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EVALUATING THE DISTRIBUTIONAL EFFECTS OF REGIONAL TRANSPORTATION PLANS AND PROJECTS

Final Report

NITC-RR-862

by

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16. Abstract

Metropolitan planning organizations (MPOs) have long been required to consider the equity implications of their regional transportation plans and processes. Funded by the National Institute for Transportation and Communities, this research aims to provide additional guidance to MPOs on how to evaluate distributional equity in regional plans and projects. The report begins with an overview of federal requirements related to equity in transportation planning. We then synthesize contemporary methods for measuring transportation equity and the distributional effects of plans and projects from a review of the literature and MPO plans and studies. The report concludes with exploratory case studies of equity analysis in two regions representing distinctly different planning contexts and stages of addressing equity, and a summary of key methods to serve as a resource for use by MPOs in integrating equity into the regional transportation planning process.

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DISCLAIMER

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Introduction and Objectives

Metropolitan planning organizations (MPOs) have long been required to consider the equity implications of their regional transportation plans and processes. Federal law and guidance relative to Title VI and Environmental Justice requires MPOs to engage historically disadvantaged communities in the planning process, to address the equity effects of MPO plans and projects, and to systematically incorporate these analyses into their planning processes. Despite widespread evidence that MPOs are making efforts to address equity goals, the role of equity analysis in shaping long-range transportation plans and project decisions is often unclear and undefined. More guidance is needed on best practice methods and performance measures for addressing equity in a regional transportation planning context.

Funded by the National Institute for Transportation and Communities, this research aims to provide additional guidance to MPOs on how to evaluate distributional equity in regional plans and projects. The project evolved as a partnership between Portland State University and the University of South Florida and their respective MPOs. The team used the varied interests of the Portland Metro regional government and the Hillsborough MPO to create an analysis of equity metrics and planning recommendations at different stages in the planning process. Both teams were able to engage directly with their regional governments and use those experiences to inform this research project, while also generating valuable insights for the regional planning processes.

The specific research objectives of this project include the following:

1. Identify, collect and understand current practices for measuring transportation equity and the distributional effects of regional transportation plans and projects.
2. Inform current or future public engagement efforts of the Portland MPO equity analysis and the Hillsborough County transportation disadvantaged service program.
3. Synthesize methods for addressing key transportation equity issues of importance to metropolitan areas, including improved or new analyses, and related techniques and data collection methods.
4. Assist two metropolitan planning organizations – Hillsborough County in Tampa, FL, and Portland, OR – in further developing and applying methods of distributional and accessibility analysis in their regional planning efforts.
5. Document and disseminate these findings.

Methodology

The research began with an assessment of national research on the topic of equity in transportation planning. MPO planning documents and current literature were reviewed to determine the range of transportation equity analysis strategies employed nationally. The comparative review addressed how MPOs defined communities of concern and located them spatially; what strategies were employed to engage them in the planning process; and metrics used to evaluate equity in relation to transportation policies, projects and expenditures. Publicly available documents were used to conduct the analysis.

Equity Requirements and Guidance

MPOs are legally required and socially obligated to evaluate the distributional effects of long-range transportation planning and take steps to address the needs of, as well as mitigate adverse effects on, low-income communities, minority groups, older residents, those with limited English proficiency, and other historically marginalized stakeholders. These requirements are based on two streams of federal regulations: Title VI of the Civil Rights Act and the Environmental Justice Executive Order 12898. These regulations have been interpreted for transportation planning purposes at various points over the past four decades into a series of guidelines issued by U.S. Department of Transportation modal agencies.

Our report reviews some of the more significant points from these guidance documents, and emphasizes the following steps for integrating equity analysis into transportation planning:

- Developing community profiles for the planning area and maintaining a GIS database with the capability to analyze socioeconomic demographics, define target populations, and locate them spatially.
- Establishing an ongoing or concerted public involvement effort that is specially oriented toward achieving a better understanding of the needs and concerns of low-income and minority populations and other transportation-disadvantaged populations.
- Developing a system-level process for understanding the distributional effects of transportation investments on accessibility of these populations to jobs and services and on the availability of transportation alternatives in each region.
- Documenting the results for use in planning decision making. In particular, this should occur during development of the MPO long-range transportation plan (LRTP).

In addition, while we found recommendations to address the distribution of transportation benefits, what qualifies as fair distribution is open for interpretation. The academic literature points to two distributional approaches. One is a "proportionality approach," which examines whether communities of concern receive benefits in proportion to other populations. Although seemingly logical, this approach fails to compensate for what may be a history of underinvestment. This leads to a second approach, called "restorative," in which transportation investments are distributed in a manner that favors underserved communities and reduces inequalities over time. Some argue that a sustained effort over several decades will be needed to rectify the consequences of past actions and ensure investment actions produce the desired benefits in the future.

Other issues in current practice relate to the use of traditional long-range planning methods. Some argue that MPO equity analyses should focus on current needs rather than long-range forecasts, as migration patterns are rarely accurately predicted. This perspective advocates the following approach to achieving greater equity in regional planning:

- Using transportation funds to invest in needs expressed by historically disadvantaged communities;
- Allowing the community to make final decisions on proposed projects for their areas;
- Recognizing that the funds available today should be used for the needs of today rather than the predicted future; and
- Tailoring performance metrics and targets to equity objectives and tracking progress.

Evaluation of MPO Equity Planning Practices

Our report documents some of the major steps involved in addressing equity in transportation planning. We review contemporary practices in the following areas:

- Defining and Locating Communities of Concern
- Involving Communities of Concern
- Determining Distributional Equity of Investments
- Evaluating Accessibility and Transportation Options
- Examining Health and Safety Impacts
- Housing and Transportation Affordability
- Performance Indicators for Equity

For each, we highlight contemporary practices from a review of MPOs' plans and documents throughout the country. We present typical measures and data sources used for these equity analyses.

Case Studies

Building upon the findings of the literature and current practice survey, the CUTR (University of South Florida) and Portland State University research teams proceeded with case study applications with their respective MPO partners – Hillsborough MPO (Tampa, FL) and Metro (Portland, OR). Our project work attempted to engage with these two planning processes, and support their research needs while also learning from them. The Florida research team engaged with Hillsborough MPO staff on methods for identifying communities of concern and issues of transit, pedestrian and bicycle accessibility to essential destinations; housing and transportation costs; and safety. The Oregon research team engaged with the Metro planning process by supporting staff research needs as they developed the equity analysis measures for the long-range plan update. In that capacity, the research team developed a national assessment of contemporary equity measures and assisted staff in evaluating those measures for their regional planning needs. The research involved in both of these case studies is presented in our report, including equity measures developed and other mapping and analysis performed.

1.0 INTRODUCTION

Metropolitan planning organizations (MPOs) have long been required to consider the equity implications of their regional transportation plans and processes. Federal law and guidance relative to Title VI and Environmental Justice requires MPOs to engage historically disadvantaged communities in the planning process, to address the distribution of burdens and benefits created by MPO plans and projects, and to systematically incorporate these analyses and concerns into their planning processes. Yet federal guidance falls short of providing specific measures or standards to assess the distribution of benefits and burdens from projects or plans.

The lack of specific guidance on methods for evaluating distributional equity in regional transportation planning has led to a patchwork of approaches. Despite widespread evidence that MPOs are working toward equity goals, the role of equity analysis in shaping long-range transportation plans and project decisions also tends to be haphazard or undefined. MPOs would benefit from additional guidance on methods and performance measures for systematically addressing equity in a regional transportation planning context.

Funded by the National Institute for Transportation and Communities, this research aims to provide such guidance. The project evolved as a partnership between Portland State University and the University of South Florida and their respective MPOs. The team used the varied interests of the Portland (OR) Metro regional government and the Hillsborough MPO, which covers the Tampa, FL urbanized area, to create an analysis of equity metrics and planning recommendations that would be practical and implementable for MPOs in different planning contexts. Researchers then worked with their respective MPOs, each at different stages in the planning process, to provide technical support and/or to help inform public dialogue.

