TooleDesignGroup

212 Third Avenue North,
Suite 476
Minneapolis, MN 55401
612.584.4094
www.tooledesign.com

MEMORANDUM

Date:	January 25, 2018
To:	Steven Elmer, Planning Analyst
Organization:	Metropolitan Council
From:	Greta Alquist, Galen Omerso, Ciara Schlichting
Project:	Regional Bicycle Barriers Study
Re:	Technical Memorandum No 2: Scoring Methodology and Results

Background

The Metropolitan Council is conducting the Regional Bicycle Barriers Study (the Study), examining the region's major physical barriers (freeways/expressways, rivers/streams, and rail corridors) to bicycling in the Twin Cities region. With input from the public, cities, and counties, the Study involves a robust, data-driven approach to prioritizing barrier crossing improvement opportunities. The Study results will be documented in the *Transportation Policy Plan Update* which sets policies for the regional transportation system and is used for investment direction.

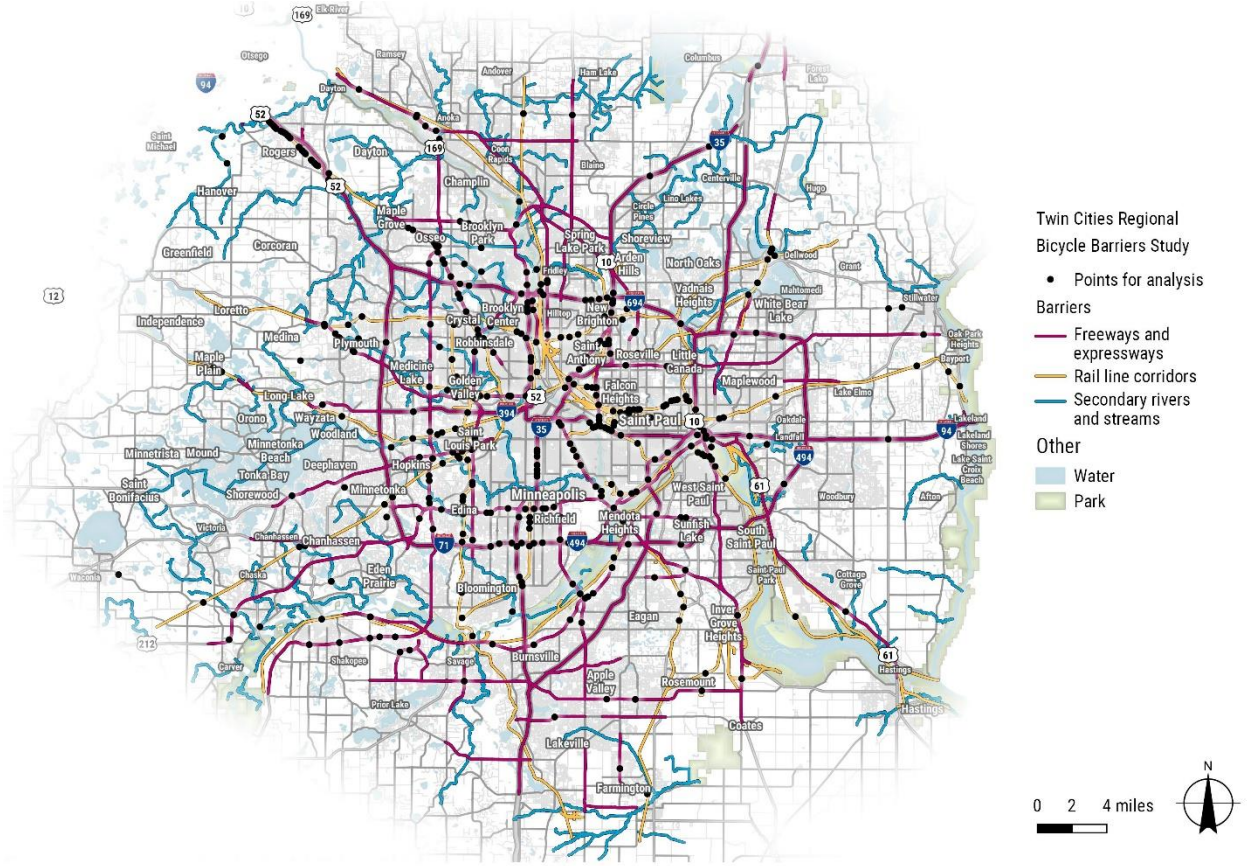
The purpose of this memo is to summarize how scoring criteria were selected, weighted, measured, and applied to prioritize barrier crossing improvement opportunities. The methodology for selecting barrier crossing opportunities to be analyzed is summarized in a separate memo, the results of which are shown in Figure 1. Metropolitan Council staff, the Technical Advisory Work Group (TAWG), the Project Management Team (PMT), and participants of two bicycling focus groups contributed to the development of the criteria and guided their application in the Study.

