

On-Street Bikeway Feasibility Study

Energy Efficiency through Regional Planning

August 2014



This study looks at energy efficiency, changing demographics, economic development opportunities, and public health benefits. It provides options for communities to implement on-street bike facilities, highlighting priority corridors and inter-city connections while considering trails, current bikeways, and employment centers.

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CONTENTS

1 Executive Summary.....	2
Purpose.....	2
Feasibility	2
Map.....	3
2 Methodology	4
Joint Subcommittee	4
Analysis	4
Review	5
3 Mapping.....	6
Proposed Bikeway Network.....	6
Missing Connections.....	6
Recommended Facility Types	6
Road Diets.....	6
4 Future Roads.....	9
TIP Review	9
Complete Streets Policy.....	9
5 Design Standards	10
Signage + Markings	10
Treatment Recommendations.....	10
Facility Design Recommendations.....	17
6 Education Needs	20
Appendix A NACTO Guidance	
Appendix B Complete Streets Policy	

1 | EXECUTIVE SUMMARY

PURPOSE

With goals laid out in *The Tomorrow Plan* and *Mobilizing Tomorrow*, the region is seeing a shift in focus towards resilient economies, healthy environments, and the health and well-being of all residents. This study provides assistance with reaching these goals by developing a regional on-street bikeway feasibility plan to shift more users from automobile to non-motorized transportation modes, thereby reducing short motor vehicle trips that have high per-mile fuel consumption and emission rates.

Changing demographics show that young professionals and baby boomers have a greater interest in living in dense walkable neighborhoods that are bike-friendly and accessible to multiple transportation options. Neighboring cities in the Midwest have become aware of this change of interest and are being proactive with their efforts to implement extensive on-street bikeway networks. The City of Minneapolis has been ranked as one of the best biking cities in the country by Bike Score, and the 2nd best biking city in the nation by Bicycling Magazine. Currently, Minneapolis has 92 miles of on-street bikeways and had a bike commuting rate of 4.1 percent in 2010, up from 1.9 percent in 2000. To be marketable and to maintain growth in the region, Greater Des Moines needs to focus on these demands of the millennial and baby boomer generations.

Promoting active transportation options benefits the public health in multiple ways. First, it supports a healthier lifestyle that allows people to not be as dependent on their automobile when making shorter trips. Second, crash rates have been proven to decrease on corridors that have undergone road diets, therefore increasing safety. In Des Moines, Ingersoll Avenue was converted to a 3-lane, with bike lanes in both directions and parking on each side. After the conversion, the total number of reported crashes with injuries decreased by 30 percent. A 2006 study by Iowa State University looked at twelve 3-lane conversions and found similar results to Ingersoll Avenue with a 29 percent reduction in the number of crashes.

This study is part of a solution to provide people with the necessary on-street facilities to support bicycle commuting. Before implementing extensive on-street networks, cities such as Minneapolis and Portland had very low commuting rates much like Des Moines. In 2010, Portland had the highest bicycle commuting rate in the nation at 6.1 percent, up from 1.8 percent in 2000. By adding an extensive on-street network, the city was able to drastically increase its bike commuting rate.

Additional economic development, health and safety, and community development benefits can be found by visiting PeopleForBikes.org.

FEASIBILITY

The intent of this study is to provide options for communities as they begin implementing on-street facilities. It asks the question, “What is feasible?” To answer that question, various factors were assessed to determine roads that currently have the capability to handle an on-street facility. It highlights corridors and inter-city connections that involve primarily low-cost road conversions that are relatively simple to do (i.e., Ingersoll Avenue).

Before communities install facilities identified in this study, a more in-depth analysis should be completed on the route to determine whether an alternative route along the same general corridor should be used or not.

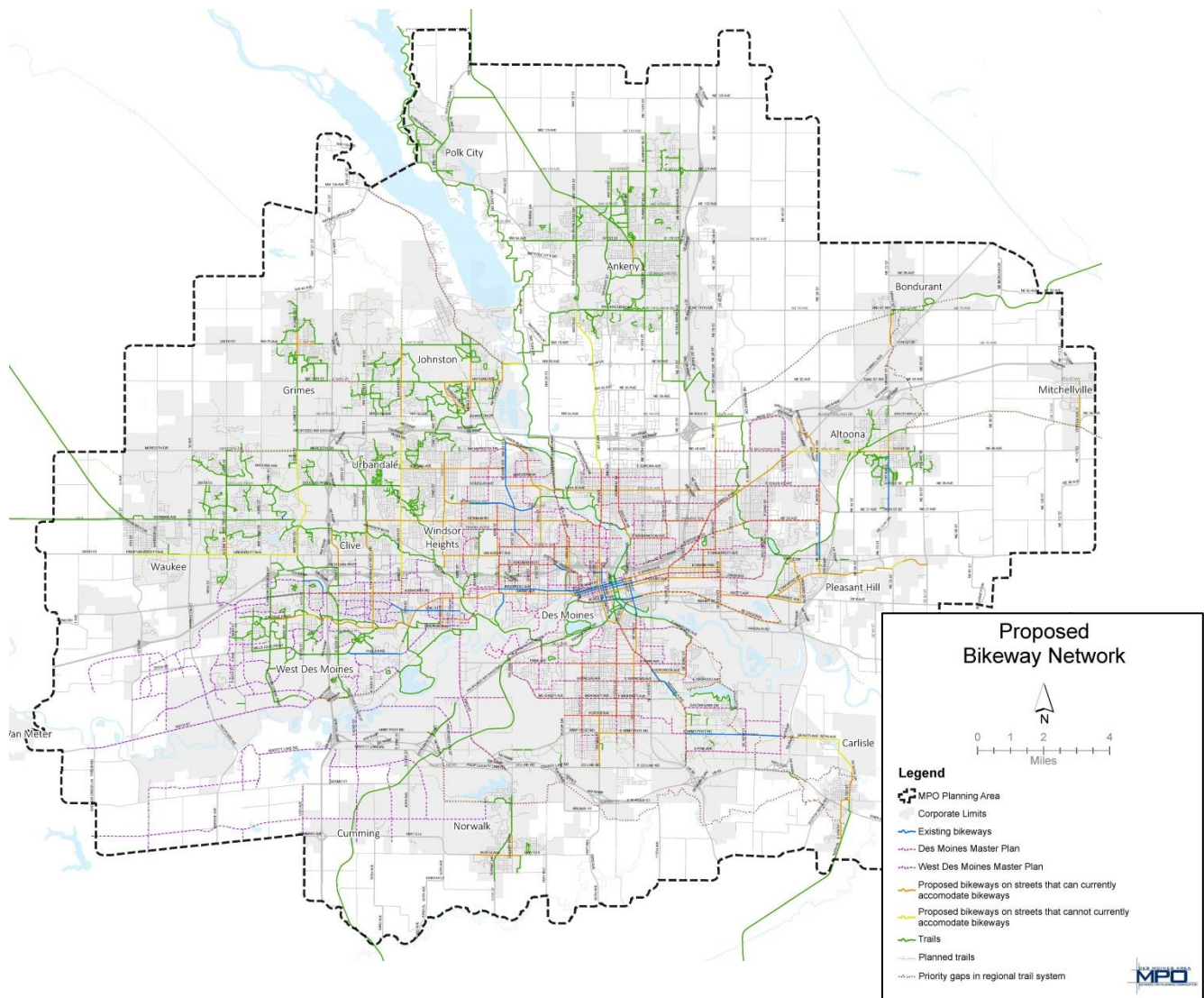
This study simply provides a recommendation for where there is potential for easy, low-cost conversions that would accommodate on-street facilities.

MAP

The proposed bikeway network was developed using guidance from the National Association of City Transportation Officials (NACTO). This guidance assessed existing roads based on their posted travel speeds, traffic volumes, and street classification. In addition to this guidance, street widths were also looked at. Local streets were not included in the analysis to develop the proposed bikeway network. Speed limits and traffic volumes tend to be low enough on local streets, allowing for it to already be considered bike-friendly.

Using the guidance from NACTO, all roads in the region that have potential for on-street accommodations were identified and mapped. From there, additional layers were assessed to develop an efficient and well-connected bikeway network for the region. A final map includes the proposed bikeway network that highlights corridors for on-street biking. A second map includes the recommended facility types to be installed on each of the corridors.

FIGURE 1 | PROPOSED BIKEWAY NETWORK



2 | METHODOLOGY

JOINT SUBCOMMITTEE

To assist with the development of this study, a joint subcommittee made up of representatives from both the MPO's Bicycle and Pedestrian Roundtable and the Engineering Subcommittee, was formed. This subcommittee included the following people:

- Vern Willey, Community Services Director, City of Altoona
- Dave McKay, Director of Engineering – Public Works, City of Urbandale
- Jennifer McCoy, City Traffic Engineer, City of Des Moines
- Mike Ring, Principal Traffic Engineer, City of Des Moines
- Mindy Moore, Park Planner II, City of Des Moines
- Mark Arentsen, City Administrator, City of Bondurant
- Joe Cory, Deputy Public Works Director, City of West Des Moines
- Cory Scott, Urban Planner, RDG Planning + Design
- Carl Voss, Des Moines Bicycle Collective
- David Fliehler, Shive-Hattery Architecture + Engineering

The subcommittee met several times over a four-month period to review/discuss several different topics, including the City of Des Moines' Bicycle Master Plan and the City of West Des Moines' Draft Bicycle Master Plan, the Bicycle Collective's Bike Commuter Map, a macro-level on-street bikeway network design, standards for the design of facilities and signage/markings to go along with them, and education needs.

