactics for navigating bicycle-specific guidance documents to create a standard for how these infrastructure decisions are made. The work documented in this paper is a first step in providing this type of guidance, by investigating the similarities and differences of how various agencies use these documents for bicyclist infrastructure decisions.

Methodology

Survey Instrument

The survey instrument for this research was designed using Qualtrics to evaluate several topics related to bicycle infrastructure design including preferred guidance documents, agency preferences, liability considerations for guidance use, and internal/external forces driving the use of specific guidance documents. It was determined by the research team to select the Bicycle/Pedestrian Coordinator of each US state DOT (including Washington, D.C.) and a similar position from the United States' twenty-five most populous cities' DOTs as the target survey group. This respondent pool was selected for their expertise in bicycle infrastructure facility design and their responsibilities in implementing bicycle infrastructure projects. Each agency was contacted prior to survey distribution to determine the appropriate contact.

A first step towards developing the survey instrument involved selecting the federal guidance documents that would be specifically included. As noted earlier, an initial literature review conducted by team members concluded that the most relevant documents to bicycle infrastructure design are the MUTCD, the GDBF, the UBDG, the USDG, and the SBLPDG. Many of the survey questions also prompt the respondent to include any State or Municipal level guidance document that they use for a certain topic or situation. Each document was reviewed in depth to develop an understanding of its history and how it applies to specific bicyclist infrastructure planning scenarios, detailed in successive sections.

To determine the survey layout and general question style that would be employed, the NCHRP documents referenced in the literature review section of this document were reviewed to determine how previous researchers designed survey instruments for Pedestrian/Bicycle Coordinators across United States DOTs (5–7, 10). It was decided by the research group that the instrument would include a mix of multiple choice, sliding scale, multiple selection, and ranking questions with the option to write in responses if desired in some places, and that the goal for survey duration was approximately fifteen minutes. Measures were taken to protect participants identities through reporting data in the aggregate and by agency type without reporting participant information.

The survey instrument is prefaced by a survey consent form which includes a description of the project, benefits and risks of this research, explanation of voluntary participation, participant's rights information, and a participant consent section, followed by an initial question which allows the user to select whether they wish to take the survey. The rest of the instrument is divided into three sections; "Demographics", "When Guidance Documents Are Used", and "Guidance Documents Not Used /

Shortcomings”. The demographics section asks for specific information about the respondent such as agency of employment, job title and email address, followed by a few questions related to how bicycle infrastructure is managed within their agency. The second section contains a variety of multiple selection, ranking, and sliding-scale style questions which ask specifically about guidance documents and how they apply to distinct scenarios related to bicycle infrastructure. The final section is comprised of multiple selection questions which ask for reasons why each of the specific federal guidance documents are not used, and ends with a final write-in question which prompts the respondent to include any additional information they desire. The survey that was sent out to the finalized contacts mentioned above is provided in the appendix.

Design Scenarios Presented to Survey Participants

As noted in the previous section, a set of design scenarios were chosen to present surveyed practitioners with hypothetical use cases for discussion. This section will describe how these specific scenarios are presented for each of the selected guidance documents.

On-Street Bike Lanes

On-street bike lanes are a specific right-of-way for bicyclists which are incorporated onto a roadway, as shown in Figure 1. The UBDG contains information for typical applications of on-street bike lanes, as well as design guidance and benefits of conventional, buffered, contra-flow, and left-sided bike lanes (3). The MUTCD contains information for pavement markings to designate portions of the road for bicyclist use and lane positioning relative to other types of lanes (2). Additionally, the GDBF outlines specific standards by which bike lanes should be designed and maintained and addresses environmental and lane width considerations (4). While the USDG does not discuss on-street bike lanes directly, it does suggest recommendations for general lane widths (8). The SBLPDG also does not specifically contain guidance for on-street bike lanes, as it is a specialized document for separated cycle tracks (9).



Figure 1: Example of an On-Street Bike Lane (11)

Separated Bike Lane

As shown in Figure 2, a separated bike lane protects bicyclists from vehicles by the use of physical barriers or roadway markings. The SBLPDG outlines planning considerations specifically for separated bike lanes (also called cycle tracks or protected bike lanes) and offers several one-and-two-way design options (9). The UBDG provides some information related to one-way protected, raised, and two-way cycle track designs. In contrast, other documents, such as GDBF and MUTCD do not directly provide information on the topic (3). The USDG minimally addresses separated bike lane design, only including a short conversation about their inclusion when considering downtown thoroughfare design strategy (8).



Figure 2: Example of a Separated Bike Lane (3)

Shared-use Pathway

A shared-use pathway is typically designed to accommodate pedestrians, bicyclists, and other non-motorized users, and has limited vehicular cross traffic (as shown in Figure 3). Regarding this treatment, the GDBF provides guidance on shared-path accessibility, characteristics, environmental considerations, and intersection treatments (4). Both the MUTCD and UBDG contain information for pavement markings on shared-use pathways, and the MUTCD includes further information about appropriate signage for this type of infrastructure (2, 3). The USDG briefly mentions shared-use pathways in its section on downtown thoroughfare design, however the information is limited in scope (8). The SBLPDG is also not a comprehensive source of information for shared-use pathway design, including only a short discussion of the differences between separated and shared-use bike lanes (9).



Figure 3: Example of a Shared-Use Pathway (12)

Mitigation of User Conflicts at Intersections

Regarding conflicts between users at intersections, the UBDG contains an extensive section of treatments for roadway user separation, with subsections that specifically address bike boxes, crossing markings, two-stage turn queue boxes, mixing zones, median refuge islands, and through-bike lanes (3). Figure 4 shows a mixing zone, one of the strategies offered in the UBDG (3). The GDBF provides guidelines on how intersections should be designed to ensure safety for all types of pathway users as well as principles for decision-making, including offering suggestions to the designer such as mindfulness of speed variability among various travel modes (4). The SBLPDG identifies considerations to make for the separation of user conflicts at intersections, specifically discussing turning movements, intersection markings, signalization strategies and phasing, offering treatment options for each (9). Regarding intersection design and operation, the USDG proves useful for its investigation of concepts related to safety, mobility, and enhanced public spaces (8). The MUTCD contains information on intersection signage, specifically including guidance for multi-use intersection pavement markings (2).



Figure 4: Example of Roadway User-Conflict Mitigation (3)

Bicycle Signals

Figure 5 shows a bicycle signal, which refers to the implementation of bicyclist-specific sensors and active traffic control. The UBGD presents a discussion on the associated factors of bicyclist signals and contains subsections for multiple treatments such as active warning beacons for bike routes at unsignalized intersections, bicycle signal heads, hybrid beacons for bicycle route crossing of major streets, and signal detection and actuation (3). The USDG can be referenced for recommendations for bicycle signals to improve safety through space and time management, with subsections that address signal cycle lengths and coordinated signal timing (8). The SBLPDG presents several treatments and strategies for signalization to protect bicyclists such as separate signal phases (9). To address improving traffic signals for bicyclists through modifications, the GDBF discusses accommodating bicyclists in the shared-use environment (4). Section 1A.10 of the MUTCD approves interim use of new traffic control devices, revisions of previously approved devices, or other provisions that are not specifically described in the MUTCD but are backed by existing research (2). The MUTCD provides guidance on bicycle signals through interim approval IA-16 in section 1A.10 (13).



Figure 5: Example of a Bicyclist Signal (14)

Results

Survey Response and Cleansing

The survey was sent to the Bicycle/Pedestrian Coordinator of each US state DOT (including Washington, D.C.) and a similar position from the United States' twenty-five most populous cities' DOTs, for a total of 76 possible survey respondents. After cleansing the responses to remove incomplete responses and combine response data from multiple individuals at a single agency, the content from a total of 44 responses were evaluated and the results are presented in the subsequent sections.

Demographics and Bicycle Infrastructure Considerations

The first section of the survey was intended to establish background knowledge about survey respondents and gain an understanding of the role bicycle infrastructure plays within their agency. An initial question prompts respondents to identify their specific job title within their agency. As is shown in

Figure 6, the largest group of respondents are Pedestrian and Bicyclist Coordinators or Engineers of various levels (23 total respondents) while eight each identified as Project Managers and Planners, respectively. Two individuals reported themselves as Complete Streets Directors or Engineers, one coming from a city agency and the other from a state.