The final report catalogues the various methods in use by MPOs to evaluate equity in planning, including emerging methods, data sources and processes for distributional and accessibility analyses. Example performance measures are also identified for use in evaluating and monitoring plan impacts and guiding project priorities. Selected methods and measures are tested in two diverse metropolitan areas (Hillsborough County/Tampa, FL, and Portland, OR) for further insight. The report concludes with a synthesis of methods and measures and a brief discussion of contemporary directions for advancing regional transportation equity in the context of metropolitan transportation planning.

1.1 RESEARCH OBJECTIVES

Specific research objectives include the following:

1. Identify, collect and understand current practices for measuring transportation equity and the distributional effects of regional transportation plans and projects.
2. Inform current or future public engagement efforts of the Portland MPO equity analysis and the Hillsborough County transportation disadvantaged service program.
3. Synthesize methods for addressing key transportation equity issues of importance to metropolitan areas, including improved or new analyses, and related techniques and data collection methods.

4. Assist two metropolitan planning organizations – Hillsborough County in Tampa, FL, and Portland, OR – in further developing and applying methods of distributional and accessibility analysis in their regional planning efforts.
5. Document and disseminate these findings.

1.2 METHODOLOGY

The research team used quantitative and qualitative methods to achieve its research objectives. These methods included a comprehensive review of the literature, as well as a comparative review of MPO plans to document national best practices in equity analysis. We then documented a variety of measures, data sources and analysis techniques, and explore how these measures could be applied in the regional planning process through the use of geographic information systems (GIS), travel demand models and stakeholder engagement.

The research began with an assessment of national research on the topic of equity in transportation planning. MPO planning documents and current literature were reviewed to determine the range of transportation equity analysis strategies employed nationally. Methods used by large MPOs were documented, as well as notable practices of smaller MPOs in various parts of the country. The comparative review addressed how MPOs defined communities of concern under Title VI and other guidance; how they located them spatially; what strategies were employed to engage these communities in the planning process; and metrics used to evaluate equity in relation to transportation policies, projects and expenditures. Publicly available documents were used to conduct the analysis.

New methods and data sources for equity analysis were then developed that consider the needs of two distinctly different metropolitan planning areas: 1) Hillsborough County is a relatively low-density, sprawling, auto-dependent area with limited public transportation; and 2) Portland is a higher-density, compact urban area with a variety of travel options and a strong urban growth management system. The two MPOs also differ in their approach to addressing transportation equity in previous planning and public engagement activities. Portland has a formal working group dedicated to measuring equity as a key performance measure in the regional plan, following up from efforts in previous plans, while Hillsborough County is exploring how to more systematically evaluate equity in the regional planning process.

Both MPOs are in the process of updating their long-range transportation plans and related plans, such as transportation-disadvantaged service plans, which aim to improve and coordinate transportation resources and services for elderly, disabled, or economically disadvantaged people. The specific priorities of each region vary and were identified based upon MPO staff recommendations, a review of current practices, and feedback from communities of concern and other identified stakeholders. Dimensions of equity of interest to the MPOs include: health and safety; affordability (e.g., combined transportation and housing costs); accessibility to employment and essential services; the potential for transportation investments to create pressures for displacement; and distributional equity of transportation investments.

Given the planning timeline of both MPOs, these analyses either served as recommendations for current or future plan or project evaluation. The new methods or data collection needs were tested and subsequently refined, and provided to each agency for their consideration in ongoing and/or future evaluation and data collection practices. Efforts were also made to assist MPO staff and other interested parties in the understanding and use of selected transportation equity measures.

1.3 EQUITY REQUIREMENTS AND GUIDANCE

MPOs are legally required and socially obligated to evaluate the distributional effects of long-range transportation planning and take steps to mitigate adverse effects on low-income communities, minority groups, older residents, those with limited English proficiency, and other historically marginalized stakeholders. These requirements are based on two streams of federal regulations: Title VI of the Civil Rights Act and the Environmental Justice Executive Order 12898. These regulations have been interpreted for transportation planning purposes at various points over the past four decades and are listed in Table 1. Further detail is given below about the regulations and their interpretation for regional planning.

Table 1: Federal Regulations, Laws, and Guidance for Equity in Regional Transportation Plans

	Title VI Lineage	**EJ Lineage**
1960s	Title VI of the Civil Rights Act of 1964, 42 U.S.C. 2000(d) et seq. (July 2, 1964)	
1970s	Department of Transportation of the United States (DOT). (1970) Nondiscrimination in Federally-Assisted Programs of The Department of Transportation--Effectuation of Title VI of the Civil Rights Act of 1964. U.S. Code of Federal Regulations. 49 CFR Part 21. (June 18, 1970)	
1980s	Federal Transit Administration of the United States (FTA). (1988) Circular 4702.1 "Title VI and Title-VI Dependent Guidelines for Federal Transit Administration Recipients" (May 26, 1988)	
1990s	Federal Highway Administration and Federal Transit Administration of the United States (FHWA and FTA). (1999) Memorandum on Implementing Title VI Requirements in Metropolitan and Statewide Planning (Oct 7, 1999)	Executive Order 12898, entitled "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (Feb 11, 1994).
		Department of Transportation of the United States (DOT). (1997) Order 5610.2 Department of Transportation Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (April 15, 1997).
		Federal Highway Administration of the United States (FHWA). (1998) Order 6640.23 FHWA Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Dec 2, 1998).

2000s	Federal Transit Administration of the United States (FTA). (2007) Circular 4702.1(a) "Title VI and Title-VI Dependent Guidelines for Federal Transit Administration Recipients" (May 13, 2007)	
2010s	Federal Transit Administration of the United States (FTA). (2012) Circular 4702.1 (b) "Title VI Program Guidelines for Federal Transit Administration Recipients" (Oct 1, 2012)	Department of Transportation of the United States (DOT). (2012) Order 5610.2(a) Department of Transportation Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (May 2, 2012).
		Federal Highway Administration of the United States (FHWA). (2012) Order 6640.23(a) FHWA Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (June 14, 2012).
		Federal Transit Administration of the United States (FTA). (2012) Circular 4703.1 Environmental Justice Policy Guidance for Federal Transit Administration Recipients (Aug 15, 2012).

Federal statutes and subsequent regulations from transportation agencies addressing social equity in regional transportation planning rest on Title VI of the Civil Rights Act of 1964(42 CFR 2000(d) et seq.), which states:

> *No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance. (Sec 2000(d))*

The regulation to apply and enforce the act in the transportation realm is found in the Department of Transportation (DOT) (1970) regulation entitled Nondiscrimination in Federally-Assisted Programs of the Department of Transportation -- Effectuation of Title VI of the Civil Rights Act of 1964(49 CFR part 21). It interprets the core Title VI requirement for transportation as follows:

> *A recipient [of DOT assistance], in determining the types of services, financial aid, other benefits, or facilities which will be provided under any such program (…) may not (…) utilize criteria or methods of administration which have the effect of subjecting persons to discrimination… (Sec. 21.5(2)).*

Since regional transportation planning affects the types and configurations of transportation services and facilities, it must meet the requirements of this regulation. Perhaps most relevant to regional transportation planning is this statement from the 1970 DOT regulation,

which encourages taking affirmative steps to remove or overcome the effects of past discrimination in planning:

> *This part [of the DOT Title VI regulation] does not prohibit the consideration of race, color, or national origin if the purpose and effect are to remove or overcome the consequences of practices or impediments which have restricted the availability of, or participation in, the program or activity receiving Federal financial assistance, on the grounds of race, color, or national origin. Where prior discriminatory practice or usage tends … to deny them the benefits of … any program or activity to which this part applies, the applicant or recipient must take affirmative action to remove or overcome the effects of the prior discriminatory practice or usage. Even in the absence of prior discriminatory practice or usage, a recipient in administering a program or activity to which this part applies, is expected to take affirmative action to assure that no person is excluded from participation in or denied the benefits of the program or activity on the grounds of race, color, or national origin. (Sec. 21.5(b)(7))*