The PMT consisted of Metropolitan Council staff and Minnesota Department of Transportation Metro District staff. The TAWG included representation from the following agencies:

- Metropolitan Council
- Minnesota Department of Transportation, Metro District
- Anoka County
- Carver County
- Dakota County
- Hennepin County
- Ramsey County
- Scott County
- Washington County
- City of Bloomington
- City of Maplewood

- City of Minneapolis
- City of New Brighton
- City of Richfield
- City of Saint Paul
- Three Rivers Park District
- Transit for Livable Communities

Figure 1: Points for analysis



ANALYSIS METHODOLOGY OVERVIEW

The prioritization process for the Study was derived from the Active Transportation Prioritization Tool (APT), a spreadsheet-based method for prioritizing active transportation projects. The APT was developed through National Cooperative Highway Research Program (NCHRP) Project 803 and includes a programmed spreadsheet to facilitate implementation of the Active Transportation methodology, as documented in a final report on the research approach, findings, and conclusions. The programmed spreadsheet contents were developed based on previous research, transportation agency input, professional guidelines and reports, and practical experience. The general APT process and programmed spreadsheet was used in this Study.

The first step in the APT process is to define the purpose of the Study, and to identify the types of locations that will be evaluated in the prioritization analysis. In this case, the location types are "barrier crossing improvement opportunities" represented as points along physical barriers (see Figure 1: Points for Analysis). This step is summarized in a

separate technical memorandum, *Preferred Spacing of Barrier Crossing Opportunities*, that describes how potential barrier crossing improvement opportunities were identified for inclusion in the analysis.

The next series of steps in the APT process involves selecting **factors** (or criteria) that should influence prioritization scores, establishing **weights** for the selected factors, and identifying **variables** to measure each factor. A factor can be represented by more than one variable, for example "demand" could be represented by population density, employment density, and number of stakeholders requesting an improvement to a crossing location.

Once the factors, weights, and variables were established, the potential barrier crossing improvement locations were scored. The resulting scores and ranks were reviewed by the PMT, the TAWG, and Metropolitan Council staff by reviewing the completed APT spreadsheet, summary scores spreadsheet, and an accompanying .kmz map file. The final versions of all three files are available in the final report. The following sections detail these steps and summarize the results.

Selecting Factors

The Metropolitan Council involved the PMT and the TAWG in identifying the factors to be used in the Study analysis. As a starting point, the National Cooperative Highways Research Project 803 was referenced, which examined best practices in prioritization.

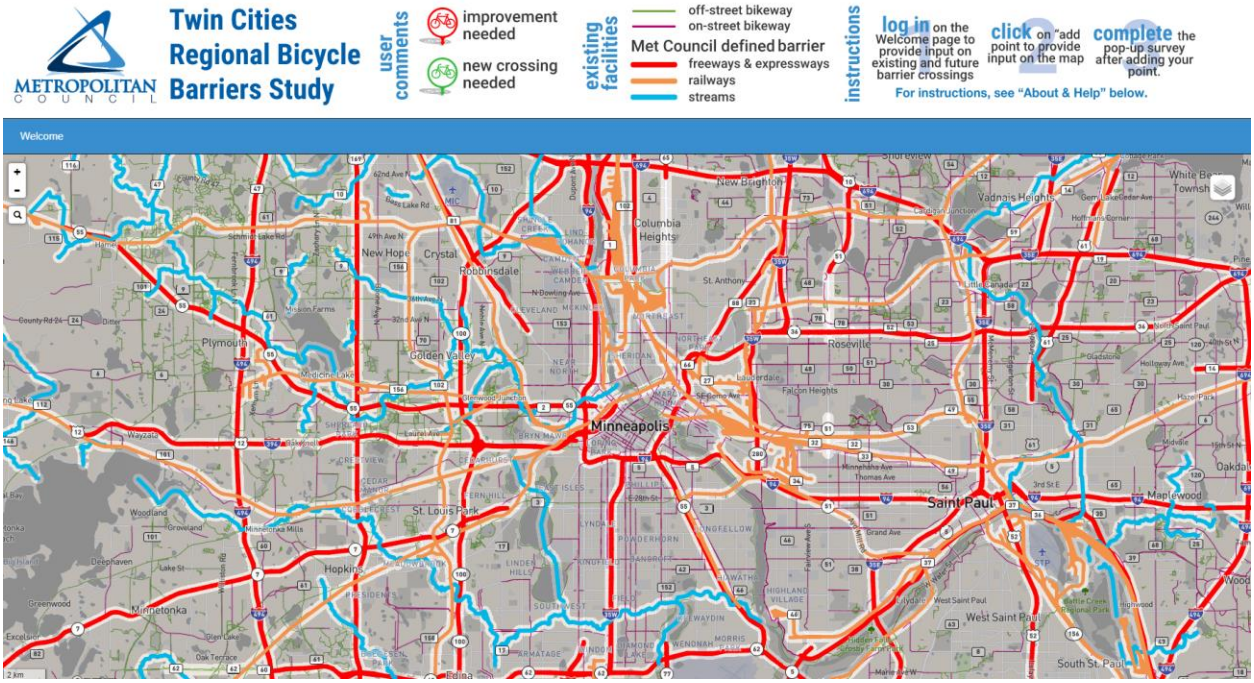
Metropolitan Council staff (with guidance from the TAWG and PMT) selected the following factors to be applied in the study analysis:

- Social equity
- Network connectivity
- Bicycling travel demand
- Safety/existing conditions of biking facilities

To involve the public, the Metropolitan Council hosted two focus groups with targeted stakeholders. One focus group involved people from around the region that identified as avid bicyclists who regularly used biking as a form of transportation. A second focus group recruited people from disadvantaged communities or underrepresented racial and ethnic groups with bicycling experience. Each focus group helped review ways to measure each factor, and weight their importance.