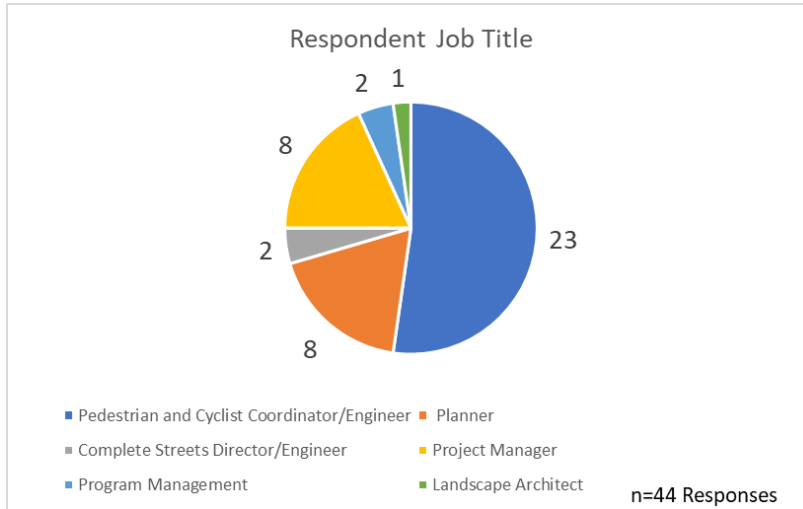
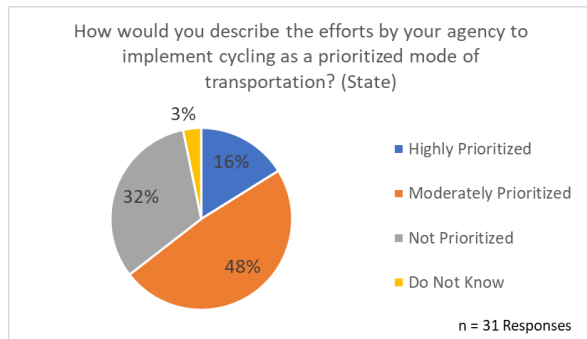
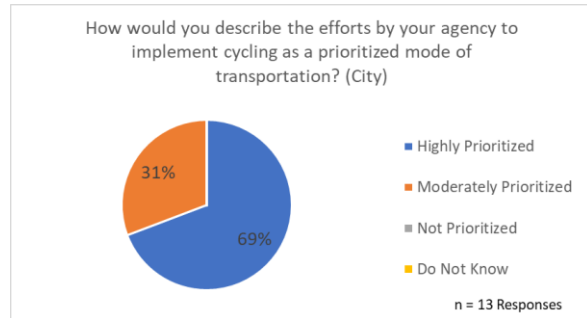


Figure 6: Respondent job title category

The next question from this section prompts respondents to describe their agency’s effort to prioritize cycling as a mode of transportation within the communities they manage. As is shown in Figure 7, the prioritization of cycling as a primary mode of transportation is more common amongst city-based respondents (69% of city respondents report high prioritization compared to 16% of state respondents). It should also be noted that among the pool of city respondents, not a single representative indicated that cycling was not prioritized within their agency, compared to 32% of respondents from the state agency pool.



a: State-agency responses



b: City-agency responses

Figure 7: Agency efforts to implement cycling

The next question prompted respondents to characterize the current usage of cycling infrastructure within their agency. As is shown in Figure 8, responses were similar between the State and City respondents. Fifteen percent of representatives from the city pool indicated high utilization of bicyclist infrastructure, compared to 13% from the state pool. Most responses to this question fell into the “moderately utilized” category, with a response rate of 54% from the city pool and 58% from the state pool.

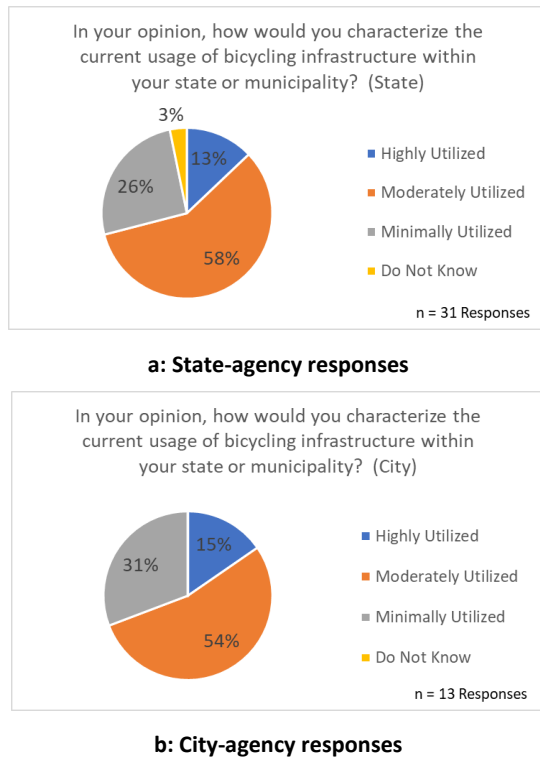
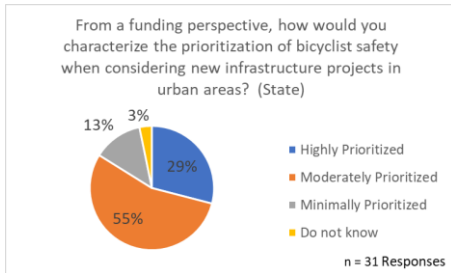


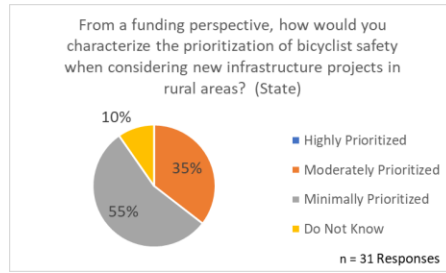
Figure 8: Community characterization of bike infrastructure usage

The next question asked respondents to characterize the prioritization of bicyclist safety when considering new infrastructure projects in urbanized areas. As is shown in Figure 9, respondents among the state pool had a lower prioritization rate of bicyclist safety in urban areas (Figure 9a) compared to the same category from the city respondent pool (Figure 9b). According to city respondents, 31% believe that bicyclist safety is minimally prioritized when considering new infrastructure projects in urban areas (Figure 9b) – a higher rate than what is observed for the same category among the state pool at 13% (Figure 9a). Additionally, 54% of state respondents, versus 29% of city respondents noted that safety is highly prioritized.

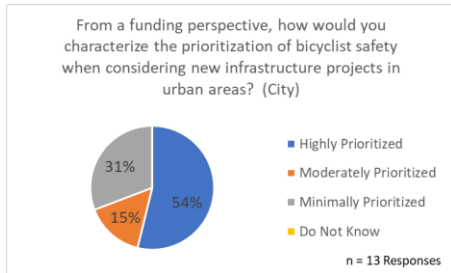
The next question asked about the prioritization of funding for improving bicyclist safety when considering new infrastructure projects in rural areas (see Figure 9). Both state (Figure 9c) and city (Figure 9d) pools indicated the largest response category as “minimally prioritized” with a 55% response rate for state representatives and 38% for city representatives when considering rural areas. It should be noted that 38% of city respondents reported they did not know how bicycle safety was prioritized for new infrastructure projects in rural areas, likely because it is outside the scope of their work.