1.3.1 U.S. Department of Transportation Regulations Directing Social Equity Assessments

Requirements pertaining to protecting civil rights in regional transportation plans are derived from the Civil Rights Act of 1964 (Title VI specifically). The requirement to meet Title VI is clearly noted in the Department of Transportation's Planning Assistance and Standards – Subpart C: Metropolitan Transportation Planning and Programming (23 CFR 450), the main regulations governing regional transportation plans and transportation fund programming. These regulations include the requirement that the "metropolitan transportation planning process is being carried out in accordance with… Title VI of the Civil Rights Act of 1964, as amended (42 U.S.C. 2000d-1) and 49 CFR part 21." (23 CFR 450.334 (a) (3))

Additionally, recent "Planning Emphasis Areas" memoranda (FHWA, 2015b, 2016) from the former U.S. Secretary of Transportation Anthony Foxx to MPOs and state transportation agencies have highlighted the importance of equity among the various competing demands for priorities in regional planning. For example, the 2016 memorandum includes, in a section titled "Ladders of Opportunity," the following language:

> *We encourage State DOTs, MPOs, and providers of public transportation, as part of the transportation planning process, to identify transportation connectivity gaps in accessing essential services. Essential services include employment, health care, schools/education, and recreation. …tasks include developing and implementing analytical methods to identify gaps in the connectivity of the transportation system and developing infrastructure and operational solutions that provide the public, especially the traditionally underserved populations, with adequate access to essential services. Other effective work tasks could include: evaluating the effectiveness of public participation plans for engaging transportation disadvantaged communities in the transportation decision making process; updating the Section 5310 Coordinated Human Service Public Transportation Plans; assessing the safety and condition of pedestrian and bicycle facilities; and evaluating compliance with Americans with Disabilities Act, particularly around schools, concentrations of disadvantaged populations, social services, medical, and transit facilities. (p. 2)*

The Ladders of Opportunity Program is intended to repair and replace infrastructure that expands economic opportunity and socioeconomic mobility (USDOT, 2016b). In 2016, the USDOT announced its National Transit Map Initiative, which will display stops, routes and schedules for all participating transit agencies and be a useful tool for supporting "ladders of opportunity" (USDOT, 2016a). The next sections present a subset of federal guidance that directly addresses the regional transportation plan.

1.3.2 Title VI Guidance for Addressing Social Equity in Regional Transportation Plans

The most relevant federal guidance for MPOs implementing Title VI in regional plans is the "Memorandum on Implementing Title VI Requirements in Metropolitan and Statewide Planning" released jointly by the FHWA and the Federal Transit Administration (FTA) in 1999. The memorandum contains a short introduction with two attachments outlining standards for assessing Title VI compliance. The standards are presented as a series of questions used to evaluate the quality of Title VI compliance in regards to regional transportation plan analysis. Some questions relate to public involvement and others to the analysis and contents of the regional transportation plan. Table 1 illustrates required and frequently encountered Title VI and environmental justice components for MPO plans and products.

1.3.3 Executive Order 12898 and Application to Social Equity Assessments

To recognize and address environmental injustices often intertwined with civil rights, including Title VI infringements, President Clinton signed Executive Order 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Population (herein EO 12898) in 1994. The order directed federal agencies to identify and address the impacts of their actions on EJ communities, develop a strategy for implementing EJ, and added income as a dimension of protection from unequal treatment. The EO's implementation in the various federal transportation agencies has important implications for regional transportation planning.

EO 12898 tends to focus on understanding and addressing unequal burdens in communities near transportation facilities; it has less direct relevance to long-range regional transportation plans. Still, there is relevant language found throughout the implementing guidance from DOT modal agencies concerning incorporating environmental justice concerns into regional transportation planning processes.

1.3.4 Interpretations and Recent Updates of Title VI and EJ Guidance

Two recent updates have further clarified MPO responsibilities in relation to equity and environmental justice (EJ). In 2012, the U.S. Department of Transportation (USDOT) issued an update to Departmental Order 5610.2(a) "Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (USDOT, 2012a). The update reaffirms the USDOT's commitment to environmental justice; clarifies aspects of the 1994 Executive Order (e.g., the definitions of "minority" populations); clarifies distinctions between Title VI analysis and EJ analysis as part of the NEPA review process; and asserts the importance of EJ in early planning activities (USDOT, 2012a).

Rules for Title VI in public transportation were also updated in 2012 and were included in Federal Highway Administration Order 6640.23A (FHWA, 2012) and Federal Transit Administration Circular 4703.1 (FTA, 2012). These rules provide further guidance for implementing Title VI in planning. The FTA circular defines the benefits that shall be considered, such as increased transportation options, enhanced connectivity, improved air quality, increased property values, expanded employment opportunities, and reductions in travel time (FTA, 2012). It also requires agencies to address headways, vehicle loads, on-time performance, service availability, amenities and average fare payment (Martens & Golub, 2014a).

While the overall goals of environmental justice have remained constant, the 2012 updates laid out two primary responsibilities for MPOs and other agencies receiving federal funds in regards to environmental justice. One is to ensure equitable access to information. It is stated in the USDOT order that (USDOT, 2012a, pg. 6-7):

> *"Planning and programming activities for policies, programs, and activities that have the potential to have a disproportionately high and adverse effect on human health or the environment shall include explicit consideration of the effects on minority and low-income populations. Procedures shall be established or expanded, as necessary, to provide meaningful opportunities for public involvement by members of minority population and low-income populations during the planning and development of programs, policies, and activities…Steps shall be taken to provide the public, including members of minority and low-income populations, access to public information concerning the human health or environmental impacts of programs, policies, and activities, including information that will address the concerns of minority and low-income populations regarding the health and environmental impacts of the proposed action."*

The second key responsibility of MPOs relates to data collection and analysis. MPOs must scrutinize demographic data to identify underserved communities and determine if they are burdened by any disproportionately high or adverse impacts (USDOT, 2012a). Disproportionately high and adverse impacts are defined as an adverse effect that is predominately placed on a minority and/or a low-income population or an adverse effect that will be placed on a minority or low-income population and is substantially more severe than the adverse effect that would be placed on the non-minority and/or non-low-income population (USDOT, 2012a). Any impacts that are unavoidable must be mitigated or minimized (USDOT, 2012a; FDOT, 2015).

To carry out such efforts, MPOs and agencies are advised to "use all reasonable and available means at their disposal to better understand the demographics and needs of the communities within their areas" (FDOT, 2015, p. 13). For example, developing a Community Characteristics Inventory is one way to improve the ability of MPOs to identify underserved communities and evaluate distributional effects (FDOT, 2015). Additionally, MPOs can review their environmental justice strategies for effectiveness each year, as well as provide information and technical assistance to partner agencies.

1.4 KEY FINDINGS FROM THE LITERATURE

A review of the literature offered several key findings and recommendations for better integrating equity considerations into the MPO transportation planning process. Table 2 identifies required and frequently encountered Title VI and EJ components of MPO planning documents. Required components are considered the minimum necessary to meet federal guidelines. Equity components that are frequently encountered illustrate typical ways that MPOs address or go beyond the minimum federal guidelines.