Input from bicycling stakeholders from an on-line interactive WikiMap (Figure 2, Regional Bicycle Barriers Study WikiMap) was used as a measure under the "social equity" and "bicycling demand" factors. Participants in the mapping exercise helped identify existing problem crossings of major barriers to identify potential sites where new crossings (bridges or underpasses) would be most beneficial. The more people that identified the same location as needing improvement, the higher the demand. In addition, participants we asked to complete a short, optional demographic survey that allowed input from underrepresented and/or underserved participants to receive additional weight in the equity factor. Each factor used in the Study is further detailed in subsequent sections of this memo.

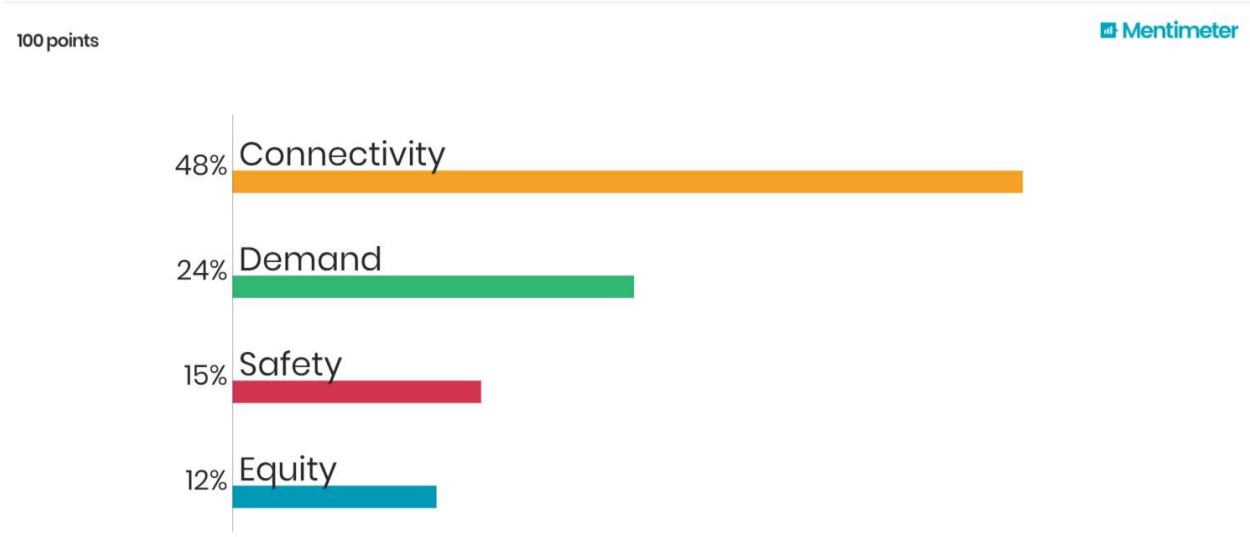
Figure 2: Regional Bicycle Barriers Study WikiMap



Establishing Factor Weights

Factor weights in the APT spreadsheet are applied on a scale of 0 to 10. Factor weights for the Study were guided by input from the Technical Advisory Work Group and Project Management Team. After the factors had been selected, the TAWG participated in a discussion and live poll about weighting preferences (Figure 3: Factor weight TAWG poll results). The results of the poll showed connectivity as the highest priority factor followed by demand, safety/existing conditions, and equity.

Figure 3: Factor weight TAWG poll results



The results of the live poll were then converted to the 10-point weighting scale to be compatible with the APT spreadsheet, as summarized in Table 1.

Table 1: Factor Weights

Factor	Weight (scale of 0-10)
Connectivity	4.825
Demand	2.425
Safety	1.525
Equity	1.225