ANALYSIS

As previously mentioned, this study used guidance from the National Association of City Transportation Officials (NACTO) to develop a regional bikeway network for the MPO planning area that offered recommendations for what types of facilities get implemented and where they are located based on several factors. The following factors were assessed for all existing, non-local streets in the region:

- Posted travel speed (mph)
- Annual Average Daily Traffic (AADT)
- Street Federal Functional Classification (FFCS)

This analysis mainly looks at existing streets that would create a network which, in theory, could be implemented today, with recommended facility types based on the characteristics of those streets. The following facility types from the NACTO guidance were considered when making recommendations:

- **Shared lane marking:** marking that is applicable on roadways where speed differential between motorists and bicyclists is low and/or to fill short gaps in the bikeway network.
- **Bike lane:** exclusive space for bicyclists through the use of pavement markings and signage (without buffers or barriers).
- **Buffered bike lane:** traditional bike lane separated by painted buffer to vehicle travel lanes and/or parking lanes.
- **Cycle track:** physically separated bikeway. Could be one or two way and protected by a variety of techniques.

Certain facility types included in the NACTO guidance were not considered in this study. The first one, neighborhood greenway, is defined as a comfortable and attractive bicycling environment that doesn't utilize physical separations. Neighborhood greenways are found on local streets, where traffic volumes and speed limits are low. As previously mentioned, these streets could already be considered bike-friendly and wouldn't need extra markings and/or signage to identify it as that. The second type not considered is a shared use path, defined as being completely separated from a roadway. Since this study's purpose is to create an on-street network, shared use paths do not apply.

Facility types were recommended based on the factors listed above. Depending on the amount of traffic, the posted speed limit, and the street classification, a specific facility type would get recommended for each road segment. A detailed breakdown of the NACTO guidance can be found in [Appendix A](#) of this report.

In addition to using the NACTO guidance, various other layers were assessed to ensure that the proposed network is well-connected and provides efficient routes for riders to choose from. These layers included the following:

- Des Moines Bicycle Collective Commuter Map
- Existing facilities (trails/on-street)
- Planned facilities (trails/on-street), including the Des Moines Bicycle Master Plan and West Des Moines Draft Bicycle Master Plan
- Employment centers
- Transit routes (DART)
- Inter-city connections

Connecting the regional network to each of these layers is crucial to its success as it shows where people are already going and where communities are already investing their money and time. Also, by connecting to each of the layers, inter-city connections will be made as these factors are spread out across multiple jurisdictions.

REVIEW

Throughout the process of developing this study, feedback was sought after from various MPO committees that included city/county staff and elected officials. A draft version of the proposed bikeway network map was presented to the following MPO committees for comments and feedback:

- Central Iowa Bicycle and Pedestrian Roundtable;
- Planning subcommittee;
- Engineering subcommittee;
- *Mobilizing Tomorrow* steering committee;
- Transportation Technical Committee; and
- Policy Committee.

Additionally, the draft proposed bikeway network map was posted to the MPO's website and included in the June MPO newsletter to give the public an opportunity to provide feedback.

3 | MAPPING

Two critical maps were created as outcomes of this study. The first map displays the proposed bikeway network, overlaid with various other bicycle and pedestrian layers. A second map provides recommendations for the type of facility that could be installed on each of the routes in the regional network. The Proposed Bikeway Network and Recommended Facility Types maps are included on the following pages. These maps are best viewed digitally where you can zoom further into areas of interest.

PROPOSED BIKEWAY NETWORK

The proposed bikeway network map incorporates multiple layers to establish an extensive, well-connected system for Greater Des Moines. The network includes proposed routes from the City of Des Moines' Bicycle Master Plan and the City of West Des Moines' draft Bicycle Master Plan, existing on- and off-street facilities, priority gaps in the regional trail system, and additional proposed on-street routes identified using the NACTO guidance. Proposed on-street routes provide connections to the off-street system, and are viewed as the priority corridors to complete an extensive regional bikeway network. Priority corridors can be found in the **Proposed Bikeway Network** map.

MISSING CONNECTIONS

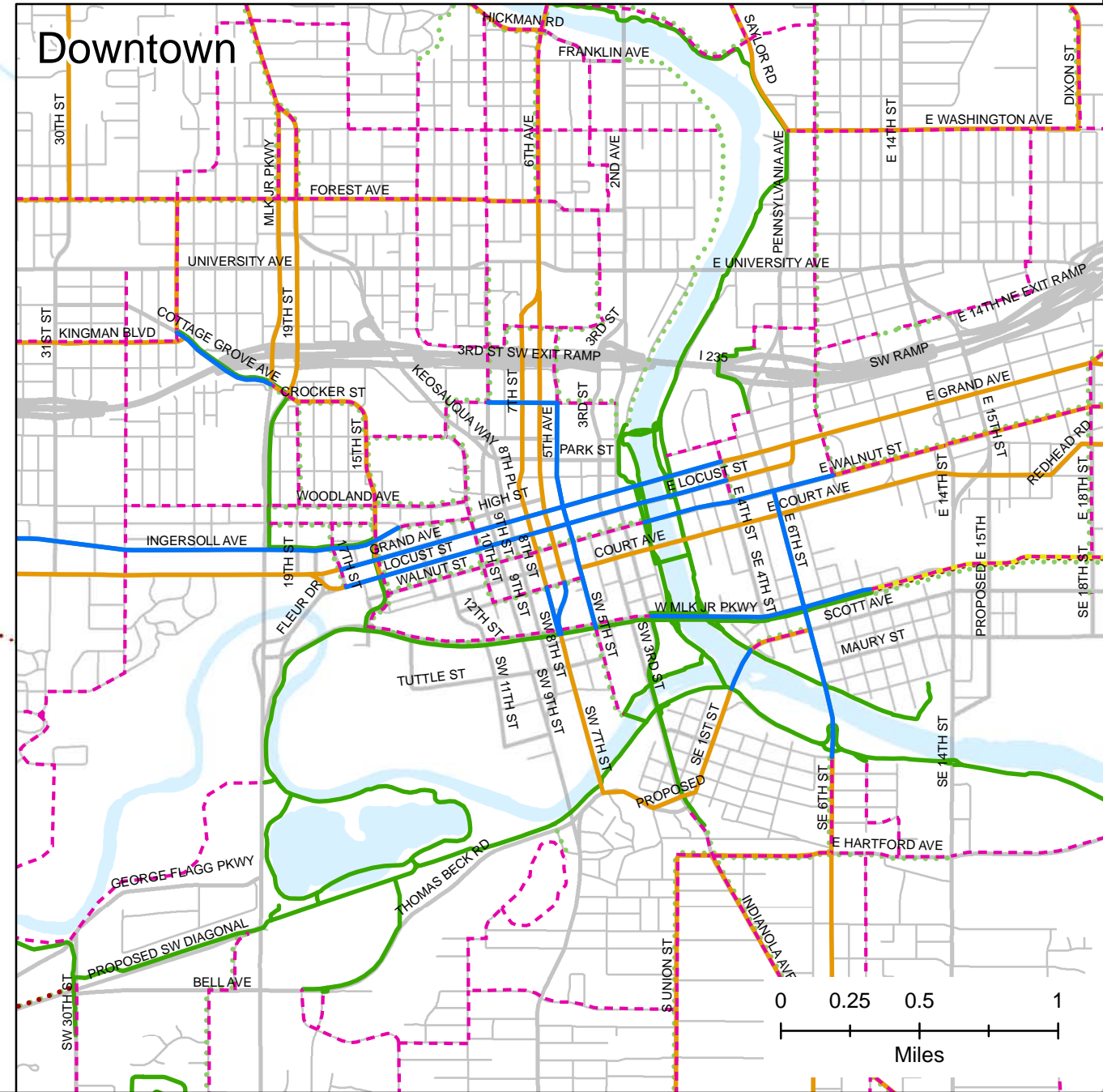
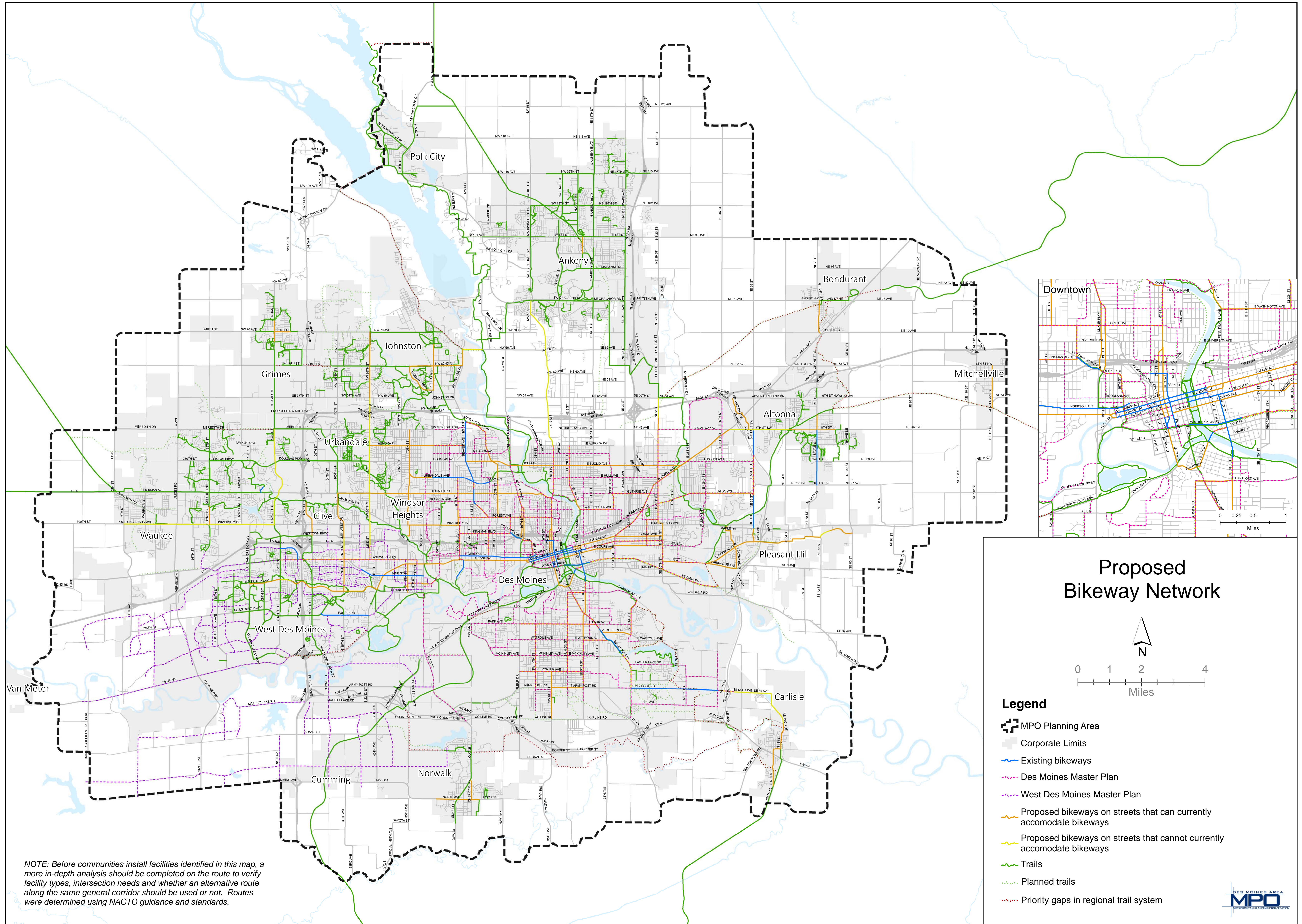
A majority of the routes included in the proposed on-street network are ones that would involve simple, low-cost conversions based on road widths, speed limits, and traffic volumes. However, gaps were still present in parts of the region. Gaps existed in areas where roads are currently not capable to accommodate on-street facilities, or in some cases, where a road currently does not exist. They were viewed as necessary to include in the network as they created important connections to certain areas in the region. These gaps were identified in the proposed bikeway network with a different color to make aware of the fact that these routes could be more costly and require major improvements to the road.