Table 2: Required and Encountered Title VI and Environmental Justice Components of MPO Documents

Document Name	Required Components	Frequently Encountered Components
Unified Planning Work Program	• Certification of Disadvantaged Business Enterprise and Equal Employment Opportunity • Assurance of Compliance with Title VI	• Tasks and funds for low-income and minority population outreach and involvement • Tasks related to LEP populations • Tasks and funds for necessary data collection on low-income and minority populations
Long-Range Transportation Plan	• Identify and provide information to "interested parties" about the Long-Range Transportation Plan • Assurance of Compliance with Title VI	• Collection of data regarding low-income and minority populations and cultural resources • Analysis of locations of low-income and minority populations • Goals and objectives for servicing low-income and minority populations • Project selection criteria for the cost-feasible plan that incorporate projected impacts and benefits of infrastructure on low-income and minority populations • Selection of cost-feasible projects that minimize impacts on low-income and minority populations and cultural resources • Discussion of mitigation efforts • Execution and documentation of public involvement efforts that target low-income and minority populations • Preparation of a Coordinated Public Transit-Human Services Transportation Plan
Transportation Improvement Program (TIP)	• Identify and provide "interested parties" information about the TIP and its projects • Compliance with previously-adopted Non-Discrimination Statement	• Project selection criteria that incorporate projected impacts and benefits of infrastructure on low-income and minority populations • Public involvement efforts that target low-income and minority populations
Public Participation Plan	• Compliance with previously-adopted Non-Discrimination statement	• Description of LEP program • Identification of methods to involve low-income and minority populations

Source: CUTR, 2011 pg. 6

The academic literature and plans of select MPOs have also expanded equity analysis through more inclusive or detailed definitions of communities of concern with regard to equity, dynamic public involvement strategies, and the analysis of additional dimensions of equity. In line with this process, a Florida study (CUTR, 2011) noted that MPOs should focus future equity analysis efforts in the following areas:

- Developing community profiles for the planning area and maintaining a GIS database with the capability to analyze socioeconomic demographics, define target populations, and locate them spatially.
- Establishing an ongoing or concerted public involvement effort that is specially oriented toward achieving a better understanding of the needs and concerns of low-income, disabled, and minority populations.
- Developing a system-level process for understanding the distributional effects of transportation investments on accessibility of the target populations to jobs and services, and on the availability of transportation alternatives in each region.
- Documenting the results for use in planning decision making. In particular, this should occur during development of the MPO long-range transportation plan (LRTP).

1.4.1 Defining and Locating Communities of Concern (COCs)

Equity analysis begins with the identification of demographic characteristics of communities in a region and the spatial mapping process. This process can be challenging where communities of concern are dispersed across a region. Other issues include the multitude of interpretations for community, which can include, "legally-defined jurisdictions, statistically-defined enumeration units, culturally-defined neighborhoods, and socially-defined affiliations" (Rowangould, Karner, and London, 2016).

A variety of indicators may be used to help target transportation disadvantaged and historically marginalized communities for equity analysis. Although race/ethnicity and income are central to EJ analysis, other indicators of disadvantage are recommended to ensure that the analysis does not overlook important needs (Rowangould, Karner, and London, 2016). Indicators used as a proxy for transportation disadvantage or to expand analysis beyond EJ communities include zero-vehicle households, limited English proficiency, single parent households, disability, and age (youth, elderly).

Once the indicators are selected, the analysis proceeds to the spatial mapping process. Rowangould et al. (2016) evaluate three distinct methodologies for spatially locating low income and minority communities for equity analysis: (1) a threshold-based approach that groups geographic areas using demographics, (2) a population-weighted approach that calculates weighted means of performance measures, and (3) community-based identification of target areas. They conclude that for EJ analysis in planning, it is best to use both a population-weighting method to first identify non-white, low income populations and then community-based identification of geographic area or population of concern, to better understand impacts of concern to the given community.

Threshold methods are most commonly used by MPOs for locating and mapping EJ and other target communities for equity analysis. Threshold methods can include: a) identifying equal shares of target versus non-target communities in an area, b) equal percent greater than the regional mean methods, and c) standard deviation greater than the regional mean methods. There

is no guidance for selecting a threshold, and the threshold that is set can cause substantial variability in outcomes, particularly where COCs are dispersed across a region (Rowangould, Karner, and London, 2016). Therefore, the literature advises planners to corroborate the initial results through further specific analysis and community engagement. Population weighting methods, participatory mapping, or demographic analysis of service areas can be useful in this regard (Rowangould, Karner, and London, 2016).

Indices are sometimes used as an extension of the threshold method to combine multiple indicators of disadvantage into a single measure that identifies degrees or levels of disadvantage. While this method can be effective in identifying geographic areas of particular concern, it risks obscuring the needs of individual demographic groups (Rowangould, Karner, and London, 2016).

A population-weighting method of locating COCs does not identify discrete geographic areas, such as block groups, but rather the outcome for a particular group is calculated as the weighted mean of that demographic variable over all areas. An example map of this approach is provided in Figure 1: Population Weighting Method in City of Fresno This method represents actual locations of these communities and concentrations across the entire geographic area, rather than relative concentrations in relation to other communities within subunits of the study area. The methods used in this approach are more limited and less subjective than threshold methods (Rowangould, Karner, and London, 2016).

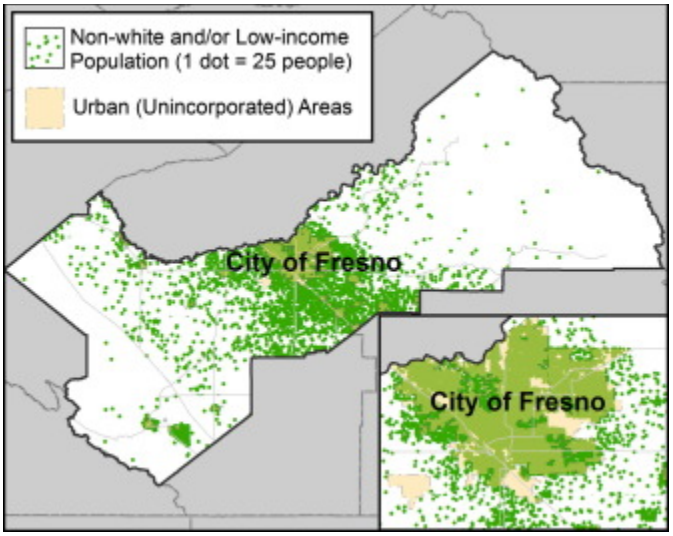

Figure 1: Population Weighting Method in City of Fresno

Source: Rowangould, Karner, and London, 2016

Another method for locating COCs is to involve a diverse group of community members and stakeholder organizations in self-identifying the locations of target communities. This approach can be part of the MPO public involvement process. While this method risks biased identification of COC areas, it can provide crucial insights as to the history and perception of neighborhoods by citizens and advocates. Given the functions and intentions of equity analysis, this approach can serve as a crucial part of involving COCs and empowering these communities (Rowangould, Karner, and London, 2016).

1.4.2 Involving Communities of Concern

Public involvement is a core tenet of Title VI of the Civil Rights Act and Executive Order 12898. Federal guidance, including the 1999 Federal Highway Administration and Federal Transit Administration joint guidance, and the 2012 FTA Circular 4703.1, requires MPOs to identify how the needs of COCs are identified and considered in long-range planning efforts. A series of questions can be used to assess the effectiveness of an MPO's public involvement efforts with vulnerable communities (NITC, 2016):

- *Does the public involvement process have an identified strategy for engaging minority and low-income populations in transportation decision making? What strategies, if any, have been implemented to reduce participation barriers for such populations? Has their effectiveness been evaluated? Has public involvement in the planning process been routinely evaluated as required by regulation? Have efforts been undertaken to improve performance, especially with regard to low-income and minority populations? Have organizations representing low-income and minority populations been consulted as part of this evaluation? Have their concerns been considered?*
- *What mechanisms are in place to ensure that issues and concerns raised by low-income and minority populations are appropriately considered in the decision making process? Is there evidence that these concerns have been appropriately considered? Has the metropolitan planning organization (MPO) or State DOT made funds available to local organizations that represent low-income and minority populations to enable their participation in planning processes?*

An innovative method of engaging COCs in transportation equity has been developed and applied by Skeo Solutions, a Washington D.C. firm specializing in collaborative solutions to pressing issues in environmental stewardship, social equity and economic opportunity. The process involves Community Transportation Equity Dialogues (CTED) that are structured to cover three key issues:

1) Historic and current status of relationship between MPOs and impacted communities;
2) Community identification of transportation priority needs and gaps; and
3) Building community capacity to effectively engage in MPO planning and decision-making processes, and building MPO knowledge and capacity to adopt an equity approach to transportation planning.