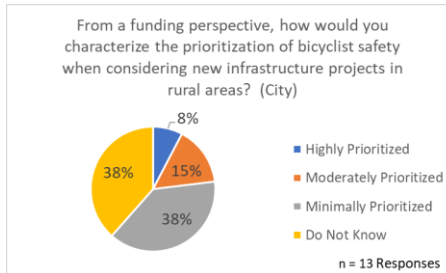
a: State agency responses



c: State agency responses



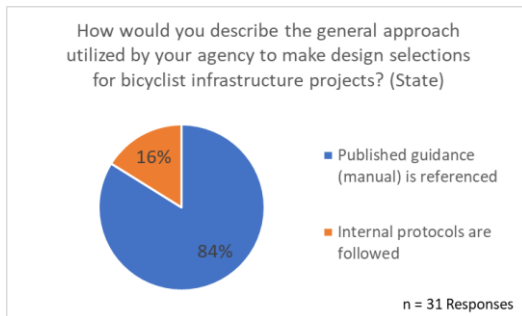
b: City agency responses



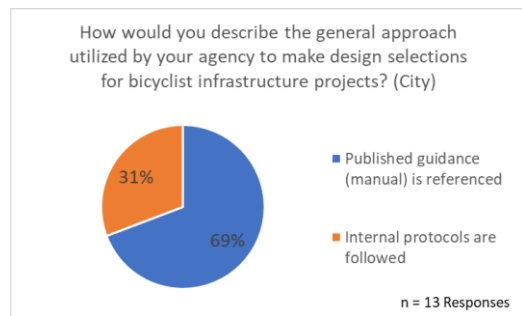
d: City agency responses

Figure 9: Characterization of bicyclist safety through funding

The final question from the first section of the survey asked respondents to select whether published guidance documents were referenced or internal protocols were followed when describing the general approach taken by their respective agencies to make design selections for bicyclist infrastructure projects. As shown in Figure 10, a majority of respondents from both the state and city pools agree that a published guidance document is referenced (84% and 69%, respectively) instead of solely following internal protocols. It should be noted that 31% of responses from the city pool follow internal protocols when making design selections for bicyclist infrastructure projects, while the state pool responses indicate half the rate of the city pool for the same category (16%). This could be because state DOTs typically deal with fewer or less complex bicycle infrastructure contexts than what city personnel must handle, requiring the latter group to reference a more specific guidance protocol.



a: State-agency responses



b: City-agency responses

Figure 10: General agency approach for bicycle infrastructure design selections

When Guidance Documents are Used

The next section of the survey asked questions about specific published guidance documents and how frequently they are referenced for different scenarios in which they are used. The first of these questions prompted respondents to check a box next to a specific document if it is used by their agency for bicycle infrastructure design and operations. As is shown in Figure 11, the most widely utilized document by all agencies is the MUTCD followed by the GDBF (the percentages indicate the share of agency respondents that use a specific document). It can also be observed that in this survey, NACTO guidance documents are used more often among city agencies than they are for states. Additionally, it is also worth noting that over 50% of city respondents indicated using an internal guidance document, while just over a quarter of state respondents indicated using a similar document.

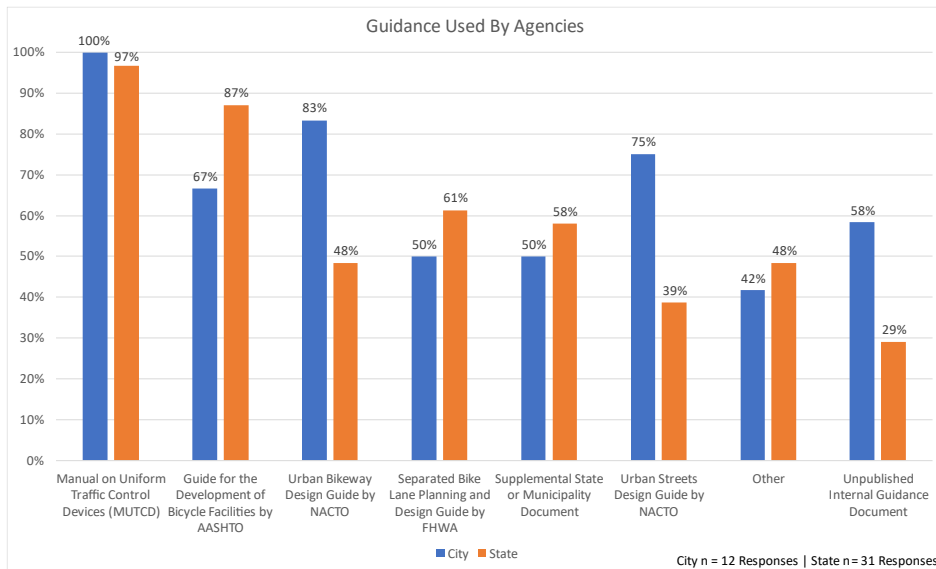


Figure 11: Guidance document usage by agencies

This question also had a write-in option, and 35 respondents provided a response, with the most frequent response indicated an internal-agency guidance document from either the state (16 respondents) or city (7 respondents). Other documents mentioned by survey respondents included an array of FHWA supplemental guides and documents, including the Complete Streets Design Guidelines, and Design Information Bulletins. One respondent from a state agency wrote in the Federal Department of Interior’s Recreational Trails Guidance and the related E-Bike Guidance, representing the only respondent to reference recreational trails.

Document Usage for Specific Scenarios

The next set of questions utilized a slider response which allowed respondents to rate the frequency a guidance document is used for a specific bicycle infrastructure scenario outlined in the question. The slider allowed responses from 0 (agency does not use this document) to 10 (agency always uses this document) and prompts recipients to provide an answer for the MUTCD, UBDG, GDBF, SBLPDG, USDG, and a Supplemental State or Municipality Document.

Figure 12 displays the results of the first of these questions, which asks respondents to rate each document based on its frequency of use when applied to on – street bicycle lanes. Results indicate that for both state and city municipalities, the MUTCD is most frequently utilized. It is also notable that both city and state respondents frequently refer to a supplemental municipality document when working with on – street bike lanes. The GDBF was also a moderately utilized document for this purpose especially among state respondents, receiving an average score of 7.1 among the state agency response pool. This may be related to a preference of state agencies to use federally supported guidelines,

however there was no follow-up question to determine that. The NACTO documents were preferred by cities as opposed to states, a trend that will continue in subsequent responses.

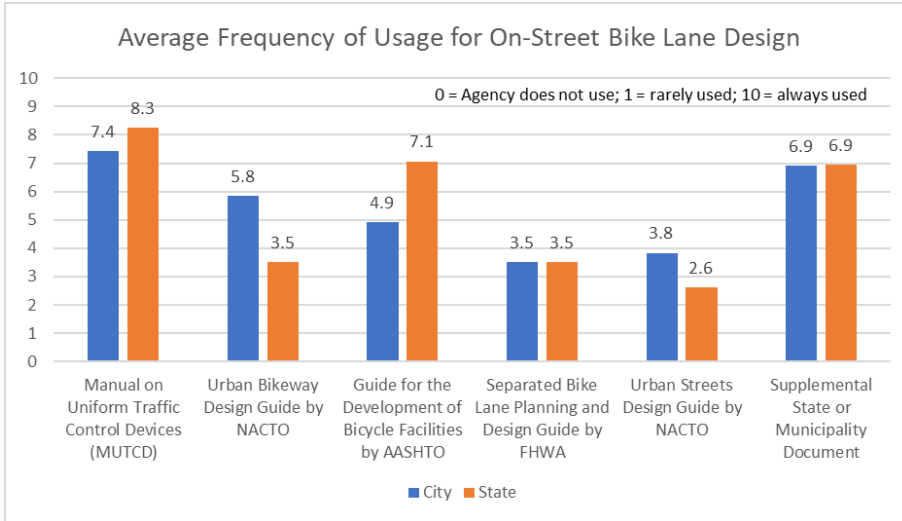


Figure 12: Document usage for On-street bike lane design

The next scenario discussed in this section of the survey referred to the design of separated bicycle lanes. As is shown in Figure 13, the MUTCD and SBLPDG received consistent ratings between state and city respondents. Again, the NACTO documents were noted to be used more often by cities than by states.