RECOMMENDED FACILITY TYPES

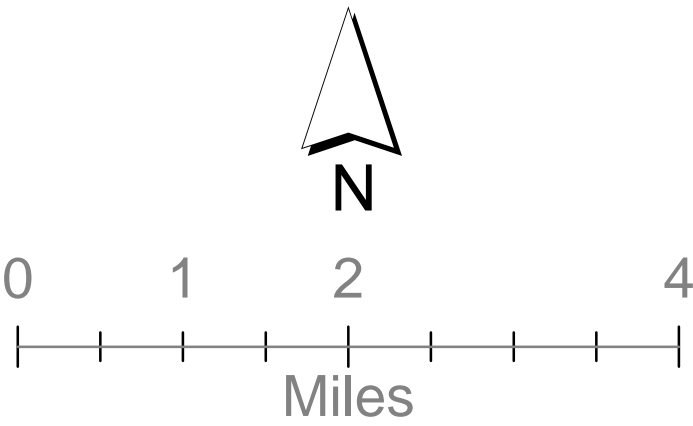
Using the NACTO guidance, facility types were identified for each of the proposed on-street routes in the network. Recommendations were not made for all of the planned routes in Des Moines' Bicycle Master Plan and West Des Moines' Draft Bicycle Master Plan, as facility types have already been determined for these routes. Occasionally, multiple facility types were indicated for the same route segment. For these instances, a facility type was chosen based on consistency with the entire corridor or route and the level of separation for the facility type (higher level of separation results in higher levels of user comfort). Recommendations can be found in the **Recommended Facility Types** map.

ROAD DIETS

Routes identified through this mapping process primarily include projects that would involve a road diet. Road diets happen when the number of lanes is reduced to improve safety and allow space for other modes of travel. For example, a four-lane road may be reduced to three-lanes, with one travel lane in each direction and a turning lane in the middle. Applying road diets to routes on the proposed bikeway network will allow for more space to include an on-street bike facility. An example of a local road diet project is the Ingersoll Avenue project in Des Moines. More information on road diets can be found at <http://safety.fhwa.dot.gov/>.

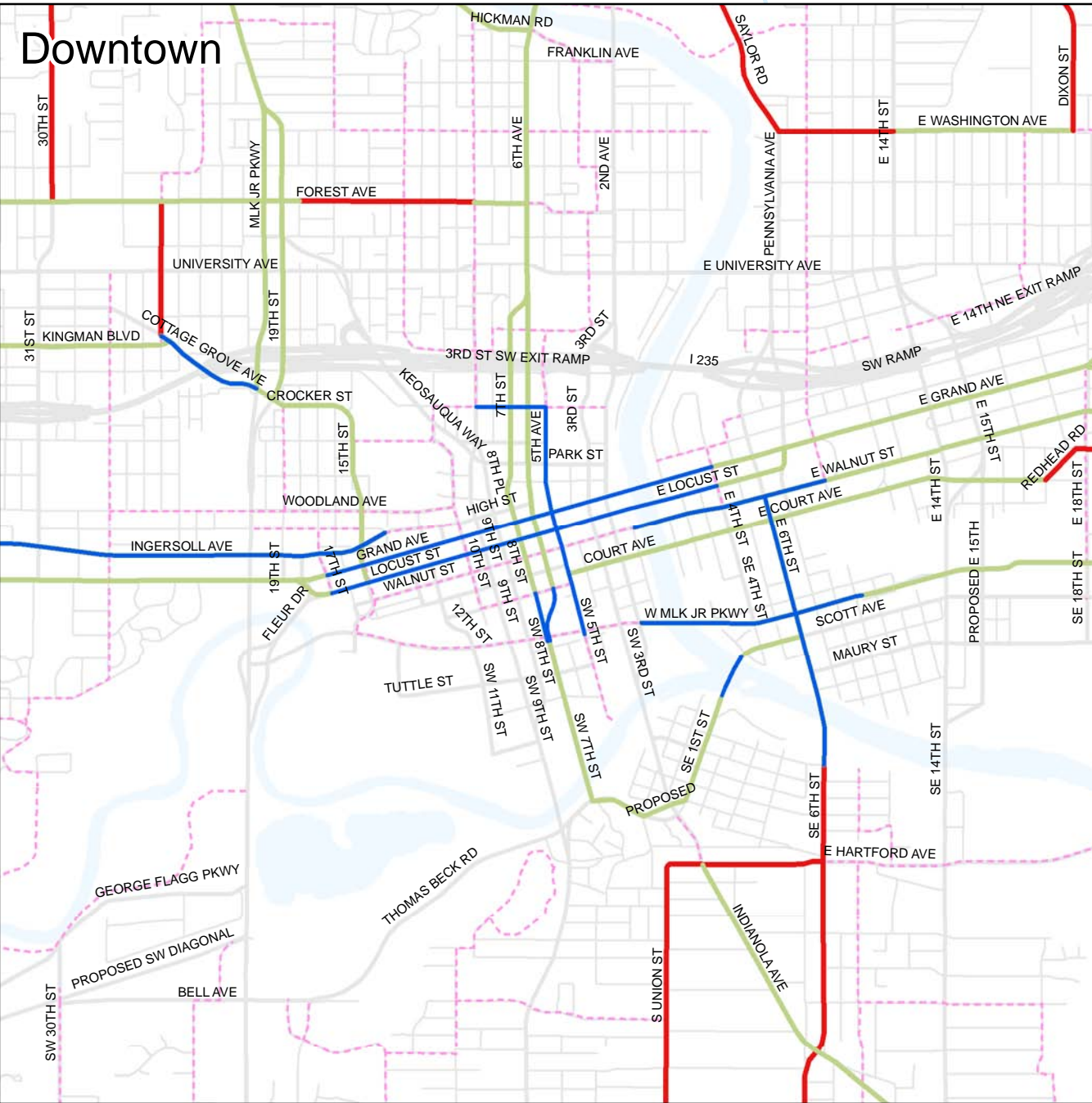
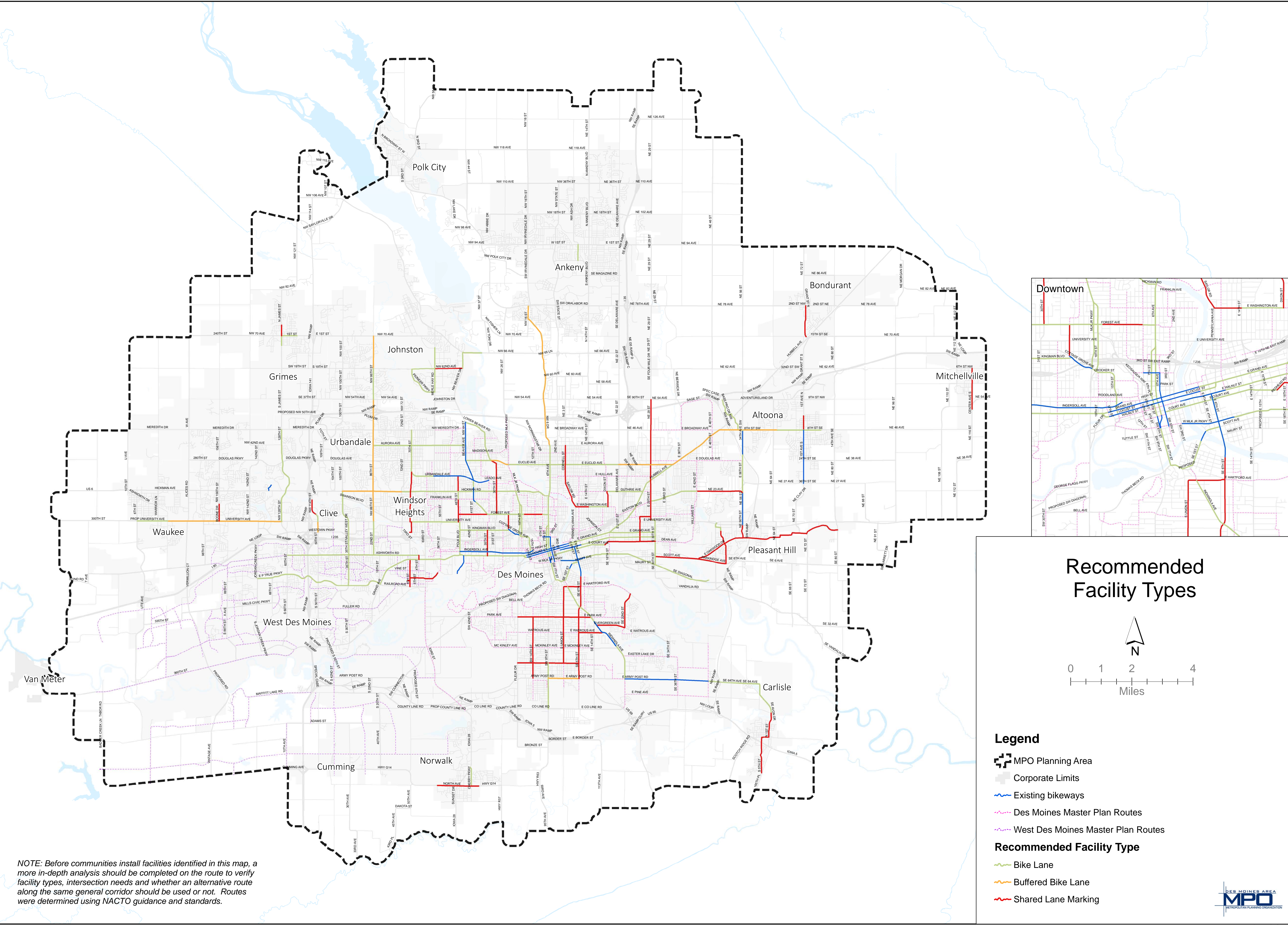