Pre-community dialogue information is first gathered to ascertain current levels of engagement of impacted communities in MPO planning and decision-making processes, and the nature of past planning and public engagement activity. To make each CTED effective, extensive outreach is conducted to gather a broad, representative and authentic audience from the impacted communities. Traditional forms of MPO outreach are augmented with meeting notices distributed through ethnic radio and ethnic newspaper public service announcements (PSAs), outreach to local civic and faith-based organizations and neighborhood associations, as well as through local political representatives (council, state and congressional representatives). Where applicable, outreach notices and PSAs are translated into Spanish and distributed to radio and newspapers and civic groups that serve this population.

The initial CTED focuses on the history of transportation planning and investment in the impacted community, current state of relationship between the impacted community and MPO, and community identification of transportation needs and gaps. The second CTED would focus on an equitable development approach to transportation planning. This second CTED would explore the concepts of transportation equity, civil rights applicability and equitable development. Two-way learning between MPO board members and staff and impacted community members is achieved through the dialogue and joint exercises. The second CTED focuses on developing an equity framework and guidance for expanded public engagement in MPO transportation planning and decision making.

The third and final CTED focuses on building the knowledge of impacted community residents about the structure and decision-making process of the MPO; the transportation project planning process and calendar; and growing their capacity to engage, participate in and serve on various MPO public decision-making structures. Where the impacted communities have significant non-English speaking populations, simultaneous translation is provided as well as translation of some materials.

The findings, results, outcomes and recommendations from each of the CTEDs are then captured in the narrative report prepared for each community to serve as a lasting reminder of the deliberations and to provide guidance for ongoing community engagement. Table 13, which appears in Section 1.5.7, provides examples of performance indicators that complement the approach. Further guidance on methods for involving communities of concern is provided in Section 1.5.2.

1.4.3 Accessibility and Transportation Options

A primary tenet of contemporary planning practice is a growing emphasis on accessibility to jobs and services as a critical performance measure. Manaugh, Badami and El-Geneidy (2014) note that to study equity within a region, the focus must be on determining levels of accessibility. Better connecting people to critical destinations and infrastructure in fiscally and environmentally sustainable ways, that are affordable to people of various incomes has become a key issue (Tomer et al., 2016).

The ability of low-income and minority populations to reach jobs, school, services and recreation has a profound impact on economic opportunity and quality of life. Accessibility is measured “to ensure that transportation systems are serving their intended purpose for all segments of the population, including EJ groups” (Martens, 2012; McCahill & Ebeling, 2015, p.7). Several factors affect accessibility, including (Litman, 2016):

- Modal options: refers to the modes of transportation available to the user. Also includes the affordability, comfort, safety and convenience of those modes.
- Transport network connectivity: the density of paths and roadway connections and the directness of travel between destinations. Also includes connectivity between modes (i.e., bus stops and bike routes).
- Land use proximity: refers to the density and mix of land uses and the distance between destinations

Both model and non-model approaches are presented in the literature for evaluating the accessibility of targeted groups to essential destinations, along with a multitude of components or

factors for analysis. Given the significant travel-cost differences between modes, accessibility is split, with transit, auto, biking, and walking accessibility to destinations evaluated separately. Accessibility can be measured at the individual/person-based level, or the location/place-based level. Travel-costs, an indicator of accessibility, can be measured based on travel time or distance.

Place-based accessibility is the most commonly used method, providing a relatively comprehensive view that can account for travel costs to specific destinations, land use characteristics, and the existing transportation network of a specific mode. For equity analysis, place-based measures should address the individual component factors through incorporating socio-economic characteristics (Boisjoly, 2017). In addition, as the essential component of accessibility is the ability to reach destinations, accessibility analyses should stratify essential destinations such as grocery stores, health facilities, government offices, and in particular, jobs and evaluate their accessibility for COCs separately to determine the extent of transportation disadvantage, as well as major gaps in the transportation system (Litman 2017; FTA 2014). Using these indicators, MPOs can compare the benefits and burdens of potential transportation investments or plans to inform decision-making. Section 3.3 and 3.4 provide an overview of key methods and measures for evaluating accessibility for equity.

1.4.4 Health and Safety

Given the well-established link between the urban form and the living environment on health and safety, examining the impacts of regional transportation plans on COCs in terms of these two components are important dimensions of equity (Kjellstrom, 2007). Examples of these impacts include but are not limited to exposure to crashes, exposure to emissions, and noise pollution. This topic also overlaps with accessibility in terms of availability of active transportation options as well as access to healthy food, healthcare and recreational opportunities.

Pedestrian and bicycle safety in particular is a growing concern for COCs. The report "Dangerous by Design 2014" (p. 13) released by the National Complete Streets Coalition (a program of Smart Growth America) noted that pedestrian fatalities disproportionately affect seniors, minorities and children. According to the report, people over age 65 make up 21% of pedestrian fatalities nationwide despite constituting just 12.6% of the population. African Americans have a 60% higher pedestrian fatality rate than Caucasians, and Hispanics have a 43% higher rate. Pedestrian fatalities are the third leading cause of death for children age 15 or younger. Further evidence shows a lack of adequate infrastructure for active transportation in many low-income and minority communities, as well as street designs neglecting users with special needs.

These statistics illustrate the importance of safety and health as it relates to COCs, and exemplify the need for evaluating the health and safety impacts of transportation plans and projects on disadvantaged communities. Sections 3.6 and 3.7 provide an overview of key measures for evaluating safety in terms of infrastructure and exposure, while section 3.8 provides key measures for evaluating the public health impacts of transportation plans and projects.

1.4.5 Transportation and Housing Affordability

Housing and transportation consume the largest percentage of income of American households. Location-efficient neighborhoods (e.g., compact, mixed-use, modal options,

convenient access to jobs and services) tend to have lower transportation costs, but often lack affordable housing options. This can reduce accessibility of disadvantaged populations to jobs, services, healthy food and other important needs, and burden these populations with longer travel distances and higher transportation costs. An analysis of 28 metro regions in the U.S. found that lower income households typically have a higher cost burden for both housing and transportation, indicating the need for examining the implications of transportation plans and projects on transportation and housing affordability for disadvantaged communities (CNT, 2006).

A key resource for MPOs evaluating housing and transportation affordability is the online mapping tool developed by the Center for Neighborhood Technology (CNT), called the H+T Index, which provides interactive housing and transportation cost maps as well as other data at a neighborhood scale. The index evaluates neighborhood variables such as households per area, average block size, transit connectivity index, job density, average commute, income, household size, and workers per household. This tool further provides the data necessary for users to conduct their own H+T analysis, allowing MPOs to easily evaluate affordability in their region, and ultimately incorporate it into their long-range planning processes (USDOT, 2015). The Hillsborough MPO case study provides a method for analyzing housing and transportation affordability in communities of concern using the CNT tool and data set. Sections 3.1 and 3.2 provide key methods and measures for evaluating housing and transportation affordability.

1.4.6 Distributional Equity

One of the foundational civil rights and environmental justice questions facing MPOs is whether transportation investments are distributed equitably. As distributional equity is typically not a stated goal in current practice, specific objectives and measures should be included to address this issue in the regional transportation plan (Martens, Golub & Robinson, 2012).The following recommendations were offered for addressing the distributional effects of transportation investments (CUTR, 2011):

- Evaluate the impacts on relative accessibility of special-needs populations to jobs, services and other basic needs during alternatives analysis. Accessibility in large urban areas may be readily evaluated using travel demand models, activity-based models or GIS. Other ways to evaluate accessibility include sketch planning, documenting issues identified by the community, and professional judgment.
- Address the needs of all populations in the planning area. For transit-dependent populations, it is particularly important to address the availability of a range of alternatives to private ownership of automobiles, such as high-quality transit service, carshare/bikeshare programs, transportation-disadvantaged programs, and quality bicycle and pedestrian networks. Spatial analysis tools such as GIS are the primary method for evaluating these options.
- Consider resource distribution in relation to sociodemographic needs and whether equivalent priority is placed on providing high-quality service to low-income and minority communities.
- Consider whether adverse effects of transportation actions are being shifted onto low-income and minority populations. This is particularly important for new highway

alignments, transit station location decisions, or projects that would increase rail or roadway traffic through largely low-income or minority areas.