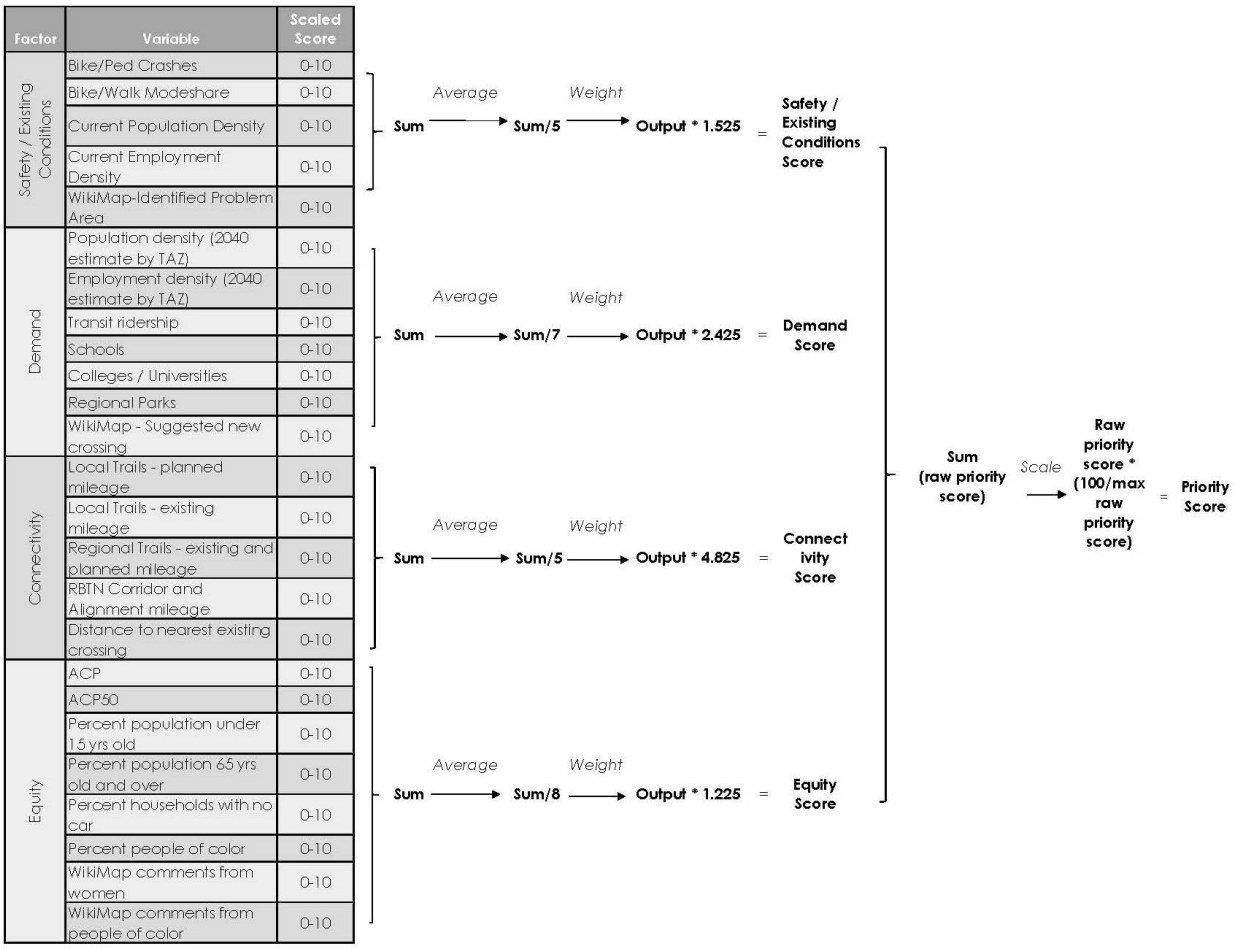
Identifying Variables

Several variables, or measures, were chosen for each factor. These variables were then averaged to develop a composite score for the factor. For example, the Safety/Existing Conditions factor included bicycle- and pedestrian-involved crashes, bicycling and walking mode share, current population density, current employment density, and WikiMap-identified problem areas. Raw scores for these items were calculated using Geographic Information Systems (GIS). The raw scores were then normalized to account for the difference in units and disparity in the value ranges. To address this, each variable was proportionately scaled to a range of 0 -10.

All variables within a factor were weighted equally by calculating an average of all variables; this average was then multiplied by the factor weight as shown in Table x.

The Safety/Existing Conditions scores were then added to the analysis point composite scores for the three other factors (demand, connectivity, and equity) to determine the analysis point composite score.

Table 2. Analysis point scoring example.



CONNECTIVITY

The factor score for "connectivity" is an average of the following five variable scores:

Proximity to Existing Local Bikeways

Proximity to existing local bikeways was selected as a variable to measure connectivity because it indicates a higher immediate impact to the connectivity of the broader bicycle network if a barrier crossing improvement were made.

Scores were calculated by taking the sum length in miles of existing local bikeways within ¼-mile of the barrier crossing opportunity, then scaled to fit the 0-10 score range.

Data Source: Metropolitan Council provided regional bicycle system inventory layer including existing and planned on-road and off-road facilities throughout the region.

Proximity to Planned Local Bikeways

Proximity to planned local bikeways was selected as a variable to measure connectivity because it indicates a higher impact to the connectivity to the broader planned local bicycle network if a barrier crossing improvement were made.

Scores were calculated by taking the sum length in miles of planned local bikeways within ¼ mile of the potential barrier crossing, then scaled to fit the 0-10 score range.

Data Source: Metropolitan Council provided regional bicycle system inventory layer including existing and planned on-road and off-road facilities through the region.

Proximity to Regional Bicycle Transportation Network (RBTN) Corridor Centerline or Alignment

Whether a barrier crossing improvement opportunity is located near an RBTN alignment or corridor centerline was selected as a variable to measure connectivity because it indicates an improvement will serve a regional bicycle transportation connection.

Scores were calculated by taking the sum length in miles within a ½-mile of a potential barrier crossing improvement analysis point, then scaled to fit the 0-10 score range.

Data Source: Regional Bicycle Transportation Network files from Minnesota Geospatial Commons (MnGeo).

Proximity to Existing or Planned Regional Trail

Whether a barrier crossing opportunity is aligned with an existing or planned Regional Trail was selected as a variable to measure connectivity because it indicates it will fill a gap in or make an improvement to a Regional Trail.