Proposed Bikeway Network

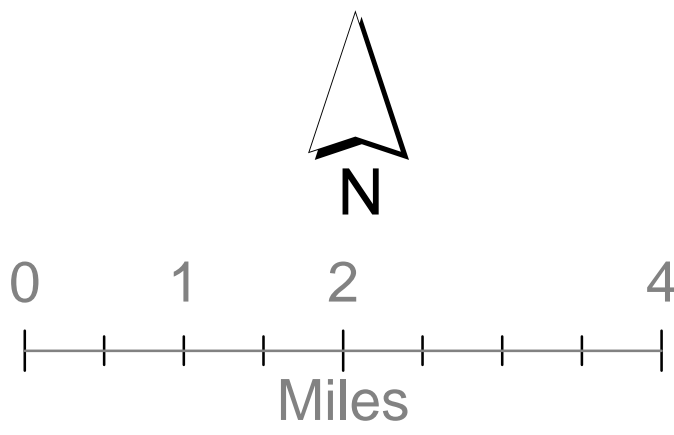


- Legend**
- MPO Planning Area
 - Corporate Limits
 - Existing bikeways
 - Des Moines Master Plan
 - West Des Moines Master Plan
 - Proposed bikeways on streets that can currently accomodate bikeways
 - Proposed bikeways on streets that cannot currently accomodate bikeways
 - Trails
 - Planned trails
 - Priority gaps in regional trail system

NOTE: Before communities install facilities identified in this map, a more in-depth analysis should be completed on the route to verify facility types, intersection needs and whether an alternative route along the same general corridor should be used or not. Routes were determined using NACTO guidance and standards.



Recommended Facility Types



- Legend**
- MPO Planning Area
 - Corporate Limits
 - Existing bikeways
 - Des Moines Master Plan Routes
 - West Des Moines Master Plan Routes
 - Recommended Facility Type**
 - Bike Lane
 - Buffered Bike Lane
 - Shared Lane Marking

4 | FUTURE ROADS

Future roads were not included in the development of the proposed bikeway network¹ with the intent that new roads would already be considering on-street bikeway possibilities. In addition to that, many communities in the region that have built new roads, are doing so with trails alongside them to provide links to the regional trail network.

TIP REVIEW

Using the MPO's Transportation Improvement Program (TIP), road projects programmed out to 2018 were assessed to determine whether or not they are located on segments of the proposed bikeway network. If a project is located on the network, and the cost of incorporating on-street facilities does not exceed twenty percent of the total project cost, it would be recommended that the project sponsor work with MPO staff to try and incorporate an on-street facility into the project.

The following projects programmed in the [Federal Fiscal Year 2015-2018 Transportation Improvement Program](#) are located on the proposed bikeway network and should consider on-street facilities:

Year	Location/Description	Sponsor
2015	NW 66 th Ave: From NW Beaver Dr to NW 26 th St – Grade and Pave, Pavement Widening, Bridge Replacement	Des Moines
2015	SE Connector: From SE 15 th St to SE 30 th St – Grade and Pave, ROW	Des Moines
2015	E Indianola Avenue: SE 16 th Ct to Army Post Rd – Grade and Pave, ROW	Des Moines
2015	E Euclid Ave: From east of US 69 east 0.8 mile and from I-235 to Hubbell Ave – Pavement Rehab	MPO-26/DMAMPO
2015	Hickman Rd: From 3 blocks west of 63 rd St to 1 block south of Hickman Rd – Scenic or Historic Hwy	Windsor Heights
2015	Downtown Bicycle Plan implementation	Des Moines
2017	Euclid Ave: Highland Park Streetscape from 6 th Ave to Cornell St	Des Moines
2017	SE Connector: From SE 30 th St to US 65 – Grade and Pave, Traffic Signals, ROW	Des Moines
2017	US 6: From I-35/80 to Merle Hay Rd – Pavement Rehab	MPO-26/DMAMPO
2018	Indianola Ave: From E Army Post Rd to US 69 – Pavement Widening	Des Moines
2018	E Douglas Ave: From E 42 nd St to E 56 th St – Grade and Pave, Pavement Widening, ROW	Des Moines

COMPLETE STREETS POLICY

Looking beyond currently funded projects, it would be recommended that future road projects applying for funding from the MPO would need to comply with a Complete Streets policy. By adopting a Complete Streets policy, transportation planners and engineers in the region will routinely design and operate right-of-ways to allow safe access for all users, resulting in healthier and improved street networks. An example Complete Streets policy for the MPO can be found in [Appendix B](#).

¹ With the following exceptions: routes identified in city bike master plans, proposed University Avenue in Waukee, SE Connector extension, and Meacham Drive extension in Pleasant Hill.

5 | DESIGN STANDARDS

SIGNAGE + MARKINGS

An important element of implementing on-street facilities in a new area is both education within the community and continuity among design elements to convey the intended method of use. In efforts to provide on-street facilities with the same look and feel, the subcommittee identified signage and markings as an area to review the current design standards and provide guidance where appropriate. The intent is to provide on-street facilities, regardless of type, that look and feel the same throughout the metro area. For the user, this not only offers a facility that is familiar and easy to navigate, but also has a unique identity.

NACTO provides three levels of guidance: Required, Recommended and Optional. Required and Recommended Features are elements necessary for the facility's proper function and safety. It is suggested that these features are adhered to wherever possible. Optional Features however, are elements that can vary across cities and may add value depending on the circumstance. The subcommittee felt it was important to evaluate the Optional Features and provide guidance where possible. Cities such as West Des Moines and Des Moines who have already implemented on-street facilities were also consulted as part of the process to help determine what facility types and practices are currently being used within the surrounding metro area.

Ultimately the subcommittee identified seven key areas to provide guidance.

- Bike Lane and Shared Lane Markings
- Intersection Crossing Treatments
- Bicycle Signal Detection
- Pavement Marking Material Guidance
- Green Lanes and Bike Boxes
- Facility Signage
- Route Wayfinding

TREATMENT RECOMMENDATIONS

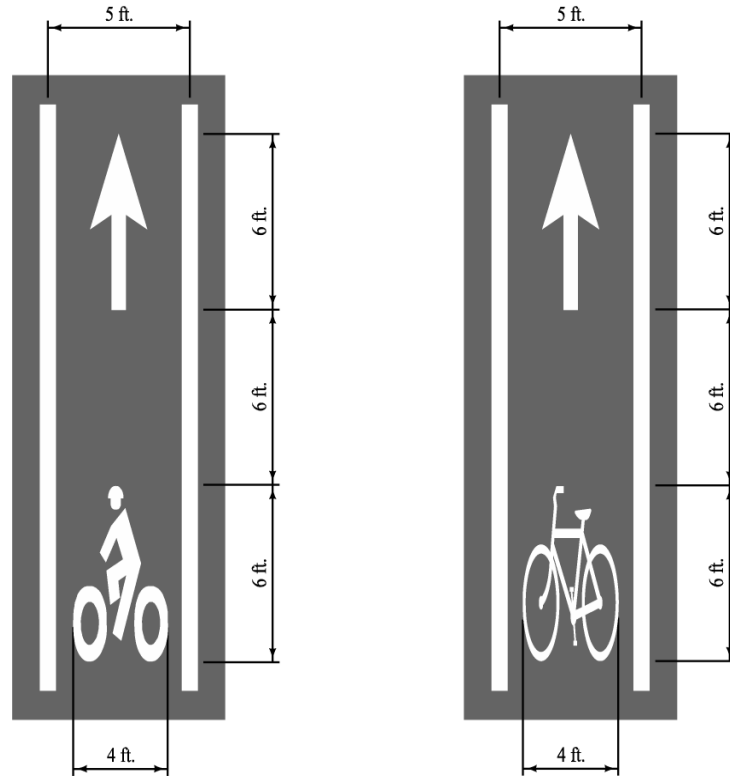
BIKE LANE AND SHARED LANE MARKINGS

Two of the most frequently used on-street bicycle treatments are bike lanes and shared lanes. Review of existing guidance through National Association of City Transportation Officials (NACTO), Iowa Statewide Urban Design and Specifications (SUDAS), and Manual for Uniform Traffic Control Devices (MUTCD) guide books identified two acceptable bicycle lane markings as shown in **Figure 2**. At minimum, the bicycle symbol shall be used to define the preferential use of the bike lane. The MUTCD designates the directional arrow as optional, however it is listed as a Required Feature through NACTO.