- Ensure that consideration of benefits and burdens are reflected in the long range transportation plan (LRTP) goals, objectives and measures of effectiveness. For example, MetroPlan Orlando included the following objective in its LRTP: "Identify the needs of low-income and minority populations, involve these populations in the planning process, and seek to equitably distribute the benefits and burdens of transportation investments among all populations."

While transportation planning officials are mandated to address the distribution of transportation benefits, what qualifies as an equitable distribution is open for interpretation. Two general approaches have been discussed in the literature. One is a "proportionality approach," which examines whether communities of concern receive benefits and burdens in proportion to other populations, whether per capita or by another standard (Martens and Golub, 2014a, p. 25). Although seemingly logical, this approach fails to compensate for what may be a history of underinvestment.

This leads to a second approach, called "restorative," in which transportation investments are distributed in a manner that favors underserved communities and reduces inequalities over time. Some argue that a "sustained effort over several decades" will be needed to rectify the consequences of past actions, and ensure investment actions produce the desired benefits in the future. In addition, a clear goal is necessary to avoid assuming "the existing distributions are acceptable and are only in need of slight improvements" (Martens and Golub, 2014b, p. 19).

Other issues in current practice relate to the methods used. Marcantonio (2016) argues that MPO equity analysis should focus on current needs rather than long-range forecasts, as they rarely predict racial/ethnic migration patterns accurately. He further suggests that equity in regional transportation planning could best be achieved through adherence to the following four principles:

1) Using transportation funds to invest in needs expressed by the community;
2) Allowing the community to make final decisions on proposed projects for their areas;
3) Recognizing that the money available today should be used for the needs of today rather than the predicted future; and
4) Tailoring performance metrics and targets to equity objectives and tracking progress.

Marcantonio notes that substantial burdens to underserved communities, such as increased exposure to toxins, net losses in affordable housing and displacement, should be avoided, and that equity should be assessed in terms of whether priority needs are met and how well they are met to the underserved community – the benefits should be significant. Marcantonio suggests setting aside 25% of any new revenue, compiled during the first four years of the regional transportation plan, to meet the needs expressed by the underserved communities. For example, the San Francisco Bay Area allocated 25% of $3 billion in anticipated revenue to be spent to benefit low-income communities and communities of color. A portion of these funds can be provided to underserved communities to assist them in identifying their needs, and investments should then be specifically targeted to benefit low-income populations within these areas (Marcantonio, 2015).

Institutional challenges and a lack of clear equity indicators and targets are barriers to equity in regional transportation planning. Regional transportation plans frequently fail to indicate or clearly specify social equity goals or performance indicators and, without doing so, progress may never come (Martens, Golub & Robinson, 2012; Martens & Golub, 2014b). Inconsistent federal oversight standards, differences in agency planning capacity and support for equity analysis, and funding constraints at both the state and regional level are other ongoing barriers to equity in planning (Lowe, 2014; Amekudzi et al., 2012; Karner & Niemeier, 2013). In addition, although most MPOs strive to involve historically disadvantaged communities in the planning process, doing so "…is not sufficient in and of itself to ensure that an agency achieves EJ outcomes" (Amekudzi et al., 2012).

1.5 REVIEW OF MPO EQUITY PLANNING PRACTICES

To identify the current state of the practice, the research team reviewed a cross section of MPO long-range transportation plans and environmental justice studies from across the U.S. The reviews of the MPO plans focused on a range of issues including: (1) defining and spatially locating communities of concern (COC); (2) methods to involve COC in the decision-making process; (3) methods for evaluating selected equity outcomes of plans; and (4) any performance measures for monitoring equity. This section summarizes key findings and observations as to the state of current practice for integrating equity into the MPO transportation planning process, documenting notable practices from MPOs.

1.5.1 Defining and Locating Communities of Concern

A key step in evaluating equitable distribution of benefits and burdens in transportation planning is defining and locating COCs. Title VI of the Civil Rights Act and Executive Order 12898 on Environmental Justice identify race, color, national origin and low-income status as factors that must be considered in equity analysis. However, many MPOs use additional factors to identify vulnerable groups. COCs are often defined as areas having greater-than-average populations of one or more of the following demographic groups:

- Minority
- Low-income
- Elderly (typically 65 years or older)
- Limited English Proficiency (LEP)
- Disabled
- Carless households

Although "low-income" is sometimes defined as households at or below the federal poverty level, it encompasses only the very poor (about 20% of households). Therefore, MPOs at times expand the definition to 185% or 200% of the federal poverty level to capture working-class households and the working poor in their analysis. Several MPOs also included other variables related to economic disadvantage, such as:

- Single-parent households
- Female-headed households with children

- Households receiving food stamps
- Households in neighborhoods with low to medium home values
- Households where the head has no high school education

Table 3 summarizes the various methods used by MPOs to define and locate COCs. Most MPOs used census data to identify areas where minority, low-income and other target populations exceeded regional averages for minority and low-income populations. A few MPOs, namely the Houston-Galveston Area Council and Delaware Valley Regional Planning Commission, used indices in their demographic analysis, as shown in Table 4.

Table 3: MPO Methods for Identifying Communities of Concern

MPOs	Variables	Data Source(s)
Association of Bay Area Governments/Metropolitan Transportation Commission (MTC, 2013)	Low-income, minority, LEP, zero-vehicle households, elderly (75+ years old), persons with disabilities, single-parent families	2000 Bay Area Travel Survey 2010 Census 2010 American Community Survey
Atlanta Regional Commission (ARC, 2011b)	Elderly, no high school education, low to medium housing values, low-income, minorities, LEP, and disabled persons	2009 ESRI data
Delaware Valley Regional Planning Commission for Pennsylvania (DVRPC, 2013a)	Low-income populations, minorities, elderly (75+), carless households, persons with disabilities, LEP, and female head-of-household with child populations; Degree of Disadvantage (DOD) Index	2010 Census
Hamptons Roads Transportation Planning Organization (HRTPO, 2014)	Minorities, low-income, LEP, female head of household, households receiving cash public assistance or food stamps, elderly (65+), carless households, and persons with disabilities	2009-13 American Community Survey
Houston-Galveston Area Council (HGAC, 2011)	Elderly (65+ years old), minorities, and low-income populations; Environmental Justice Index	2000 Census
New York Metropolitan Transportation Council (NYMTC, 2013);	Low-income and minority populations	2000 Census
North Central Texas Council of Governments (NCTCOG, 2013)	Low-income, minorities, elderly (65+), carless households, female head of households, and persons with disabilities	2000 Census
Omaha-Council Bluffs Metro Area Planning Agency (OCBMPA, 2015)	Low-income, minorities, carless households, and transit-dependent populations	2010 Census 2013 American Community Survey
Polk Transportation Planning Organization (PTPO, 2015b)	Low-income, transportation-disadvantaged and minority populations	2007-2011 American Community Survey data
Puget Sound Regional Council (PMRG, 2014)	Minorities, low-income, special-needs populations (i.e., persons with disabilities, youth, seniors, LEP, homeless persons, school-aged children, families who have experienced domestic violence, veterans, and limited literacy residents)	2010 Census