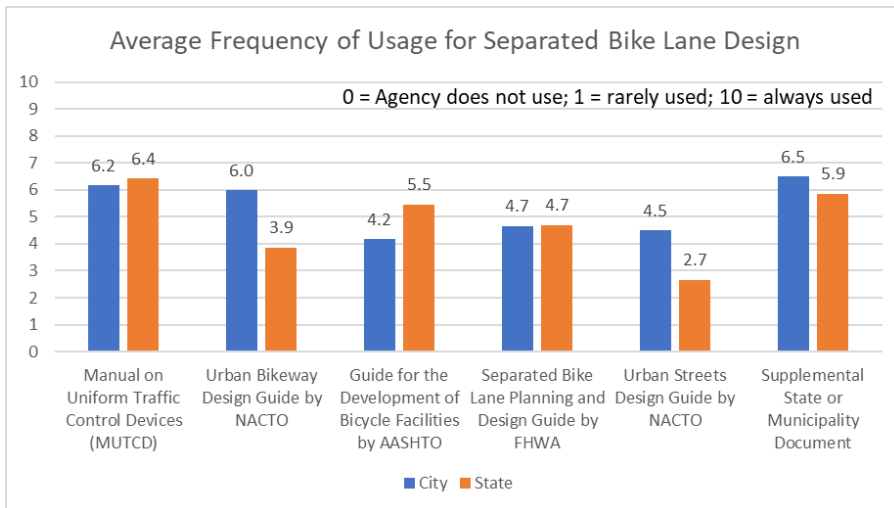


Figure 13: Document usage for separated bike lane design

The next question asked survey recipients to report their frequency of usage of various guidance documents to designing shared – use pathways for bicycle infrastructure. As shown in Figure 14, the NACTO documents exhibit the same trend as seen with previous questions, although neither cities nor states reported using them very often. For this type of design, the MUTCD and GDBF were reported to be used most often as well as supplemental guidance documents.

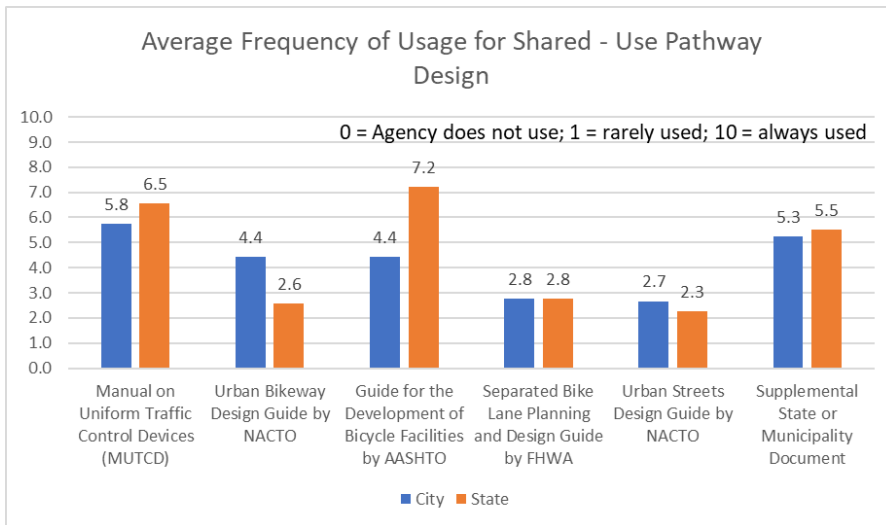


Figure 14: Document usage for shared-use pathway design

The following question asked respondents to report their frequency of usage of the guidance documents for designing infrastructure related to the separation of roadway user conflicts at intersections. Again, cities reported using the NACTO-authored documents more often than states, as is shown in Figure 15. The MUTCD was reported as used most frequently, with scores of 7.2 and 6.5 for city and state respondents, respectively. It should also be noted that over half of the respondents reported using supplemental guidance documents.

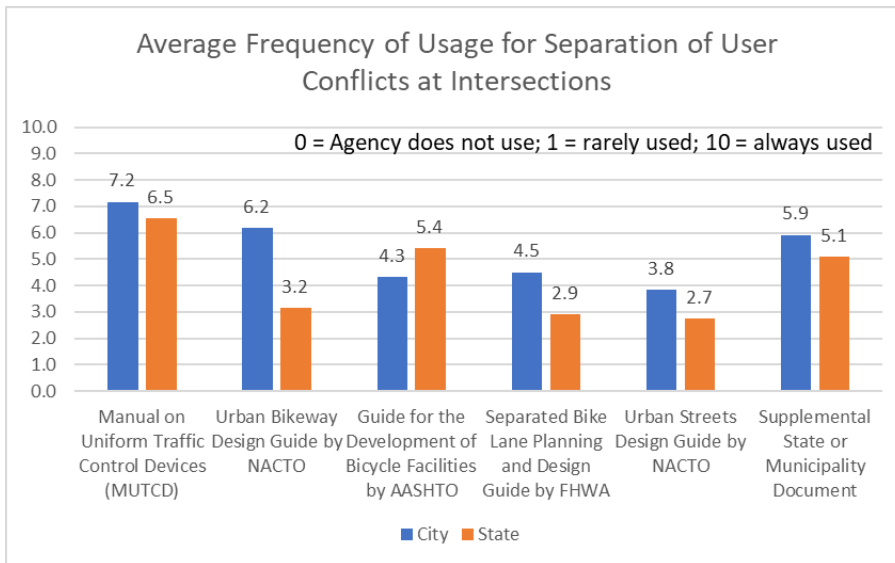


Figure 15: Document usage for separation of user conflicts at intersections

The next question asks about frequency of usage of these documents for bicycle signal design and operation. As is shown in Figure 16, most agencies tended to use the MUTCD and/or supplemental agency document. Aside from those two options, results indicate that other documents in question do not get used frequently, although the UBDG does have a chapter on bicycle signals.

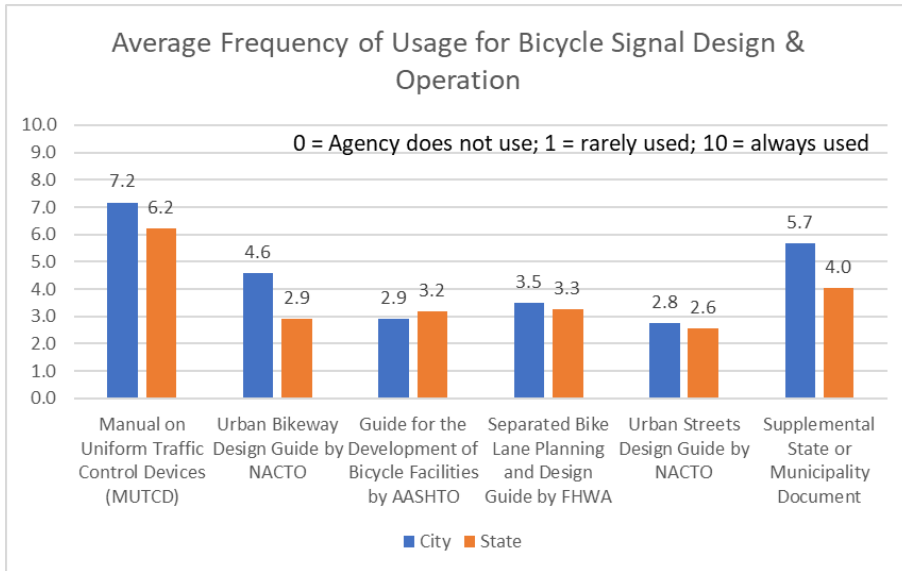


Figure 16: Document usage for bicycle signal design and operation

The final question of this set asks respondents to indicate their frequency of usage of the documents for shared bicycle and motor vehicle lane infrastructure design. As is shown in Figure 17, the MUTCD is reported as being used most often, followed by the supplemental document. The GDBF is noted to be used a little more than half of the time by state respondents, with the UBDG reported as being used 50% of the time city-agency respondents (5.0). Again, cities reported using the NACTO-authored guides more often than states.