Scores were calculated by taking the sum length in miles of existing or planned regional trail with a ½-mile of a potential barrier crossing, then scaled to fit the 0-10 score range.

Data Source: Regional trails from the Minnesota Geospatial Commons (MnGeo)

Distance to Nearest Crossing

Distance to the nearest existing barrier crossing was selected as a variable to measure connectivity because it indicates the degree to which a bicyclist must go out of their way to cross a barrier without an improvement.

Scores were calculated by measuring the distance (in meters) to the nearest existing crossing, then scaled to fit the 0-10 score range.

Data Source: Existing crossings were defined as any place an existing bikeway or local road crossed one of the defined barriers (expressway, railroad, stream).

DEMAND

The factor score for "demand" is an average of the following eight variable scores:

Point-type Score

Point-type refers to how the analysis point was identified to be included in the Study.

The first point type is any location where a planned bikeway intersected with a regional barrier. The second point type is any location identified for inclusion by the Metropolitan Council staff or the TAWG.

The third point type is any location that was derived from the preferred maximum spacing frequency. Applying spacing criteria to fill barrier crossing frequency gaps at locations along barrier segments resulted in additional barrier crossing improvement points for analysis that would allow for more direct and connected networks. In addition to these spacing-generated points, analysis points were added, through reviews by Met Council and the TAWG, where logical or opportunity-driven locations may have been overlooked in the initial points for analysis identification process.

However, the Metropolitan Council staff as well as TAWG members determined that potential barrier crossings generated by local and regional bicycle plans should be given a higher priority. As such, the prioritization analysis was amended to include a "point-type" variable, then scaled to fit the 0-10 score range. This new measure was scored on a 0 to 10 scale as follows:

- Planned barrier crossings 10 points
- TAWG/Council-added crossings 6 points
- Spacing-generated crossing locations 4 points

Data Source: Metropolitan Council Regional Bicycle System Inventory, TAWG and Metropolitan Council reviews, and spacing analysis results

Employment Density 2040

Employment density projections for 2040 was selected as a variable to measure demand because these projections indicate where a barrier crossing improvement would serve the most people near their place of employment.

Scores were calculated by using the average 2040 employment density within a ½-mile of a potential barrier crossing, then scaled to fit the 0-10 score range.

Data Source: Future employment density from MnGeo.

Transit Ridership

Transit ridership was selected as a variable to measure demand because it indicates where there may be bicycling demand for "last mile" connections to a transit stop.

Scores were calculated by taking the sum of boardings and alightings within a ½-mile of a potential barrier crossing, then scaled to fit the 0-10 score range.

Data Source: Transit Stops and boarding/alighting tables for 2013 and 2014 hosted on MnGeo.

Proximity to Schools

Proximity to schools was selected as a variable to measure demand because it indicates potential usage by students, guardians, and/or staff where a barrier crossing improvement could allow for better bicycle access.

Scores were calculated by counting the number of schools within ½ mile of a potential barrier crossing, then scaled to fit the 0-10 score range.

Data Source: Public Schools from MnGeo excluding colleges.

Proximity to Colleges

Proximity to colleges was selected as a variable to measure demand because it indicates potential usage by students, faculty, and/or staff where a barrier crossing improvement could allow for better bicycle access.

Scores were calculated by counting the number of colleges within ½ mile of a potential barrier crossing, then scaled to fit the 0-10 score range.

Data Source: Public Schools from MnGeo - only colleges.

Proximity to Regional Parks

Proximity to Regional Parks was selected as a variable to measure demand because it indicates potential usage at regional resource where a barrier crossing project could facilitate improved bicycle access to a Regional Park.

Scores were calculated by counting the number of Regional Parks within a ½-mile of a potential barrier crossing, then scaled to fit the 0-10 score range.

Data Source: Regional Parks from MnGeo.

Suggested New Crossings from WikiMap

The project WikiMap online interactive tool provided participants the opportunity to suggest locations for new barrier crossings. The new crossing suggestions were selected as a measure of demand because it indicates public desire for a new barrier crossing.

Scores were calculated by taking the sum of 'suggested new crossing' responses on the WikiMap within a ¼-mile of a suggested barrier crossing, then scaled to fit the 0-10 score range.

Data Source: Project WikiMap tool output

SAFETY/EXISTING CONDITIONS

The factor score for "safety/existing conditions" is an average of the following five variable scores:

Proximity to Bicycle or Pedestrian Crashes

Proximity to bicycle or pedestrian crashes was selected as a variable to measure safety/existing conditions because it indicates where there may be an opportunity to improve conditions for nonmotorized transportation. It also indicates an area where people are walking or bicycling regardless of conditions.

Scores were calculated by counting the number of crashes within 500 feet of a barrier crossing opportunity, then scaled to fit the 0-10 score range.

Data Source: MnDOT non-motorized collisions data, 2010 - 2015

Bicycle or Pedestrian Mode Share

Bicycle or pedestrian mode share was selected as a variable to measure safety/existing conditions because it indicates where people bike or walk to commute to work.

Scores were calculated as average mode share within ½ mile of a barrier crossing opportunity, then scaled to fit the 0-10 score range.