RECOMMENDATION

The subcommittee recommends the helmeted bicyclist symbol in conjunction with the directional arrow be implemented as a minimum treatment for all future bike lanes in the MPO Planning Area. Refer to the [NACTO Urban Bikeway Design Guide](#) for placement of symbols. Intervals of placement shall not exceed 1000 feet. A cycle track, like a bike lane, is a preferential lane as defined by the MUTCD; therefore, the same symbol marking recommendations for bike lanes shall also apply to cycle tracks.

FIGURE 2 | BIKE LANE SYMBOL MARKING



Source: SUDAS

The City of Des Moines has over 4 miles of bike lanes in the Downtown area, as well as designated quiet streets marked by Shared Lane Markings (SLM). The traditional shared lane marking as defined by the MUTCD consists of two chevron “V” markings with a bicycle symbol (**Figure 3**). To minimize the cost of purchasing additional stencils, the City of Des Moines was granted approval through the FHWA to utilize the same helmeted bicycle symbol on shared lane markings as used to designate bike lanes (**Figure 4**).

RECOMMENDATION

The subcommittee recommends the use of the helmeted SLM. By using the helmeted symbol, the shared lane marking not only remains consistent with the markings used to designate bike lanes, but also minimizes cost to the local agency. Refer to the [NACTO Urban Bikeway Design Guide](#) for placement of symbols. Intervals of placement shall not exceed 500 feet.

FIGURE 3 | TRADITIONAL SLM



FIGURE 4 | HELMETED SLM



INTERSECTION CROSSING TREATMENTS

Though intersections make up a small portion of a cyclists travel distance, they are one of the most hazardous areas, accounting for approximately 50 percent of all bicycle-vehicle accidents. While guidance is provided through NACTO and the MUTCD on intersection crossing markings, it is a suggested treatment. The City of Des Moines reserves use of any bicycle specific intersection crossing treatments for unconventional crossings or maneuvering and is the exception, as opposed to normal practice.

RECOMMENDATION

The subcommittee suggests the decision to implement intersection crossing markings be left to engineering judgment and the discretion of the local agency.

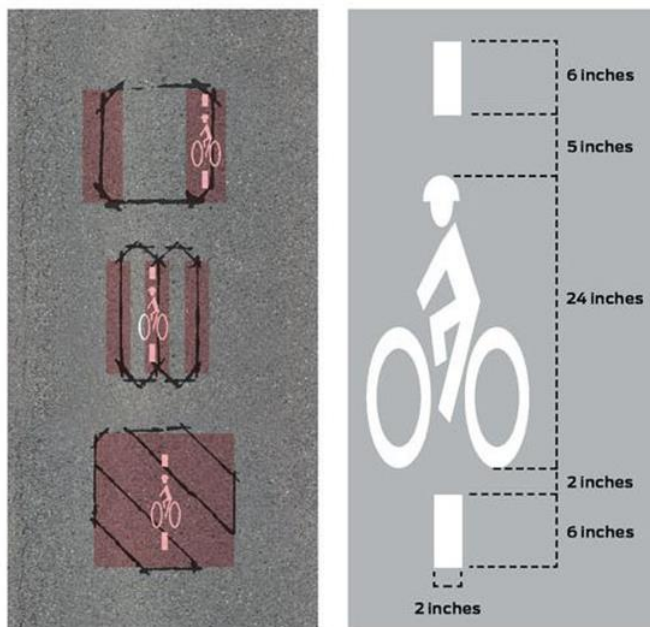
BICYCLE SIGNAL DETECTION

Bicycle signal detection occurs either by the use of a push button or by automation (inductive pavement loops, cameras, radar, etc.). A common issue cyclists encounter when navigating a signalized intersection is where to position their bicycle to activate the traffic signal. For a bicycle to be detected the bicycle must be placed within the red highlighted areas as shown on **Figure 5** and the inductive loop has to be adjusted to a higher sensitivity to detect the metallic mass of the bicycle. Otherwise, undetected cyclists are forced to wait for a vehicle, dismount and press a pedestrian button, or cross illegally. Pavement markings and signage are used to properly position the cyclist on the inductive loop or zone if using other means of detection with the highest sensitivity. In addition to increasing the sensitivity of the detector, NACTO and the MUTCD recommends use of a helmeted bicyclist symbol marking the location of the most sensitive area of the traffic sensor (**Figure 5**), and a R10-22 sign (**Figure 6**) so that the bicyclist knows the intersection has detection and where to position their bicycle to activate the signal.

RECOMMENDATION

The subcommittee recommends bicycle detection pavement markings and signage be provided at any intersection where an on-street bicycle facility is located and actuation is required to call the signal. Signs shall be mounted in a visible location in front of or adjacent to the bicycle detector pavement marking. The pavement marking shall be placed over inductive loops as shown in **Figure 5**.

FIGURE 5 | BICYCLE DETECTOR PAVEMENT MARKING



Source: NACTO

FIGURE 6 | R10-22



Source: MUTCD

PAVEMENT MARKING MATERIAL GUIDANCE

There are three main types of pavement markings in use: non-durable waterborne paint, Epoxy-based Durable Liquid Pavement Markings (DLPM), and thermoplastics.

Non-durable paint is the least expensive and the most widely used in the United States. The average installed price of non-durable paint is roughly \$4 per linear 100 feet or \$1.20 - \$1.60 per square foot. Advantages of non-durable paint include quick dry times (under 30 minutes depending on ambient temperatures) and minor surface preparation. Glass beads for reflectivity and skid resistance may be added to the paint; however, they are often worn down with high traffic and snow removal. The main disadvantage of the non-durable pavement markings is that in snowy climates or high traffic areas, they rarely hold up for more than six months to a year.

Durable Liquid Pavement Markings (DLPM) are either an epoxy or acrylic based resin. The average installed bid item price is approximately \$25 per linear 100 feet or \$3 - \$4 per square foot. More costly than non-durable paint, DLPM's can last 3-5 years depending on conditions. Reflective and non-skid materials may also be added to DLPM's, however there are some disadvantages to be mindful of. Because DLPM's are epoxy or acrylic based, dry times can require more than an hour. They are also more sensitive to existing oils on the pavement and require more surface preparation over non-durable paint. The lifetime of DLPM's can be significantly shortened if the pavement is in poor condition.

Thermoplastics are another type of durable pavement marking and typically come in square or pre-formed sheets. They are bonded to the pavement by heating the sheets to 400°-450°F. Due to the structure of thermoplastics, they are best suited for pavement symbols or colored lane markings, not linear striping. Thermoplastics are the most expensive of the three materials at \$10 - \$14 per square foot installed. Advantages to thermoplastics are an average lifetime of 5 years, easy spot fixes, and ability to provide reflectivity and skid resistance throughout the material rather than just the top coating. A significant disadvantage to thermoplastics is they have to be recessed or ground into the pavement if they are to be used in a snowy climate to avoid damage by plows. This process would be in addition to the installed cost.

RECOMMENDATION

All three types of pavement markings are appropriate for use on projects. The material type does not directly affect the functionality of on-street bike facilities. It is for this reason the subcommittee recommends the decision be left to the local agencies to decide what type of pavement marking is best suited. There are many other local factors to be considered on a case by case basis including amount of traffic, maintenance schedules, preference of the agency, and budgets. For additional Information please refer to the [NACTO Urban Bikeway Design Guide – Colored Pavement Material Guidance](#).

GREEN LANES AND BIKE BOXES

Green, reflective, colored pavement markings may be used to highlight conflict areas and increase visibility of bicycle lanes, intersection crossings and other potentially hazardous areas between bicyclists and vehicles.

Delineating these areas reinforces priority to bicyclists in conflict areas and has proven to increase motorist yielding behavior. Green pavement markings can be particularly helpful at intersection approaches with through bike lanes and right turning vehicle traffic (**Figure 7**). Bike boxes are another intersection treatment that may be used in conjunction

with green pavement markings. A bike box is a designated area at signalized intersections that provide a safe, visible space in front of traffic during the red signal phase. Bike boxes provide several benefits to bicyclists. By placing the bicyclists ahead of traffic, bicyclists are better positioned to make left and right turning movements. Additionally, bike boxes allow bicyclists to group together and clear the intersection quickly, minimizing impediment to vehicular traffic. NACTO lists colored pavement markings as a Recommended Feature for bike boxes. For bike lanes, colored pavement markings are considered an Optional Feature to delineate conflict areas. Color may be applied along the entire corridor of a bike lane with a gap in coloring to denote the conflict areas or used vice versa where color is only applied within the conflict areas (**Figure 8**).

RECOMMENDATION

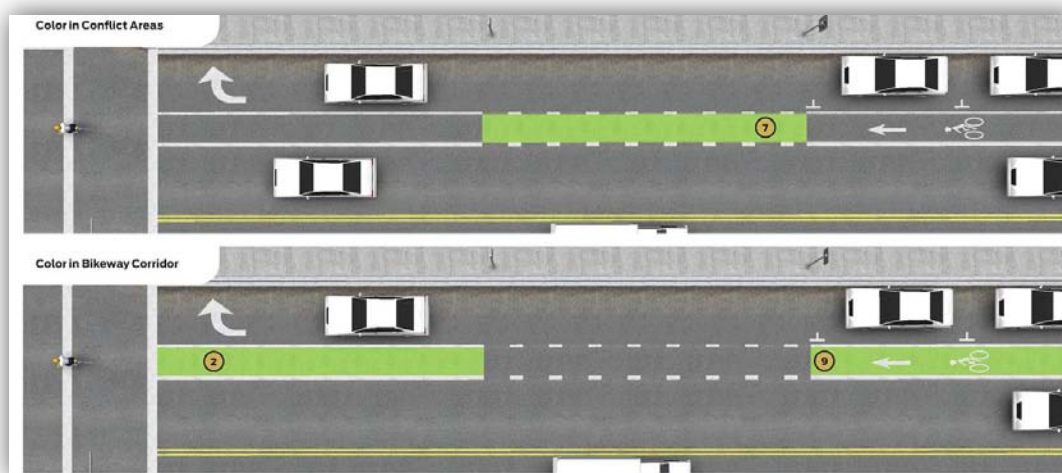
To increase visibility at conflict areas, the subcommittee recommends only using green colored pavement markings in conflict areas as shown in the top graphic of **Figure 8** or within bike boxes at a signalized intersection. Colored pavement markings will require increased maintenance over traditional striping. The use of colored bike boxes and colored bike lanes shall be reserved for higher conflict areas or at intersections with high volumes of bicycles and motor vehicles, especially those with frequent bicycle left turning movements

FIGURE 7 | COLORED BIKE LANE AND BIKE BOX



Source: NACTO

FIGURE 8 | COLORED BIKE LANE



Source: NACTO

FIGURE 9 | R3-17



Source: MUTCD

FIGURE 10 | R4-11



Source: MUTCD

FIGURE 11 | W11-1, W16-1



Source: MUTCD

FACILITY SIGNAGE

An R3-17 “Bike Lane” sign (**Figure 9**) is an optional treatment along bike lanes and cycle tracks as listed in the NACTO *Urban Bikeway Design Guide*. The sign is useful as an additional visual queue for vehicular traffic to further designate the preferential use for bicyclists. While the sign is mandatory in some states, the MUTCD classifies the sign as optional and cautions against overuse.