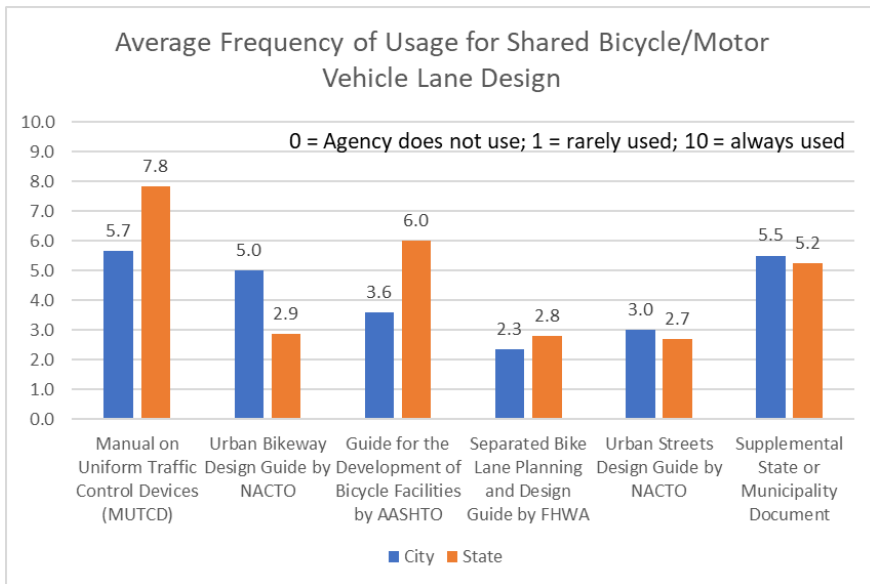


Figure 17: Document usage for shared bicycle/motor vehicle lane design

Figure 18 provides a summary of all responses for six design scenario questions and is useful for making comparisons across the various scenarios. The MUTCD is generally used most often across all documents and respondent pools, followed by supplemental state or municipal documents. Next is the GDBF, followed by the SBLPDG, with the remaining documents likely used only in certain scenarios.

Average Frequency of Usage for Various Scenarios							
Scenario	Agency Type	Manual on Uniform Traffic Control Devices (MUTCD)	Urban Bikeway Design Guide by NACTO	Guide for the Development of Bicycle Facilities Guide by AASHTO	Separated Bike Lane Planning and Design Guide by FHWA	Urban Streets Design Guide by NACTO	Supplemental State or Municipality Document
On-Street Bike Lane Design	City	7.4	5.8	4.9	3.5	3.8	6.9
	State	8.3	3.5	7.1	3.5	2.6	6.9
Separated Bike Lane Design	City	6.2	6.0	4.2	4.7	4.5	6.5
	State	6.4	3.9	5.5	4.7	2.7	5.9
Shared-Use Pathway Design	City	5.8	4.4	4.4	2.8	2.7	5.3
	State	6.5	2.6	7.2	2.8	2.3	5.5
Separation of User Conflicts at Intersections	City	7.2	6.2	4.3	4.5	3.8	5.9
	State	6.5	3.2	5.4	2.9	2.7	5.1
Bicycle Signal Design and Operation	City	7.2	4.6	2.9	3.5	2.8	5.7
	State	6.2	2.9	3.2	3.3	2.6	4.0
Shared Bicycle/Motor Vehicle Lane Design	City	5.7	5.0	3.6	2.3	3.0	5.5
	State	7.8	2.9	6.0	2.8	2.7	5.2
Note: 0 = Agency does not use; 1 = rarely used; 10 = always used							
Legend:		0.0 = not used			used more often = 10.0		

Figure 18: Results for agency usage of different guidance documents related to design scenarios

The last two questions in this section of the survey prompted respondents to rank the guidance documents in question regarding how they service community expectations of bicyclist infrastructure. As is shown in Figure 19, both city and state agencies agreed that the NACTO guidance documents were both the most consistent with what the community wants regarding bicyclist infrastructure. On the other hand, the MUTCD and supplemental guidance books were generally noted as being least in line with community expectations, even though they tended to be used most frequently, as noted from earlier questions. As a federal document, the MUTCD must undergo a lengthy process prior to updates, so its location at the bottom of this list is not surprising.

Please rank the guidance documents below with regards to community expectations of bicyclist infrastructure						
	MUTCD	NACTO Bike Guide	AASHTO Bike Guide	FHWA Separated Bike Lane Plan Guide	NACTO Streets Guide	Supplemental State/Municipality Guide
City Rank	5th	1st	6th	3rd	2nd	4th
State Rank	6th	1st	3rd	4th	2nd	5th
Overall Rank	6th	1st	4th	3rd	2nd	5th

Figure 19: Ranking of guidance documents related to community expectations for bicyclist infrastructure

The following question prompts respondents to rank the documents based on how up to date the document is with respect to the respondent’s expectations of bicycle infrastructure design and operations. Similar to the previous question, the NACTO UBDG is ranked first among both state and city respondents (see Figure 20), however the SBLPDG is listed as second place for both city and state agencies (the USDG moved the third). Again, the MUTCD is at the bottom of this list despite being one of the most frequently utilized documents in many bicyclist planning scenarios previously discussed.

Please rank the guidance documents below with regards to how much each document is up to date based on your experience with bicycle infrastructure design and operations						
	MUTCD	NACTO Bike Guide	AASHTO Bike Guide	FHWA Separated Bike Lane Plan Guide	NACTO Streets Guide	Supplemental State/Municipality Guide
City Rank	5th	1st	6th	2nd	4th	3rd
State Rank	6th	1st	4th	2nd	3rd	5th
Overall Rank	6th	1st	5th	2nd	3rd	4th

Figure 20: Ranking of guidance documents related to frequency of updates

Why Guidance Documents Are Not Used

A question early in the survey prompted respondents to select which guidance documents are used by their agency for bicycle infrastructure design and operations. If respondents didn’t select specific documents this question, they were provided additional questions for each of the documents not selected, with space provided for respondents to provide write-in responses, if desired. The results of these questions are shown in Table 1.

Table 1: Reasons why guidance documents are not used

From the following list, select all options that apply to why the guidance is not used in your agency's facility management of bicycle infrastructure.					
Guidance	Responses	Does not provide enough specific guidance	Too restrictive for safe bicycle design	Other guides provide better design	Other (please enter reason)
Manual on Uniform Traffic Control Devices (MUTCD)	0	0	0	0	0
Guide for the Development of Bicycle Facilities by AASHTO	6	2	2	3	4
Urban Bikeway Design Guide by NACTO	15	2	1	1	12
Urban Streets Design Guide by NACTO	20	5	1	3	15
Separated Bike Lane Planning and Design Guide by FHWA	15	2	0	3	12

One interesting point is that not a single participant indicated they did not use the MUTCD, which implies that everyone uses the document to some degree in their decisions about bicycle facility design. The GDBF, published by AASHTO, had only four respondents who indicated they did not use it. Two stated that it was out of date compared to the state of practice, one claimed they prefer an internal agency document over the GDBF, and another stated that bicycle facility design was outside their scope of work and therefore the guidance was not of use to them.

Regarding documents published by NACTO, the UBDG was indicated as unused by twelve respondents, with half stating they either prefer to use federally recognized documents (FHWA/AASHTO published) or that they find the UBDG conflicts with federal documents in some way. Other respondents indicate a general reluctance of engineers to use the UBDG, that an internal agency document is preferred, or it is found not to be suitable in many applications of their work.

Regarding the USDG, fifteen respondents indicated the document was not used with eight reporting that they prefer to rely on federally published documents or that they find the USDG conflicts with federal documents in some way. Other responses included general reluctance of engineers to use the document, designs within the USDG are too expensive to be practical in many applications, and an internal agency document is preferred.

Regarding the SBLPDG, eleven respondents indicated that they do not use it, with the most frequent reason being that separated bike lanes are not generally designed within their agency. Other write-in responses stated that they prefer an internal guidance document, or that bicycle facilities are outside the scope of their work.

Lastly, with the thought that specific agencies may be able to only use certain documents for legislative reasons, an additional question was asked as to whether a guidance document is not used for liability reasons; the results of this question are shown in Figure 21. Not one respondent selected the MUTCD in response to this question, which is as expected. The two guidance documents published by NACTO received the most responses, which could help explain why a number of agencies indicated they did not use the NACTO documents.