Data Source: US Census American Community Survey, 5 Year Estimates 2015, Commuting Table

Population Density

Population density was selected as a variable to measure existing conditions because it indicates where a barrier crossing improvement would serve the most people near their homes. Scores were calculated as average 2014 population density within ½ mile of a barrier crossing opportunity, then scaled to fit the 0-10 score range.

Data Source: Metropolitan Council Existing population density from MnGeo

Employment Density

Employment density was selected as a variable to measure existing conditions because it indicates where a barrier crossing improvement would serve the most people near their place of employment.

Scores were calculated as average 2014 employment density within ½ mile of a barrier crossing opportunity, then scaled to fit the 0-10 score range.

Data Source: Metropolitan Council Existing employment density from MnGeo

Problem Locations Identified through WikiMap Input

Problem locations identified on the WikiMap were selected as a measure of existing conditions because it indicates public desire for an existing barrier crossing improvement based on where participants identified an "improvement needed".

Scores were calculated as a sum of 'improvement needed' responses on the WikiMap within a ¼-mile of a barrier crossing opportunity, then scaled to fit the 0-10 score range.

Data Source: Project WikiMap tool output

EQUITY

The Metropolitan Council has adopted equity as one of the outcomes of Thrive MSP 2040, which defines equity as the following:

> *Equity connects all residents to opportunity and creates viable housing, transportation, and recreation options for people of all races, ethnicities, incomes, and abilities so that all communities share the opportunities and challenges of growth and change. For our region to reach its full economic potential, all of our residents must be able to access opportunity. Our region is stronger when all people live in communities that provide them access to opportunities for success, prosperity, and quality of life.*
>
> *-Thrive MSP 2040*

Each variable that contributes to the composite score for equity score relates to the Metropolitan Council's equity goals and is described in this section.

The factor score for "equity" is an average of the following eight variable scores:

Areas of Concentrated Poverty

Areas of concentrated poverty (ACPs) were selected as a variable to measure equity because it provides a geographic-based metric for the degree to which people with lower incomes may be served by a barrier crossing opportunity.

Scores were calculated by awarding 10 points to barrier crossing opportunities inside an ACP.

Data Source: MnGeo ACP

Areas of Concentrated Poverty with More Than 50% People of Color

Areas of concentrated poverty with more than 50% people of color (ACP50s) were selected as a measure of equity because it provides a geographic-based metric for

the degree to which people with lower incomes who are also people of color may be served by a potential barrier crossing improvement.

Scores were calculated by awarding 10 points to barrier crossing opportunities inside an ACP50.

Data Source: MnGeo ACP50

Population Under 15 Years Old

Percent population under 15 years old was selected as a variable to measure equity because this age group is not old enough to drive, but is generally old enough to make some trips by bicycle.

Scores were calculated as average percent of the population under 15 within a ½-mile of a barrier crossing opportunity, then scaled to fit the 0-10 score range.

Data Source: US Census American Community Survey 5 Year Estimates 2015, Age and Sex Table

Population 65 Years and Older

Percent population 65 years and older was selected as a variable to measure equity because this age group is less likely to drive than younger adults, and typically does not feel comfortable riding a bicycle without a designated facility.

Scores were calculated as average percent of the population 65+ within a ½-mile of barrier crossing opportunity, then scaled to fit the 0-10 score range.

Data Source: US Census American Community Survey 5 Year Estimates 2015, Age and Sex Table

Percent Zero-Car Households

Percent zero-car households was selected as a variable to measure equity because people that do not own or have access to a car are more likely to rely on transit, walking, and/or bicycling to make transportation trips.

Scores were calculated as average percent of households with no vehicle available within a ½-mile of a barrier crossing opportunity, then scaled to fit the 0-10 score range.

Data Source: US Census American Community Survey 5 Year Estimates 2015, Housing Characteristics Table

Percent People of Color

Percent people of color was selected as a variable to measure equity because it provides a geographic-based metric for the degree to which people of color may be served by a barrier crossing opportunity.

Calculated as average percent of the population that is non-white (including Hispanic and Latino) within a ½-mile of a barrier crossing opportunity, then scaled to fit the 0-10 score range.

Data Source: US Census American Community Survey 5 Year Estimates 2015, Race Table

WikiMap Input from Women

WikiMap input from people who self-identified themselves as women was selected as a variable to measure equity because the rates of bicycling for women are less than those for men. In addition, participation rates in bicycle planning are typically higher for

men than it is for women. Adding input from women to the equity score emphasizes the input from those typically underrepresented.

Scores were calculated by counting the number of comments from WikiMap users self-identifying as women within a ¼-mile of a barrier crossing opportunity, then scaled to fit the 0-10 score range.

Data Source: Project WikiMap tool output

WikiMap Input from Participants Self-Identifying as Any Race Other Than White

WikiMap input from people who identified themselves non-white was selected as a variable to measure equity because typical participation rates in bicycle planning is higher for white people than it is for many people self-identifying as any race other than white. Adding input from people of color to the equity score emphasizes the input from those typically underrepresented.

Scores were calculated by counting the number of comments from WikiMap users self-identifying as any race other than white within a ¼-mile of a barrier crossing opportunity, then scaled to fit the 0-10 score range.