Table 4: Indices Used to Identify Communities of Concern

MPO	Objective	Methodology	Data Used
Houston-Galveston Area Council (HGAC) 2035; Appendix C: Environmental Justice Report (pg. 5-6)	To determine if the 2035 RTP's costs/benefits are different for EJ communities compared to non-EJ communities.	*General approach:* Aggregate scoring *Variables used:* Elderly, minority and low-income *Unit of analysis:* Census block groups *Steps:* The percentage for each variable was calculated for each census block group. A ratio was calculated by comparing these figures with regional averages for each population. The scores for census block groups were assigned by the following: o A "0" for ratios lower than regional averages o A "1" for ratios that were equal to but less than twice the regional averages o A "2" for ratios that were at least twice the regional averages o After scores were assigned, an aggregate score was created by adding them together *The matrix used:* (p.6) 0-1 points = Areas of low EJ concern 2-3 points = Areas of moderate EJ concern 4-6 points = Areas of significant concern	2000 U.S. Census
Delaware Valley Regional Planning Commission (DVRPC); FY2012 Transportation Improvement Program for New Jersey (pg. 26)	To identify demographic groups that may be underrepresented in the planning process, or might otherwise be disproportionately impacted by planning decisions (p.26).	*General approach*: Degrees of Disadvantage (DOD) *Variables used:* Low-income, minority, elderly, carless, disabled, LEP populations and female-headed households with a child. *Unit of analysis:* Census-tract level *Steps:* • Determined that each census tract could contain 0-8 different categories considered sensitive on a regional scale. The number of sensitive categories within each census tract, if greater than the regional average, determined the degree of disadvantage for the area. • The TIP projects were mapped against the census tracts using the matrix below. *The matrix used:* • 1-4 DODs = Considered a low disadvantaged area • 5-8 DODs = Considered a highly disadvantaged area	2000 U.S. Census

1.5.2 Involving Communities of Concern

MPOs use a variety of methods for involving COCs in the transportation decision-making process. Many provide translation services, work with community group partners, ensure that public facilities are accessible to disadvantaged populations, and have advisory committees that engage underserved populations in the transportation planning process.

For example, the Metropolitan Transportation Commission in Oakland, CA, conducted a public-opinion telephone survey specifically targeted to minorities and low-income populations, and partnered with community-based organizations to conduct workshops in low-income neighborhoods (MTC, 2005). Polk TPO in Central Florida communicates regularly with community groups that represent underserved populations; develops culturally sensitive outreach materials; and attends cultural festivals, such as the Hispanic Festival in Lakeland, to discuss planning activities and solicit community feedback. Table 5 illustrates some of the varied methods used by other MPOs to involve COCs.

Table 5. Methods used by MPOs to Involve Communities of Concern

MPO	Methods
Atlanta Regional Commission (ARC, 2011)	• Focus groups and listening sessions are conducted to gather input from underserved communities. • The MPO has a Social Equity Advisory Committee.
New York Metropolitan Transportation Council (NYMTC, 2009)	• The MPO partners with community groups and religious groups, which help underserved populations get involved in the planning process. • MPO advisory groups act as mediums for community engagement. • Public transportation departments disseminate information to non-profit groups, who represent and interact with minorities and low-income populations.
Miami-Dade Metropolitan Planning Organization (MDMPO, 2014a)	• Social media, local media outlets, press releases, and multilingual advertisements and handout materials in three most common languages. • Materials are hand delivered or disseminated through venues and/or groups that serve low-income, transit-dependent and disadvantaged populations. • Community-based organizations help publicize meetings, which are held at neighborhood centers and libraries accessible to low-income residents. Translators are available at all public meetings. • MPO has “Transportation Outreach Planner” who tailors involvement strategies to community context, literacy rates, income levels, cultural composition and religious affiliations.

1.5.3 Evaluating Accessibility and Transportation Options

As discussed in section 1.4.3, the number of factors involved can make accessibility difficult to measure. MPOs have used a variety of methods to examine accessibility. Some MPOs measure accessibility by transit network coverage and connectivity, while others measure accessibility in terms of a particular type of destination, such as employment (Welch & Mishra, 2013; Welch, 2013; Currie, 2010; Mamun, Lownes, Osleeb & Bertolaccini, 2013). Still others use a combination of methods. Table 6 illustrates different metrics used by MPOs for accessibility analysis in relation to transportation modes as identified in the review of regional transportation plans.

For example, Polk TPO in Central Florida created a Mobility Index, which accounts for pedestrian and bicycle access, transit connectivity, and network gaps and barriers. Pedestrian and bicycle access was measured by network connectivity, development density, diversity of land uses, and the number of destinations within a certain distance (a quarter mile for pedestrians, one mile for bicycles). Transit connectivity was measured by the location, frequency and intensity of transit service. Network gaps and barriers were measured by gaps in connectivity (e.g., sidewalk gaps) and the presence of hindrances to walking and cycling (Polk TPO, 2015d). Overall accessibility was calculated by subtracting gaps and barriers, as discussed further in Appendix A.

Table 6. MPO Measures of Accessibility and Transportation Options

MPO	Accessibility Measures and Metrics
Atlanta Regional Commission (ARC, 2011)	• Potential Walking Demand: Number of households, services, jobs, stores people can walk to and/or receive goods/services • Multimodal Accessibility Measure: Access to jobs via three travel modes: 45-minute transit trip, 30-minute drive, and a 15-minute walk
Polk Transportation Planning Organization (PTPO, 2015d)	• Mobility Index: Potential Access with Gaps Discount and Barriers Discount o Potential Access: ▪ Walking/Biking: Existence of connectivity, dwelling density and diversity in use ▪ Transit Connectivity: Access via the location, frequency and intensity of transit service o Gaps: Transportation network gaps (i.e., gaps in sidewalk network); discount factor up to 25% of the potential access o Barriers: Presence of hindrances to walking/biking (i.e., roadway, waterway, and/or railroad); discount factor up to 25% of the potential access
San Diego Association of Governments (SANDAG, 2012)	• Access to healthcare facilities, healthy food, transit stops, parks and open space, and non-motorized trails where more than 50% of their households live within .6 miles walking distance of each destination type

The San Diego Association of Governments (SANDAG) developed a Healthy Communities Atlas, which included measures of accessibility to certain health-related destinations. The Atlas measures access to healthcare facilities, transit stations, healthy food, parks and open space, and non-motorized trails. Census block groups were deemed "accessible" if they had more than 50% of households within walking distance (.6 mile) of any one of these healthy destinations (SANDAG, 2012).

The Atlanta Regional Commission measures walkability and multimodal accessibility. Potential for walking is measured by the number of destinations within a 15-minute walking distance. Multimodal accessibility is measured by the number of jobs accessible by a 45-minute transit trip, a 30-minute drive, and a 15-minute walk (ARC, 2011). Table 7 highlights a range of methodologies used by MPOs to examine accessibility.

Table 7: Examples of MPO Accessibility Analysis Methodologies

MPO	Objective	Steps Taken	Source
Houston-Galveston Area Council (HGAC); Accessibility Analysis – Travel Times in Transportation Analysis Zone (TAZ) Areas in EJ Communities	To determine if EJ populations currently, or are expected to, experience longer travel times either by automobile or local transit due to the 2035 RTP.	Calculated average travel times for auto and transit from each TAZ within EJ communities to an identified TAZ area with a major activity center. • Using a travel demand model, the most frequented TAZ from EJ communities was identified and travel times to this TAZ destination was calculated for the current year of 2005, the year 2035 with the plan, and year 2035 without building changes. • The more trips recorded to TAZs with higher EJ populations, the more TAZ sites were recommended for projects, especially for pedestrians and bicyclists.	Source: 2035 RTP, Appendix C: Environmental Justice Report, Pg.11-12.
Southern California Association of Governments (SCAG)	To compare the accessibility to medical services and grocery/general merchandise stores between EJ and non-EJ groups.	Identified areas where stores were accessible by walking, biking, and local bus transit. Using 2008 data, three- and five-mile radii were used to determine the distance to each. Accessibility to these areas by EJ groups was compared with that of non-EJ groups.	(SCAG) 2012-2035 RTAP: Sustainable Communities Strategy Towards a Sustainable Future Environmental Justice Appendix Accessibility Analysis – Medical Services and Grocery/General Merchandise Stores