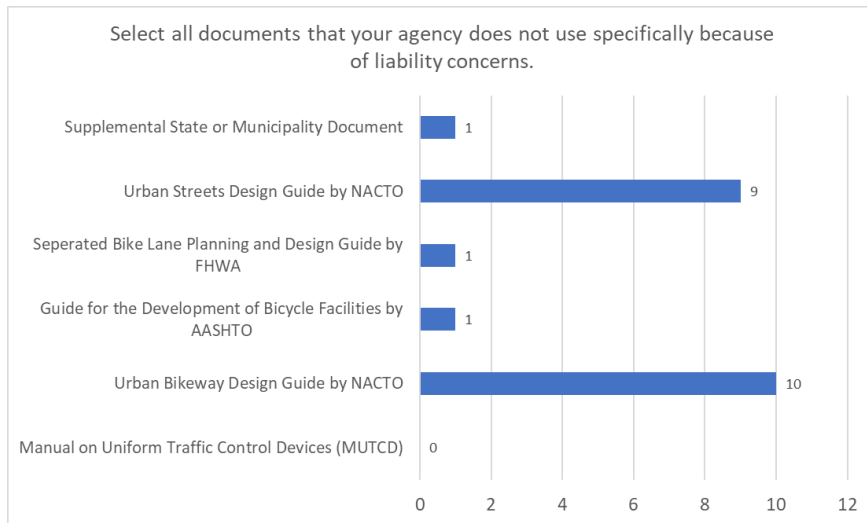


Figure 21: Documents not used due to liability concerns

Additionally Supplied Information from Respondents

The final question of the survey provided a space for respondents to share any additional information they wished to include related to guidance documents for bicycle infrastructure and design. Those responses are summarized in the subsequent sections.

AASHTO and MUTCD Updates and Shortcomings

Of the twelve responses to this write-in section at the end of the survey prompting respondents to offer any additional information they were willing to share, five state and city agencies included information about AASHTO Bike guidance documents and the MUTCD as it relates to bike infrastructure. A few responses noted the outdated nature of both federal guidance documents, with one city representative specifically stating that AASHTO bike guidance does not currently provide facility design recommendations that are consistent with community expectations. One state agency representative noted that physical bike infrastructure design is outside the scope of the MUTCD and that it is therefore not a useful reference for the topic. Two state respondents, however, indicated that they have been involved in the development of updated AASHTO guidance documents which will be published in the near future. One of these respondents also included that the AASHTO updates allow for greater design flexibility and inspiration from guidance found in the Green Book.

Implementation of NACTO Designs

Numerous respondents from both state and local agencies commented on the use of NACTO guidance documents. One response stated that it is helpful when the FHWA announces flexibility on use of specific non-federal guidance like the ones produced by NACTO. Another state respondent indicated that recent inter-agency publications show that a movement toward Complete Streets legislation and use of Level of Traffic Stress as a metric for decision-making will increase use of NACTO documents. The

only agency respondent representing a city to comment on the topic stated that their city is currently piloting multiple NACTO-inspired designs which allow the city to move forward with more protected bicyclist facilities.

Reliance on Outside Consultation for Bicycle Facility Design

A theme which emerged specifically among state-agency respondents was a dependence on using outside consultants when planning bicycle infrastructure design. One such respondent indicated that while they did not specifically use some of the guidance documents included in this survey, their outside consultant may use a wider array. Another state-agency respondent claimed that they were currently conducting numerous Road Safety Audits for bicyclist/pedestrian facilities and simultaneously encouraging their design consultants to recommend standard changes to be considered for future implementation.

Conclusions

After completing analysis of relevant literature and survey results, while a wealth of information on bicycle infrastructure planning is available, practitioners still face challenges when deciding which guidance documents to use for various scenarios. The survey instrument administered to Pedestrian/Bicyclist Coordinator positions from fifty state and twenty-five DOT agencies revealed several themes:

First, while two federally published guidance documents (MUTCD and GDBF) are the most frequently referenced and are held as the standard for bicyclist infrastructure planning and design by some, they both are sparsely updated and may not align with community expectations. However, numerous respondents noted that the GDBF will be receiving an update in the near future and it will include important considerations from modern guidance documents and allow for greater flexibility of planning design.

Second, it is evident that city and state agencies prioritize guidance document usage differently from one another related to the different design scenarios discussed. While state agency respondents rely largely on the MUTCD and GDBF, city agencies seem to utilize a greater range of guidance including the UBDG and USDG from NACTO. As previously noted, this could be a result of city agencies requiring more intensive guidance to address the complicated scenarios which arise while planning multimodal traffic infrastructure in cities that ensure safety for all users. It is also revealed that many state agencies may not engage in the planning and design of bicycle infrastructure within their agency since it is outside of their scope and instead turn to outside contractors for these considerations. It should also be noted that agencies frequently rely upon a supplemental document produced within the state or municipality when making decisions about various infrastructure design scenarios.

Considerations and Areas for Future Work

The results of this research reveal a wide range of strategies for bicycle infrastructure planning across DOT agencies in the United States. A total of 44 unique survey responses were received and overall revealed that cities often utilize a wider array of guidance to make decisions, and place a higher priority on making improvements to bicyclist infrastructure. Based on the results of this survey, there is potential for agencies to reference where other practitioners are turning for their information on specific scenarios and which documents others believe are most aligned with community expectations

and the state-of-practice. It is also clear that the use of supplemental documents within an agency is common and likely possess a wealth of information and may be updated more frequently than other guidance. The results from this study reveal several areas where future work could streamline the planning process further, such as:

- Expanding the survey group to reach more practitioners from different agencies around the United States,
- Review survey results for geographical differences, the impact of urban vs. rural communities, and the impact of climate / weather,
- Comparing the supplemental guidance documents which both state and city agencies rely on for informing decisions about many different scenarios, including research about how frequently they are updated compared to the recognized guidance documents discussed in this study,
- Identifying the types of content contained in supplemental guidance documents to determine if they might contain unique content (which might represent research needs within this domain) and, if not, understanding why there is reliance on internal documents when content may be available in nationally recognized documents, and
- Follow up with respondents to conduct interviews with respondents and acquire a deeper understanding of the decision-making process around traffic design scenarios.

This work aimed to provide guidance regarding choice of design document for those charged with making bicycle infrastructure at all levels of agencies across the United States. Several themes were identified throughout this work, and recommendations were made on how to further this work in an effort to assist managing agencies to select and use the most applicable guidance document that meets their agency's needs. In the effort to reach balanced transportation in urban areas, doing so helps to include cycling as an integrated travel mode and to make improvements in mobility and safety for its users.

References

1. 2020 Bicyclists and Other Cyclists Traffic Safety Fact Sheet. National Highway Traffic Safety Administration, Jun, 2022.
2. Manual on Uniform Traffic Control Devices (MUTCD). Federal Highway Administration, Jul, 2022.
3. National Association of City Transportation Official. *Urban Bikeway Design Guide, Second Edition*. Island Press, 2014.
4. AASHTO Task Force on Geometric Design. *Guide for the Development of Bicycle Facilities*. American Association of State Highway and Transportation Officials, Washington, D.C., 2012.
5. Louch, H., K. Voros, and E. David. *Availability and Use of Pedestrian Infrastructure Data to Support Active Transportation Planning*. Transportation Research Board, Washington, D.C., 2020.
6. Thomas, L., N. Thirsk, and C. Zegeer. *Application of Pedestrian Crossing Treatments for Streets and Highways*. Transportation Research Board, Washington, D.C., 2016.
7. Kay, J., T. Qu, T. Gates, P. Savolainen, C. Zu, D. Seguin, and J. Burley. *Synthesis of National Best Practices on Pedestrian and Bicycle Design, Guidance, and Technology Innovations*. Publication SPR-1708. Michigan State University, 2022.
8. National Association of City Transportation Official. *Urban Street Design Guide*. Island Press, 2013.
9. Separated Bike Lane Planning and Design Guide. Federal Highway Administration, May, 2015.
10. Perrin, R., B. Huff, M. Flynn, C. Brown, and C. Vinyl. *Practices for Selecting Pedestrian and Bicycle Projects*. Transportation Research Board, Washington, D.C., 2021.
11. 2008: New Bike Lanes in New York City. *NYC Bike Maps*. <https://www.nycbikemaps.com/spokes/2008-new-bike-lanes-in-new-york-city/>. Accessed Jul. 4, 2023.
12. Shared Use Path Planning Primer. Massachusetts Department of Transportation, Aug, 2018.
13. Lindley, J. INFORMATION: MUTCD – Interim Approval for Optional Use of a Bicycle Signal Face (IA-16). Dec 24, 2013.
14. Schoenemann, C. New Bicycle Signal Lights Added to Busy Intersections in Central Austin. *CBS Austin*. <https://cbsaustin.com/news/local/new-bicycle-signal-lights-added-to-busy-intersections-in-central-austin>. Accessed Jul. 4, 2023.