RECOMMENDATION

The subcommittee recommends the use of the R3-17 “Bike Lane” sign. Placement shall be in accordance with the MUTCD Section 9B.04 and shall not exceed 1000 feet in spacing. It is also recommended that the placement of the sign be staggered with the bike lane symbol markings.

The R4-11 “May Use Full Lane” sign (**Figure 10**) is a sign used to designate the potential presence and right for bicyclists to occupy the road. This sign, unlike the R3-17 “Bike Lane” sign is reserved for streets with shared lanes or a designated bike route. The MUTCD added the R4-11 in the 2009 revision. Another sign combination often used to designate shared lanes and bike routes, are the combined W11-1 and W16-1 “Share the Road” signs (**Figure 11**). Many cities have abandoned the combined W11-1 and W16-1 signs and adopted the “May Use Full Lane” signs. The “May Use Full Lane” sign conveys a clearer message to users of the roadway unlike the combined “Share the Road” signs.

RECOMMENDATION

The subcommittee recommends the use of the R4-11 “May Use Full Lane” sign in place of the combined W11-1 & W16-1 “Share the Road” signs. Placement and size of signs shall be in accordance with the MUTCD Section 9B.04 and shall not exceed 1000 feet in spacing. It is also recommended that the placement of the sign be staggered with the bike lane symbol markings.

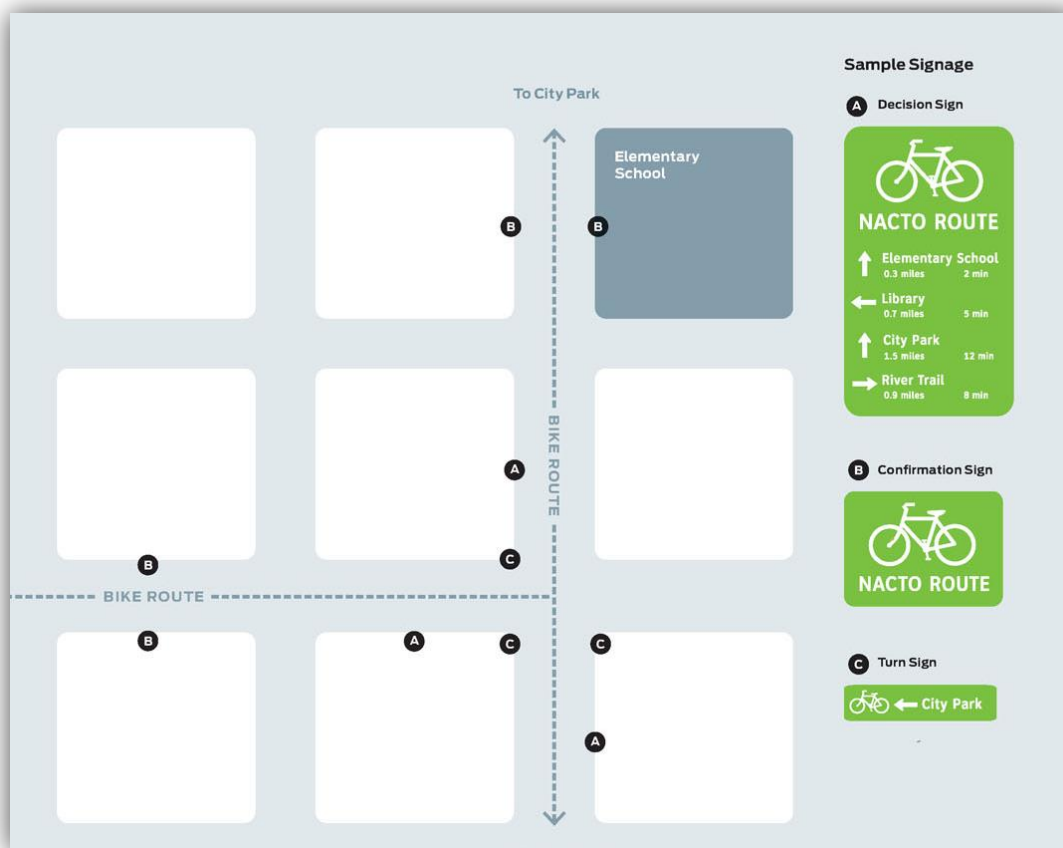
ROUTE WAYFINDING

Whether a bicyclist is riding on an off-street trail or an on-street bike route, it is necessary for them to develop a sense of awareness of where they are located in relation to their surroundings. Signage, trail guides, and maps are components of the wayfinding process that aid the user as they gather information on location and distances between destination points. Signage that includes both mileage and average travel time to destinations can also be a helpful feature to the user when estimating time it takes to travel. Though on-street bicycle routes benefit from existing street signs and landmarks to orient the user, wayfinding along routes should support the infrequent or first time user. Consistency of signage, use, message, and appearance are essential in communicating with the user.

NACTO outlines multiple Recommended Features; however the only Required Features are MUTCD standards in Section 9B.01 (Application and Placement of Signs), and Section 9B.20 (Bicycle Guides Signs). Guidance is provided on types of signs including Decision, Confirmation and Turn signs (**Figure 12**) and their placement. Prior to the development of wayfinding signage, it is recommended that a list to identify and classify points of interest be developed by the local municipalities. Once on-street routes are established, these lists can then be compiled and prioritized along the routes as primary, secondary and tertiary points of interest as shown on the sample “Decision Sign” in **Figure 12**. The level of effort to study on-street wayfinding and make proper recommendations exceeds the scope of this study.

The ultimate goal of the subcommittee is to conduct a comprehensive wayfinding study that can address sign type, placement, messages, and identity in one unified report.

FIGURE 12 | SIGN TYPES AND PLACEMENT

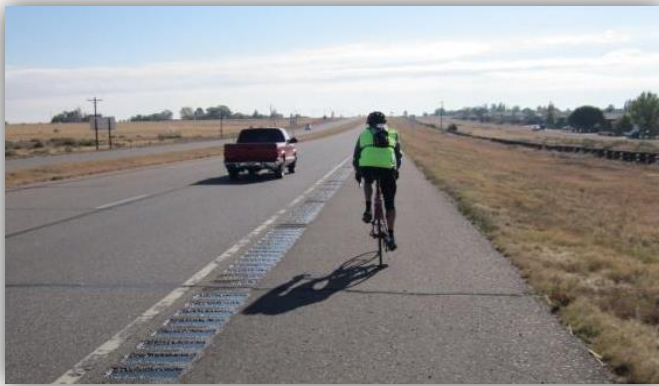


Source: NACTO

FACILITY DESIGN RECOMMENDATIONS

The following pages provide design examples for the on-street bicycle facilities discussed in this report. These examples are intended to illustrate the variety of ways to accommodate bicycle use on our streets and to provide some direction on design specifications for each facility type. It is important to note that the examples listed are not exhaustive. When converting existing streets to include facilities for bicycles, every case is unique and design standards should be used in conjunction with professional judgment and creativity. The NACTO *Urban Bikeway Design Guide* offers best practices for any community working to improve their on-street bicycle network and should be the starting point for any facility design.

Valuable Resources: <http://nacto.org/cities-for-cycling/design-guide/>
http://transect.org/docs/bicycling_pdfs.zip



PS – PAVED SHOULDER

Riding Surface Width	6-foot minimum
Movement	With traffic
Intersection Treatment	Signed, signalized
Posted Speed	≤ 55 mph
AADT	N/A



SL – SHARED LANE

Riding Surface Width	Shared vehicular lane with sharrow
Movement	With traffic
Intersection Treatment	Signed, signalized, indicator loops
Posted Speed	≤ 25 mph
AADT	≤ 8,000



BL – BICYCLE LANE

Riding Surface Width	5-foot minimum
Movement	With traffic
Intersection Treatment	Signed, dashed, Peg-a-Track, colored
Posted Speed	≤ 30 mph
AADT	≤ 15,000



BLB – BUFFERED BICYCLE LANE, TYPE 1

Riding Surface Width	5-foot minimum, 2-foot striped buffer and 2-foot shy zone
Movement	With traffic
Intersection Treatment	Signed, dashed, Peg-a-Track, colored
Posted Speed	≤ 30 mph
AADT	≤ 15,000



BLB – BUFFERED BICYCLE LANE, TYPE 2

Riding Surface Width	5-foot minimum with parking lanes and 2-foot shy zone
Movement	With traffic
Intersection Treatment	Signed, dashed, Peg-a-Track, colored
Posted Speed	≤ 35-45 mph
AADT	≤ 25,000



BLB – BUFFERED BICYCLE LANE, TYPE 3

Riding Surface Width	5-foot minimum with bollards
Movement	With traffic
Intersection Treatment	Signed, dashed, Peg-a-Track, colored
Posted Speed	≤ 35-45 mph
AADT	≤ 25,000



BLB – BUFFERED BICYCLE LANE, TYPE 4

Riding Surface Width	5-foot minimum with median separation
Movement	With traffic
Intersection Treatment	Signed, Peg-a-Track
Posted Speed	≤ 35-50 mph
AADT	≤ 30,000



BLB – BUFFERED BICYCLE LANE, TYPE 5

Riding Surface Width	5-foot minimum with planter
Movement	With traffic
Intersection Treatment	Signed, Peg-a-Track
Posted Speed	≤ 35-50 mph
AADT	≤ 30,000

6 | EDUCATION NEEDS

Education will play a key role in bringing this bikeway network to life. Interests of the Bikeway Joint Subcommittee focused on the need for education that's different for bikers, city/county staff, and policy makers. Opportunities to reach out to each of these groups were discussed and are mentioned in the sections below.