Data Source: Project WikiMap tool output

Final Analysis Results

COMPOSITE SCORE CALCULATIONS

The factor scores were calculated as an average of each factor-specific variable (measure) score. Overall factor scores were then weighted according to the scheme previously described to calculate a single composite score for each barrier crossing analysis point (Table 2: Example calculation of composite factor score).

BARRIER CROSSING POINTS ANALYSIS RESULTS

A total of 675 barrier crossing opportunities were analyzed. To determine this final set of points for analysis an initial set of 1,200 points were identified and then refined by the PMT, TAWG and Metropolitan Council staff. First, a layer was developed for any location where a planned bicycle facility (Regional Bikeways Inventory) intersected with a regional barrier. Then, any location where a collector intersected with a barrier was added (regardless of whether it had a planned bicycle facility). Local roads crossing a regional barrier were not included because the TAWG and Metropolitan Council staff determined local roads were generally suitable for bicycling and should be considered as an existing crossing. Next, spacing-generated points were added. Then, several points from the WikiMap were added. The final step in included multiple rounds of review by the TAWG and Metropolitan Council staff to identify and remove extraneous points for analysis. A point can be "extraneous" for any of several reasons including:

- There is an existing barrier crossing, or one that is fully funded and scheduled for construction (or recently constructed),
- There is a grade separated crossing in place at the barrier and a useable roadway (bike shoulder or local road included) crosses the barrier--(these are points that should have been coded as an "existing crossing"),
- The point is over a stream that flows naturally underground or through a culvert,

- Two points are in very close proximity along the same barrier and should be considered the same point for analysis,
- Two points on two tightly spaced barriers where it would not be possible to develop separate crossings (e.g. an expressway parallel and adjacent to a rail line) such that only a single separated crossing of both barriers would be necessary, or
- Any other point that seems highly illogical (especially those denoted as spacing-generated under "point type").

The prioritization methodology described in this memo is summarized in Attachment 1 with overall factor scores and weights for each barrier crossing analysis point.

Ultimately, the study determined a series of bicycle barrier crossing improvement areas along identified regional bicycle barriers; these areas are displayed as circles and grouped into three priority tiers in Figures xx and xx below for freeways/expressways and railroads corridors/secondary streams, respectively. The area circle diameters vary by aggregated Thrive planning area and correspond to the preferred maximum spacing criteria previously described Technical Memorandum No. 1. The points for analysis represented by the "barrier crossing improvement areas" shown in these maps are the top ranking 450 points identified by Metropolitan Council staff for inclusion in the draft 2040 Transportation Policy Plan Update.