Data Management Plan

Products of Research

The data described and analyzed for this report was developed through a survey sent to practitioners from the 50 states of the United States including the district of Columbia and the top 25 most populous cities, survey respondent data were collected. This data set was cleaned, summarized, and analyzed, with results and other data presented in this report.

Data Format and Content

The data set collected and analyzed for this report are formatted as an Excel Workbooks (.xlsx) file. This .xlsx data file have been uploaded to Harvard Dataverse containing the cleansed results of the survey completed for this report.

Data Access and Sharing

The data set used in this report can be found on Harvard Dataverse (<https://doi.org/10.7910/DVN/WZGVNA>).

Reuse and Redistribution

Data that is published on Dataverse may be reused and redistributed for research purposes with permission from this report's Principal Investigator.

Appendix

Northern Arizona University (NAU) queried Bicycle/Pedestrian Coordinator or similar position using the questionnaire provided below.

ii Do you wish to take the survey?

- Yes, I agree and wish to begin the survey.
- No, I do not agree and do not wish to participate in the survey.

1.0 This section asks questions related to your role within your agency and how bicyclist infrastructure is managed.

1.1 Which agency do you work for?

1.2 What is your email address?

1.3 What is your official job title?

1.4 How would you describe the efforts by your agency to implement cycling as a prioritized mode of transportation?

- Highly Prioritized
- Moderately Prioritized
- Not Prioritized
- Do not know

1.5 In your opinion, how would you characterize the current usage of bicycling infrastructure within your state or municipality?

- Highly Utilized
- Moderately Utilized
- Minimally Utilized
- Do not know

1.6 From a funding perspective, how would you characterize the prioritization of bicyclist safety when considering new infrastructure projects in urban areas?

- Highly Prioritized
- Moderately Prioritized
- Minimally Prioritized
- Do not know

1.7 From a funding perspective, how would you characterize the prioritization of bicyclist safety when considering new infrastructure projects in rural areas?

- Highly Prioritized
- Moderately Prioritized
- Minimally Prioritized
- Do not know

1.8 How would you describe the general approach utilized by your agency to make design selections for bicyclist infrastructure projects?

- Published guidance (manual) is referenced
- Internal protocols are followed
- Do not know

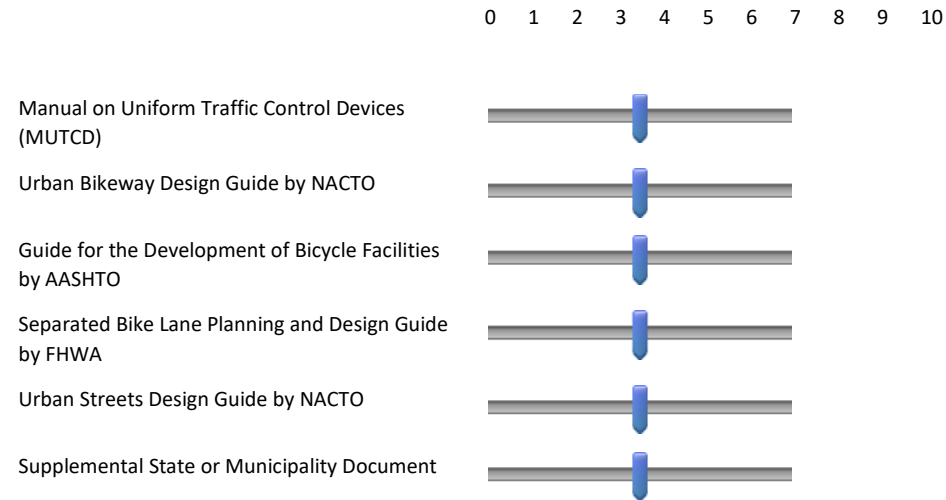
2.0 This section asks questions related to how specific guidance documents are utilized by your agency.

2.1 Please select which guidance documents are used by your agency for bicycle infrastructure design and operations. Check all that apply.

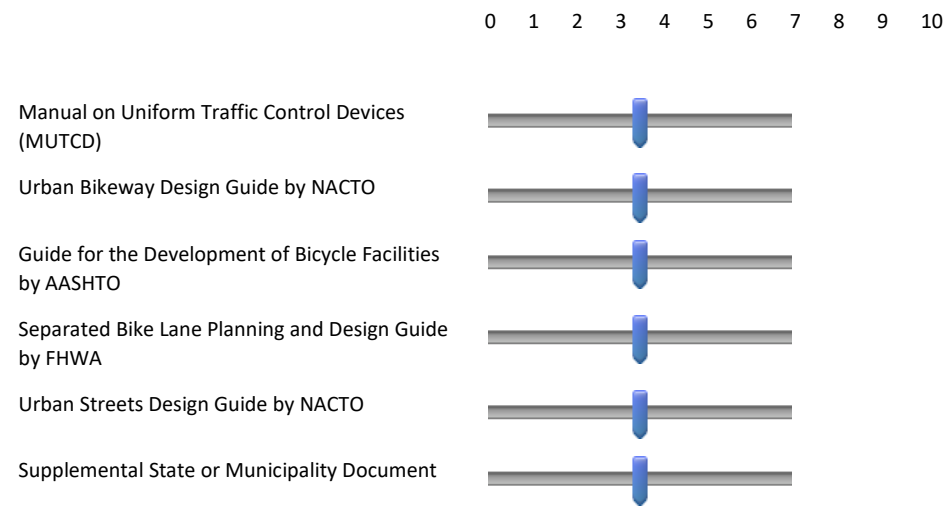
- Manual on Uniform Traffic Control Devices (MUTCD)
- Urban Bikeway Design Guide by NACTO
- Guide for the Development of Bicycle Facilities by AASHTO
- Separated Bike Lane Planning and Design Guide by FHWA
- Urban Streets Design Guide by NACTO
- Supplemental State or Municipality Document
- Unpublished Internal Guidance Document (Please fill in name of guidance if selected, and link, if available) _____
- Other (Please specify name of Guidance Document if selected, and link if available)

Prioritizing Bicyclist Safety and Mobility: Which Guidance Do I Use?

2.2 Rate how frequently each guidance document is used for on-street bike lane design. (0 = agency does not use; 1 = rarely used; 10 = always used)

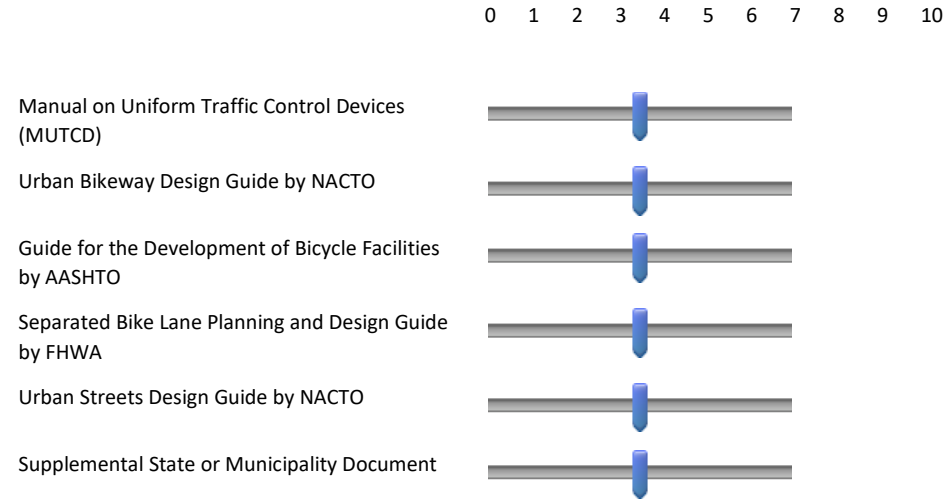


2.3 Rate how frequently each guidance document is used for separated bike lane design. (0 = agency does not use; 1 = rarely used; 10 = always used)