BIKERS

Two areas of focus for educating bikers are on traffic laws and overall safety. It's important for those that are using the bikeway system to be familiar with local laws related to on-street biking. These laws could potentially dictate where a biker can and cannot ride. Knowing and understanding the laws will also contribute to overall safety as they are often put in place to minimize the risk and reduce conflicts for bikers. For instance, in Iowa, a bicyclist that is traveling at a speed less than the speed of traffic must ride as close as practicable to the right-hand edge of the roadway (*Iowa Code §321.297*). Various workshops and educational bike rides could be held to inform bikers of these issues and help them become comfortable with riding on streets.

CITY/COUNTY STAFF

Several opportunities exist to educate staff at the city and county levels on bicycle facilities. One opportunity is to take staff members out in the field and actually ride on various facilities. This could be done locally in areas where on-street facilities are more prevalent, like Downtown Des Moines. Or, trips could be planned to cities such as Minneapolis, Chicago, or Boulder, CO where bike networks are more extensive. This would allow for staff members to experience what it's like to ride on a connected network and give them an opportunity to test out different types of facilities.

Educating city and county staff about design standards of such facilities is also very important. When staff members begin to plan on-street networks in their communities, it's essential that they have a good understanding of the proper uses of each facility and the designs that go with them to ensure that it will be successful. Bringing in speakers with experience in design standards would help provide this education to city and county staff.

POLICY MAKERS

Policy makers play a significant role in the success of bikeway networks because they will be the ones deciding whether or not such a network will be implemented. Providing them with education on bicycle facilities will give them a better understanding of the benefits that come with having on-street facilities. Along with city and county staff, policy makers also have the opportunity to "learn in the field" by planning rides in the Greater Des Moines area or scheduling trips to neighboring Midwestern cities previously mentioned to help them learn more about how bikeway networks work.

Additional opportunities to educate not only policy makers, but city/county staff and bikers as well, is to provide LCI training. LCI stands for a League Cycling Instructor, and is someone that is certified from the League of American Bicyclists to teach Smart Cycling classes to people of all ages. The goal of these classes is to teach bike safety and skills to increase the comfort levels and confidence of bikers. More information on LCI training can be found here: <http://bikeleague.org/content/take-class>.

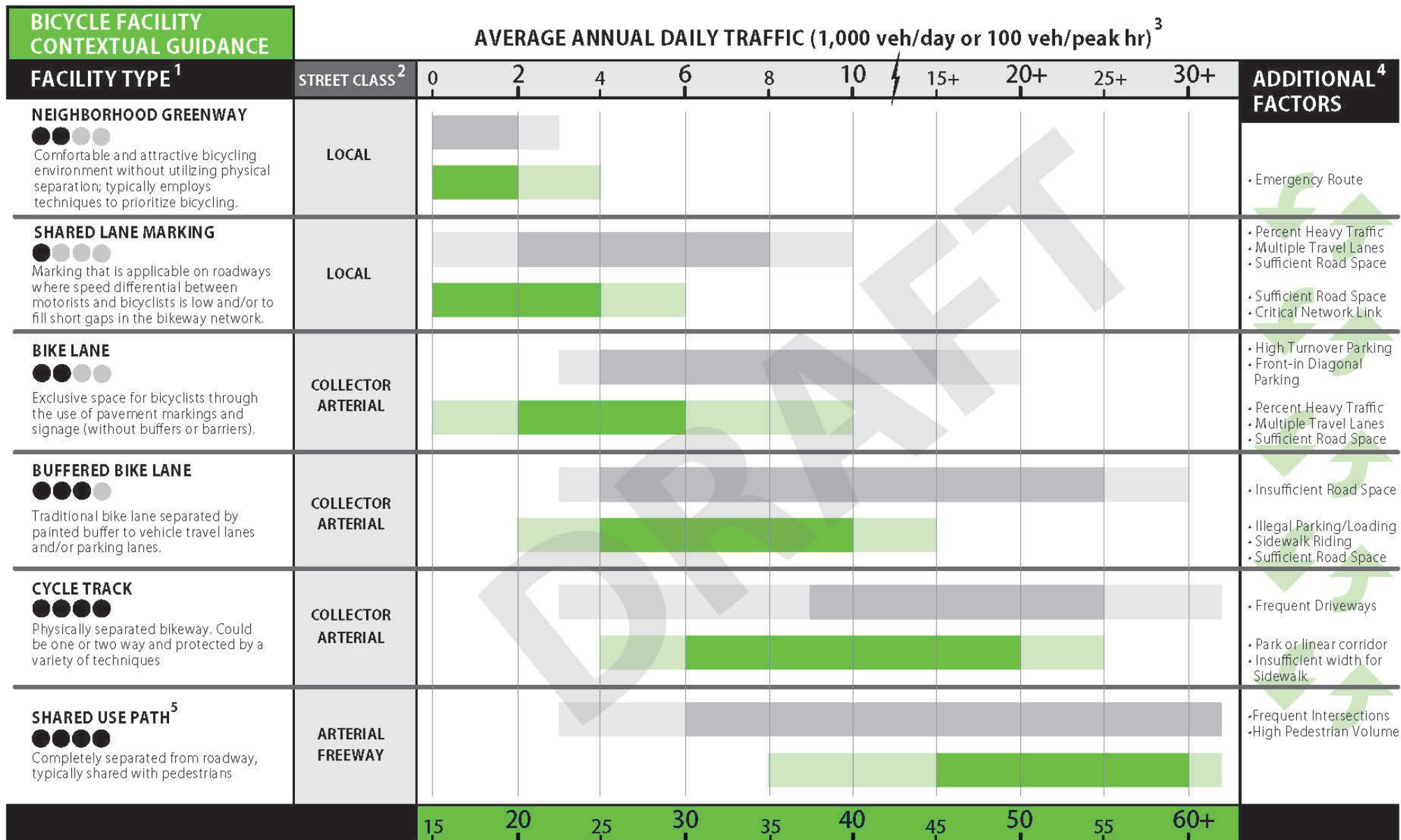
To assist with the funding of such educational efforts, the MPO's Transportation Management Association (TMA) program could allocate funds toward helping organizations, such as the Des Moines Bicycle Collective, host events to educate the public, staff members, and policy makers on safe bike riding, for example, following traffic laws.

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APPENDIX A | NACTO GUIDANCE



LEGEND

SEPARATION ⁶		
	Minimal Separation	
	Moderate Separation	
	Good Separation	
	High Separation	

min	VOLUME	max
min	SPEED	max
Acceptable	Desired	Acceptable

INSTRUCTIONS:

This chart offers guidance as to what types of treatments are recommended depending on street classification, speed, and volume. No matter where bikeway treatments are applied, special care needs to be paid to intersections, driveways, on-street parking, sight distance, and additional factors.

NOTES:

- Refers to specific bicycle facilities described in the NACTO Urban Bikeway Design Guide. See <http://www.nacto.org> for detailed design guidance. Many local roads function just fine as they are due to their low traffic volume and speed.
- Categories from http://www.fhwa.dot.gov/planning/fcsec2_1.htm. The use of functional classes provides some general context for the cases in which bicycle facilities are most likely to be implemented. Land use and additional factors (see 4) should always take precedence in determining which facility type to select.
- Urban peak hour factors typically range from 8 to 12 percent of AADT. For the purposes of this chart, the peak hour is assumed to be 10 percent of AADT.

- Noted additional factors include a selection of considerations that may influence the selection of bicycle facility type where roadway speed/volume values overlap over multiple facilities. Many of the factors that suggest increasing separation are common across multiple facility types like bike lanes, buffered bike lanes and cycle tracks.
- Design guidance for shared use paths can be found in the AASHTO Guide for the Development of Bicycle Facilities.
- Increased separation of bicycle facilities from motor vehicle traffic typically results in higher levels of user comfort and appeals to wider skill levels of bicyclists.
- This chart considers posted speed limit only. The 85th percentile speed may vary, and may change with implementation of a bikeway.



APPENDIX B | COMPLETE STREETS POLICY

Des Moines Area Metropolitan Planning Organization Complete Streets Policy

- 1.0 Defined
- 2.0 Introduction/Justification
- 3.0 Vision & Intent
- 4.0 Applicability
- 5.0 Design
- 6.0 Implementation
- 7.0 Evaluation / Performance Measures

1.0 Defined

Complete Streets are roadways designed to safely and comfortably accommodate all users, of all ages and abilities, including but not limited to motorists, cyclists, pedestrians, transit users, school bus riders, delivery and service personnel, freight haulers, and emergency responders.

Publicly owned rights of way should safely accommodate destination-based and recreational users, as well as provide opportunities as appropriate for rest and directional information within the public realm.

2.0 Introduction/Justification

Building complete streets provides many benefits to residents, business owners, developers, and the community as a whole. First and foremost, embracing the complete streets concept will help create balanced transportation systems by providing accessible, safe, and efficient connections between destinations. It will bolster economic growth and stability while increasing property values. It will enhance job growth, improve safety, improve public health and fitness, reduce harmful emissions, and reduce the overall demand on our roadways by allowing people to replace motor vehicle trips with active transportation options. Secondly, integrating sidewalks, bike facilities, transit amenities, and safe crossings into the initial design of a project spares the expense and complications of retrofits implemented at a later date. Thirdly, proactively planning for a multimodal transportation system can promote its integration with land use policies to encourage sustainable development.