Figure 4: Regional Barrier Crossing Improvement Areas: Freeways and Expressways

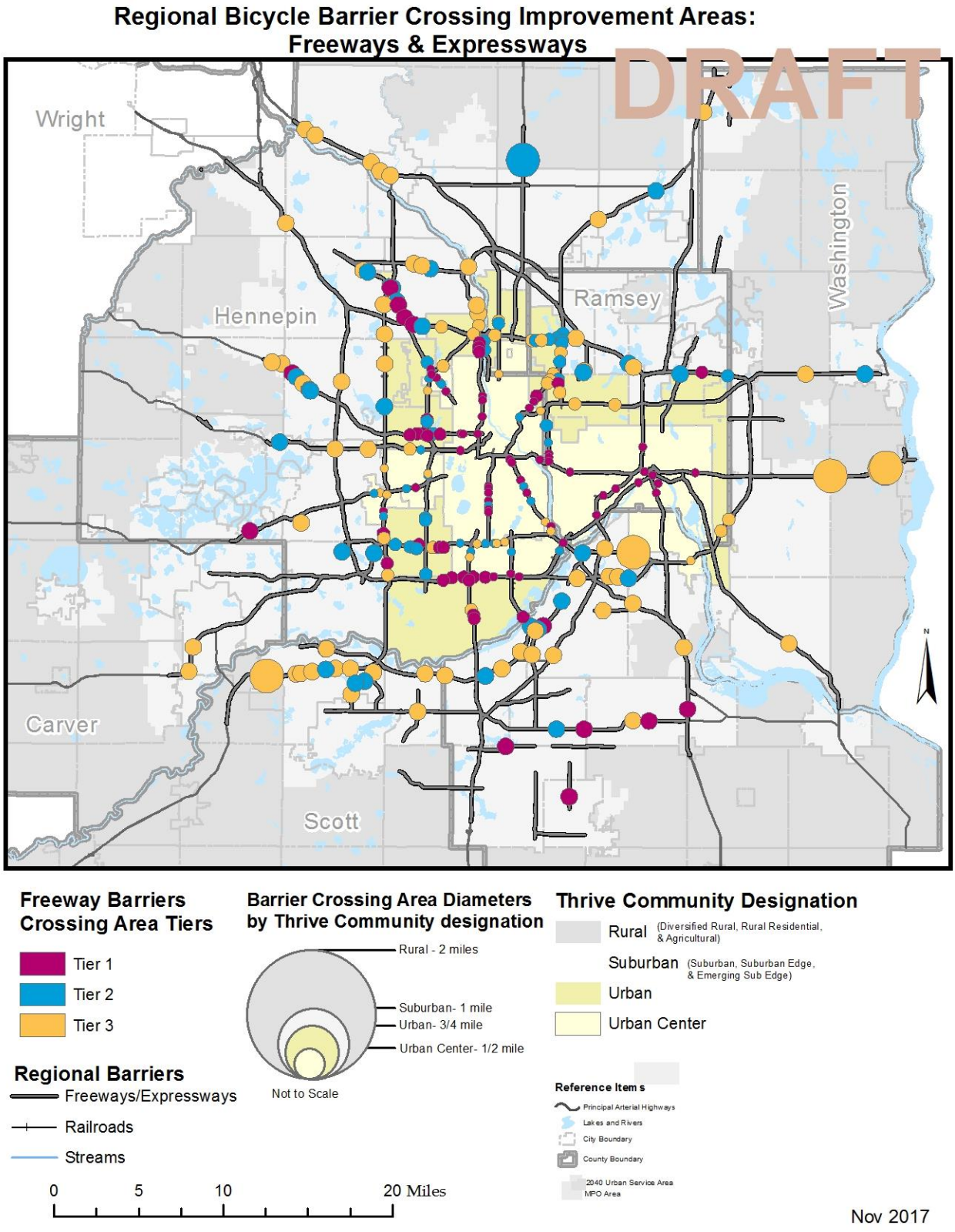
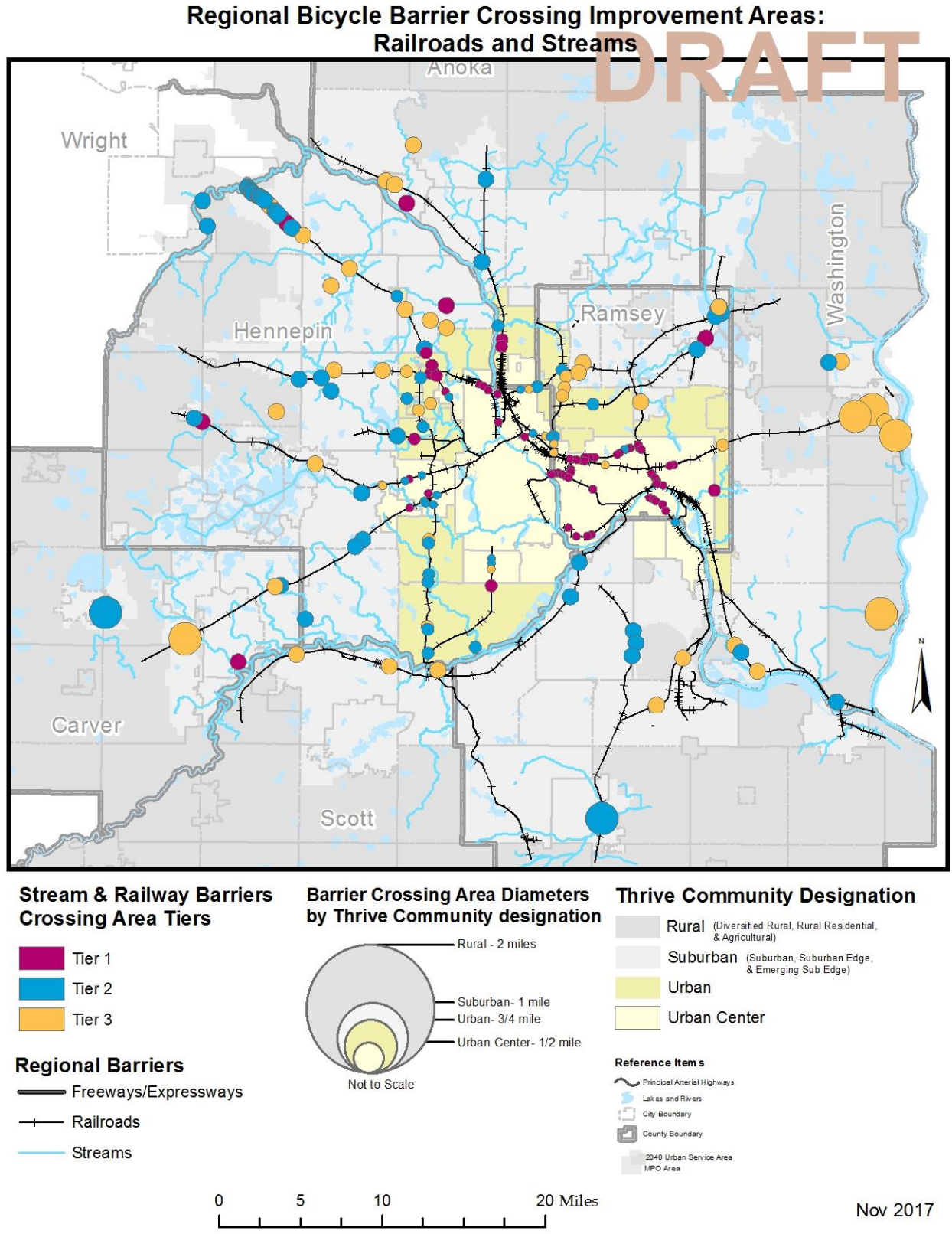


Figure 5: Regional Barrier Crossing Improvement Areas: Railroads and Streams



Attachments

Attachment 1: Scoring Summary