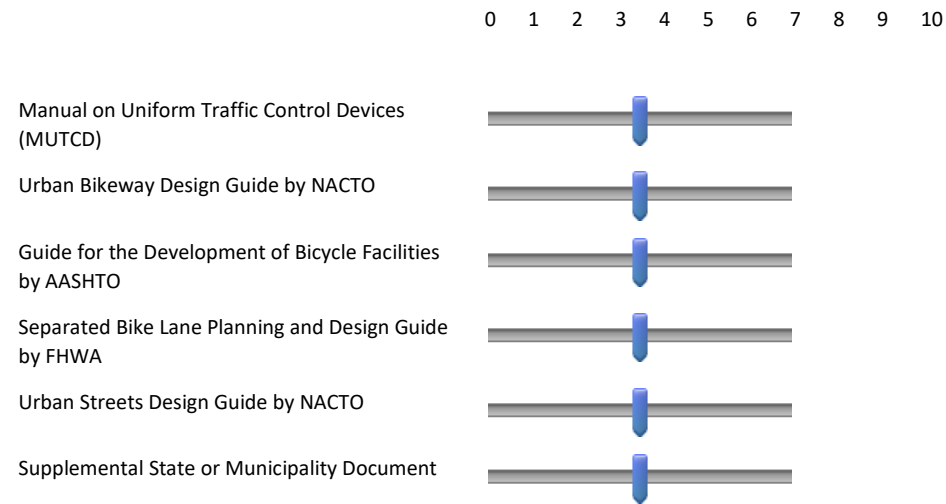


Prioritizing Bicyclist Safety and Mobility: Which Guidance Do I Use?

2.4 Rate how frequently each guidance document is used for shared-use pathway design. (0 = agency does not use; 1 = rarely used; 10 = always used)

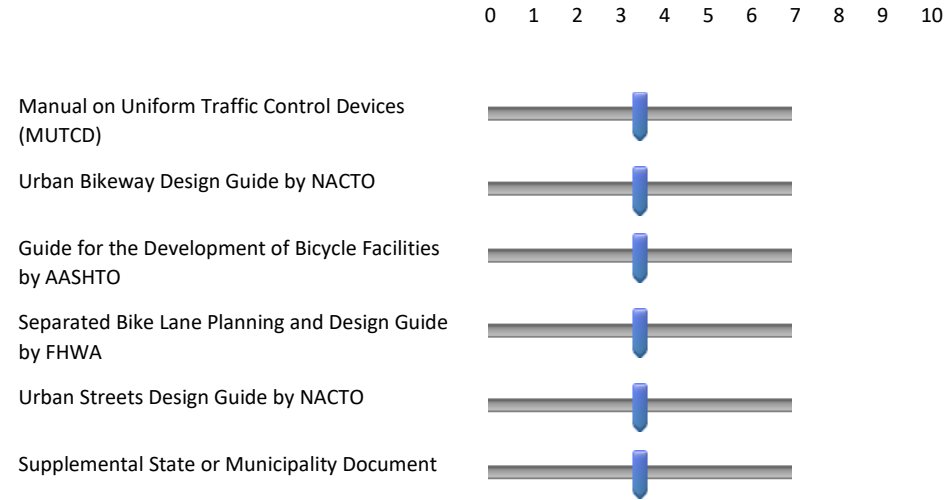


2.5 Rate how frequently each guidance document is used for separation of user conflicts at intersections. (0 = agency does not use; 1 = rarely used; 10 = always used)

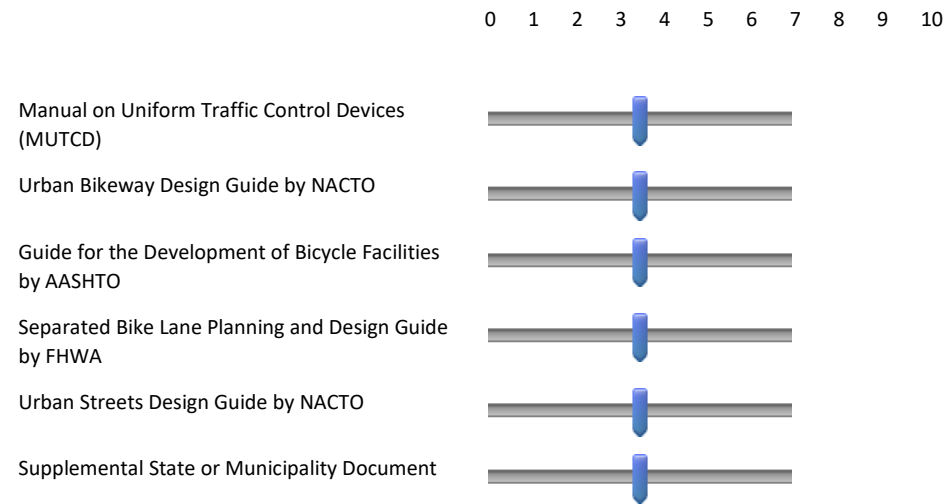


Prioritizing Bicyclist Safety and Mobility: Which Guidance Do I Use?

2.6 Rate how frequently each guidance document is used for bicycle signal design and operation. (0 = agency does not use; 1 = rarely used; 10 = always used)



2.7 Rate how frequently each guidance document is used for shared bicycle/motor vehicle lane design. (0 = agency does not use; 1 = rarely used; 10 = always used)



2.8 Please rank the guidance documents below with regards to community expectations of bicyclist infrastructure. (1 = most closely in line with community expectations, 6 = least closely in line with community expectations)

- _____ Manual on Uniform Traffic Control Devices (MUTCD)
- _____ Urban Bikeway Design Guide by NACTO
- _____ Guide for the Development of Bicycle Facilities by AASHTO
- _____ Separated Bike Lane Planning and Design Guide by FHWA
- _____ Urban Streets Design Guide by NACTO
- _____ Supplemental State or Municipality Document

2.9 Please rank the guidance documents below with regards to how much each document is up to date based on your experience with bicycle infrastructure design and operations. (1 = most up to date, 6 = least up to date)

- _____ Manual on Uniform Traffic Control Devices (MUTCD)
- _____ Urban Bikeway Design Guide by NACTO
- _____ Guide for the Development of Bicycle Facilities by AASHTO
- _____ Separated Bike Lane Planning and Design Guide by FHWA
- _____ Urban Streets Design Guide by NACTO
- _____ Supplemental State or Municipality Document

2.10 Select all documents that your agency does not use specifically because of liability concerns.

- Manual on Uniform Traffic Control Devices (MUTCD)
- Urban Bikeway Design Guide by NACTO
- Guide for the Development of Bicycle Facilities by AASHTO
- Separated Bike Lane Planning and Design Guide by FHWA
- Urban Streets Design Guide by NACTO
- Supplemental State or Municipality Document

3.0 This section asks questions related to why specific guidance documents are not utilized by your agency.

3.1 From the following list, select all options that apply to why the Manual on Uniform Traffic Control Devices (MUTCD) is not used in your agency's facility management of bicycle infrastructure.

- Does not provide enough specific guidance
- Too restrictive for safe bicycle design
- Other guides provide better design
- Other (please enter reason) _____

3.2 From the following list, select all options that apply to why the Guide for the Development of Bicycle Facilities by AASHTO is not used in your agency's facility management of bicycle infrastructure.

- Does not provide enough specific guidance
- Too restrictive for safe bicycle design
- Other guides provide better design
- Other (please enter reason) _____

3.3 From the following list, select all options that apply to why the Urban Bikeway Design Guide by NACTO is not used in your agency's facility management of bicycle infrastructure.

- Does not provide enough specific guidance
- Too restrictive for safe bicycle design
- Other guides provide better design
- Other (please enter reason) _____

3.4 From the following list, select all options that apply to why the Urban Streets Design Guide by NACTO is not used in your agency's facility management of bicycle infrastructure.

- Does not provide enough specific guidance
- Too restrictive for safe bicycle design
- Other guides provide better design
- Other (please enter reason) _____

3.5 From the following list, select all options that apply to why the Separated Bike Lane Planning and Design Guide by FHWA is not used in your agency's facility management of bicycle infrastructure.

- Does not provide enough specific guidance
- Too restrictive for safe bicycle design
- Other guides provide better design
- Other (please enter reason) _____

4.1 Please share any additional information you wish to include related to guidance documents for bicycle infrastructure and design. Thank you for your time!