The MPO Complete Streets policy also supports compliance with Federal policy [United States Code, Title 23, Chapter 2, Section 217 (23 USC 217)] requiring consideration for bicycling and walking within transportation infrastructure.

3.0 Vision & Intent

To create a safe, balanced, and effective transportation system where every roadway user can travel safely and comfortably and where multi-modal transportation options are available to everyone.

The goals of this Complete Streets Policy are:

- 1) To create a comprehensive, integrated, and connected transportation network that supports compact, sustainable development and provides livable communities.
- 2) To ensure safety, ease of use, and ease of transfer between modes for all users of the transportation system.
- 3) To provide flexibility for different types of streets, areas, and travelers to enhance the transportation experience.

4.0 Applicability

4.1 Jurisdiction

The recommendations and requirements within the Des Moines Area Metropolitan Planning Organization's (MPO) Complete Streets Policy will apply to Surface Transportation Program (STP) and Transportation Alternatives Program (TAP) projects within the MPO Planning Area Boundary.

Applicable projects include all roadway and/or intersection reconstruction projects, added travel lane(s) projects, new roadways, and new or rehabilitated bridges (including bridge decks reconstructed over the Interstate and underpasses under reconstructed/new interchanges).

The MPO recognizes that some local jurisdictions have adopted their own Complete Streets Policies. When applied to the federally funded projects as listed above, the strictest regulations of any involved Complete Streets policy applicable to a jurisdiction shall apply. Local jurisdictions that have not adopted their own policies are strongly encouraged to do so.

4.2 Network Connectivity

Applicable projects under this policy will be required to include at least:

- A continuous ADA-compliant sidewalk on one side of the roadway/bridge, or
- Designated on-street bicycle facility within the roadway project, if the inclusion of a sidewalk is anticipated to be overly burdensome to the project and therefore infeasible, or
- A multi-use trail of a sufficient width to accommodate both pedestrian and bicycle travel simultaneously.

Projects located along corridors already served by a continuous sidewalk or multi-use trail on at least one side of the roadway are considered to be compliant. Improvements to ensure good condition and ADA compliance are encouraged. If designated on-street bicycle facilities are included, the design for their width, markings, and treatment at intersections and crossings should follow the design guidance of the National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide, found online at <http://nacto.org/cities-for-cycling/design-guide/>.

If the planned facility currently has fixed route transit, or is proposed to have fixed route transit in the Long Range Transportation Plan, then the project sponsor shall request comments from the local transit agency (DART) during the project development process to ensure that collaboration occurs with these agencies and that accommodation of transit vehicles and opportunities to access transit facilities are provided.

4.3 All Projects and Phases

Every federally funded transportation improvement and project phase should be approached as an opportunity to create safer, more accessible roadways for all users. Project phases include planning, programming, design, right-of-way acquisition, construction, construction engineering, reconstruction, and operations as well as any change to transportation facilities within street rights-of-way such as capital improvements, re-channelization projects, and major maintenance.

5.0 Design

The MPO is a proponent of creating a multimodal, safe, and efficient transportation system that ensures accessibility to all roadway users. In order to increase the number of projects that provide multimodal

facilities in central Iowa, the MPO developed Multimodal Guidelines. These guidelines recognize the importance of, and encouraged the concept of, complete street development.

5.1 Context Sensitivity

In recognition of context sensitivity, public input and the needs of many users, a flexible, innovative and balanced approach that follows other appropriate design standards may be considered, provided that a comparable level of safety for all users is present.

5.2 Long-Term

MPO members shall plan for projects being long-term. Transportation improvements are long-term investments remaining in place for many years. Design and construction of new facilities should anticipate likely future demand for transit, bicycling, and walking facilities and not preclude the provision of future improvements.

5.3 Corridors

Address bicyclists and pedestrians having a need to cross corridors as well as travel along those corridors. Even where bicyclists and pedestrians may not commonly use a particular corridor being improved or constructed, they will likely need to be able to cross that corridor safely and conveniently. Therefore, the design of intersections and interchanges shall accommodate bicyclists and pedestrians in a manner that is safe, accessible, and convenient.

5.3 Design Guideline References

MPO members shall follow accepted or adopted design standards and use the best and latest design standards available, while remaining flexible according to user needs and community context. Sources for design guidelines include:

- *SUDAS: Iowa Statewide Urban Design and Specifications Manual*;
- American Association of State Highway and Transportation Officials' (AASHTO) *Guide for the Development of Bicycle Facilities*;
- AASHTO's *A Policy on Geometric Design of Highways and Streets*;
- AASHTO's *Guide for the Planning, Design, and Operation of Pedestrian Facilities*;
- Federal Highway Administration's *Manual on Uniform Traffic Control Devices for Streets and Highways*; and,
- Institute of Transportation Engineers' (ITE) *Recommended Practice – Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities*.
- Des Moines Area MPO *Design Standards Policy*.

6.0 Implementation

This policy will require all projects funded with federal dollars awarded by the MPO to support Complete Street principles. It is required that all projects in the Transportation Improvement Program (TIP) be consistent with this Complete Streets policy before federal funds are programmed and approved in the MPO's TIP.

6.1 Implementation Process

The following steps will be utilized to assure this policy is uniformly implemented:

1. MPO member governments are encouraged to consider the Complete Streets Policy at the time of project conception, and to contact MPO staff early on with any questions regarding what can be expected at the time of project application and, if the member government anticipates an exception request, what will be expected.
2. At the time of project application, the project sponsor shall indicate either the project's compliance with this Complete Streets Policy or request for an exception including supporting rationale.
3. During project selection, projects will be first sorted according to procedures in place prior to the effective date of this policy. Projects selected as priorities for funding will then be evaluated for compliance with this Complete Streets Policy. Exception requests will be reviewed according to section 6.2 Exception Process of this policy. Projects found not in compliance with this policy, or for which an exception request is denied, will be found ineligible for funding during the applied for funding cycle.

The TIP tracking process will be utilized to ensure continued compliance to this Complete Streets policy throughout project implementation.

The MPO recognizes that, during the course of project development, unforeseeable changes sometimes occur. However, member governments are encouraged to review equitably all elements of a proposed project prior to eliminating components due to budget constraints.

After the MPO has committed funding to a project, MPO staff should be notified immediately of significant project scope changes. Projects should be updated in the TIP to ensure that the system includes accurate information. Mention of the project scope change should also be included in the report tracking process. Depending on the significance of the change, a TIP amendment may be necessary. MPO staff can advise on this matter.

Due to the flexibility of the policy and the variety of approaches that a sponsor may take to complete a street, MPO staff, as stewards of the Complete Streets Policy, will work with the project sponsor throughout the final design process to find an acceptable solution for both parties.

6.2 Exception Process

If a project cannot meet the Complete Streets Policy, the project sponsor may request an exception when one or more of the following three conditions are met:

1. When bicyclists and pedestrians are prohibited, by law, from using the roadway. In this instance, a greater effort may be necessary to accommodate all users (bicyclists, motorists, transit vehicle users, and pedestrians of all ages and abilities) elsewhere within the right-of-way or within the same transportation corridor.
2. When the cost of establishing bikeways and walkways would be excessively disproportionate to the need or probable use, or would exceed budget costs (ex. Resurfacing). Excessively disproportionate is defined as exceeding twenty percent of the cost of the larger transportation project to include bikeways and walkways. In such a case, the project sponsor may propose an alternate design or spend twenty percent of the project cost of the larger project to improve accommodations for all users.

3. Where population is sparse or where other factors indicate an absence of future need. This condition's definition would be streets developed as a cul-de-sac with four or fewer dwellings or if the street has severe topographic or natural resource constraints. Also, an indication of absence of need would be daily traffic (ADT) projections being less than 500 vehicles per day over the life of this project.

Exception requests will be initially reviewed and sorted by MPO staff. Exceptions shall be granted only by a recommendation of the MPO's Surface Transportation Program (STP) Funding Subcommittee, be documented with supporting data that indicates the basis for the decision, and that the MPO approves the STP Funding Subcommittee's recommendation.

6.4 Continuing Support

As a part of implementing this regional Complete Streets policy, the MPO encourages member governments to

- Notify and maintain regular communication with relevant departments, agencies, and committees within their jurisdictions when planning for transportation facilities;
- Review current design standards, including subdivision regulations which apply to new roadway construction, to ensure that they reflect the best available design standards and guidelines, and effectively implement the regional Complete Streets policy;
- Form, or utilize an existing, local Technical Advisory Committee to discuss potential transportation projects and identify opportunities to include multimodal facilities;
- Encourage staff to undergo professional development and training for non-motorized transportation issues by attending conferences, classes, seminars, and workshops;
- Promote inter-departmental project coordination among city departments with an interest in the activities that occur within the public right-of-way in order to better use fiscal resources;
- Include an educational component to ensure that all users of the transportation system understand and can safely utilize Complete Streets project elements; and
- Consider the creation of a local Complete Streets policy to apply to all non-MPO supported projects. Local policies established after the effective date of the MPO Complete Streets Policy should strive to equal or exceed the requirements herein.

7.0 Evaluation / Performance Measures

The MPO shall, at a minimum, evaluate this policy and the documents associated with it every two years. This evaluation may include recommendations for amendments to the Complete Streets Policy.

The MPO will report on the annual increase or decrease for each performance measure listed below, compared to the previous year(s), in order to evaluate the success of this Complete Streets policy.

- Total miles of on-street bicycle facilities
- Total miles of off-street bicycle facilities
- Completion of Safe Routes to School projects
- Percentage of transit stops accessible via sidewalks and curb ramps
- Rate of crashes, injuries, and fatalities by mode
- Number of approved and denied exceptions