Southern California Association of Governments (SCAG)	To evaluate travel times to places of employment, shopping accessibility, and accessibility to public parks for EJ groups.	Created TAZ travel time matrix by examining TAZ zones by mode (i.e., auto, local bus transit, and all other transit) to create a study area. Selected all TAZs accessible with different transportation modes within 45-minutes of travel. Using SCAG's employment database, medical facilities, general merchandise stores, and grocery stores were identified, as well as the growth projections for retail jobs and number of total jobs within the study area. In addition, measurements included access to total acreage of parks.	(SCAG) 2012-2035 RTP: Sustainable Communities Strategy Towards a Sustainable Future Environmental Justice Appendix (pg. 63)

The North Jersey Transportation Authority (NJTPA) developed a methodology for evaluating the performance of transportation projects, including effects on accessibility (NJTPA, 2011). Dimensions of accessibility were access to jobs, access to labor force, access to regional amenities (such as hospitals, universities, retail activities, recreation, etc.), and access to community amenities. Bicycle and pedestrian projects were evaluated to determine which destinations became accessible by walking and bicycling as a result that previously were not accessible by certain segments of the population. As part of the project prioritization process, NJTPA uses improved accessibility for EJ communities as a major deciding factor. Data and metrics used in the assessment are provided in Table 8.

Table 8: NJTPA Bicycle and Pedestrian Accessibility Methodology

Data Sources and Inputs	Measures
• Locations of working-age population (U.S. Census Bureau) aggregated to TAZs • Locations of jobs (from U.S. Census Bureau, Center for Economic Studies, Longitudinal Employer-Household Dynamics Program) aggregated to TAZs • Locations of regional amenities (from GIS database of regional amenities) • Locations of local amenities (from GIS database of local amenities) • Peak-hour travel speed data for links in the NJRTM-E model network (from INRX or other vehicle probe data) • NJRTM-E model network link attributes (link length, toll information)	**Access to Community Amenities**: Distance-based cumulative opportunity accessibility measure **Access to Destinations Other Than Community Amenities**: Travel time-based cumulative opportunity accessibility measure

Source: NJTPA, 2011, pgs. 3.10-16 – 3.10-17

1.5.4 Examining Health and Safety Impacts

Varying approaches are being used by MPOs to measure health and safety impacts and to reduce adverse impacts and/or improve health and safety outcomes for underserved communities. Table 9 compares the different approaches used by MPOs to measure bicycle and pedestrian safety, health and safety impacts, and air quality in COCs.

Table 9. MPO Health and Safety Analysis

MPO	Bike/Ped Safety	Health & Safety Impacts on COCs	Air Quality Impact Measurements
Atlanta Regional Commission (ARC, 2014)	• Identifies crash locations by mode to be targeted for investment	• Projects at crash locations are assumed to address safety issues • Equitable Target Areas (ETAs) identify EJ communities and targets them for investment	N/A
San Diego Association of Governments (SANDAG, 2012)	• Maps pedestrian- involved motor vehicle crashes • Maps cyclist-involved motor vehicle crashes • Maps pedestrian and cyclist crash rate • IDs block groups by level of safety and determines how many are COC	• Traffic Safety for Youth • Designed to find areas where investment is needed	• Measured impact zones from highways, rail yards, ports • Determined number of COC block groups by proximity to air pollution sources
San Francisco Metropolitan Transportation Council/Association of Bay Area Governments (MTC, 2013)	• N/A	• Emissions Density • VMT Density	• Emissions Distribution Index results stratified by pollution and community type, including COC

The growing interest in health impact assessments in transportation is also helping to inform equity analysis. SANDAG, for example, conducted a comprehensive analysis of health and safety in the San Diego metropolitan area, called the Healthy Communities Atlas, as mentioned above. The Atlas is accompanied by a set of GIS tools that can be used to identify geographic areas that support healthy lifestyles and areas in need of improvement (SANDAG, 2012). It also includes an index for measuring pedestrian and bicycle safety by census block group, which allows for comparison between COCs and the broader region.

The SANDAG Healthy Communities Atlas and its parent project resulted in the development of a "Regional Existing Conditions and Gap Analysis" for healthy communities, and a "Regional Health and Wellness Policy Framework and Performance Measures" that informed the development of the Regional Transportation Plan in subsequent updates. The Atlas and its parent project also resulted in the idea of healthy environments and communities being

incorporated into systematic project evaluation criteria and network performance measures for transportation projects. Table 10 shows a comparison by SANDAG of cyclist safety in all block groups to cyclist safety in block groups with COCs. SANDAG also classified census block groups by proximity to air pollution sources, and analyzed the distribution between COCs and other areas. Table 6 shown earlier in the report provides accessibility metrics applied by SANDAG relative to health.

Table 10: Block Groups by Level of Cyclist Safety

Level of Safety	All Block Groups	COC Block Groups
Very High	353 (20%)	240 (14%)
High	352 (20%)	252 (14%)
Neutral	352 (20%)	235 (13%)
Low	352 (20%)	240 (14%)
Very Low	353 (20%)	266 (15%)
All Categories	1,762 (100%)	1,233 (70%)

Source: SANDAG, 2012, p. 58

San Francisco Bay Area MTC's most recent plan, Play Bay Area 2040, is their first to analyze health with regard to impacts on active transportation, collisions, and air quality. The plan compares the impacts of plans and projects on individuals and in aggregate, using the same measure of impacts as GHG emissions and job-creation – disability-adjusted life-years. Furthermore, as a unique practice, the plan uses morbidity and mortality as factors in their cost-benefit analysis of transportation projects in the project selection process.

1.5.5 Transportation and Housing Affordability

In response to the rising cost of housing and transportation and the relationship between the two, MPOs are beginning to examine the impact of their long-range transportation plans on housing and transportation affordability (see Table 11**Error! Reference source not found.**). The Association of Bay Area Governments and Metropolitan Transportation Commission's 2013 Plan Bay Area was one of the few to apply a housing and transportation affordability measure to evaluate the equity impacts of various plan scenarios on COCs. Portland Metro and the Southern California Association of Governments in Los Angeles are also beginning to address this issue.

Plan Bay Area applies a combined housing and transportation cost index as a key performance measure when evaluating planning scenarios. The metric is calculated regionally to compare affordability between lower-income individuals (those making under $38,000 a year) and those of higher income. Average housing costs per household are combined with transportation costs and divided by average income. This metric was added in response to concerns raised in the Plan Bay Area Equity Working Group.

The H+T metric only considers impacts on residents based on income, whereas this measure works in conjunction with a measure of displacement risk that geographically locates and measures affordability impacts on areas with higher concentrations of "rent-burdened" communities of color (those paying over 30% of their income on rent). The metric does not,

however, account for other anti-displacement policy tools such as rent control and inclusionary zoning that would potentially increase affordability (MTC, 2013).

Portland Metro's 2014 Regional Transportation Plan includes a similar housing cost and transportation affordability index as a performance target. The MPO set a goal of reducing the average percentage of income spent on housing and transportation from 43% to 25%. The plan concludes that despite transportation costs remaining constant, the overall index will continue to rise to 51% by the year 2040. Metro is currently rigorously evaluating and expanding its equity metrics, including the methodology and evaluation of this target (Metro, 2014).

The Southern California Association of Governments (SCAG) 2012 Regional Transportation Plan coordinated a transportation equity working group that called for the inclusion of housing and transportation affordability as a metric. Toward that end, SCAG conducted an analysis of the risk of gentrification and displacement. The SCAG methodology looked at gentrification in transit-oriented communities (TOCs), which are defined as neighborhoods within a half-mile distance of existing rail stations, compared to the greater region and High Quality Transit Areas (HQTAs), on a census block group level.

Table 11. **Housing plus Transportation Cost Affordability**

MPO	Metric
Association of Bay Area Governments and Metropolitan Transportation Commission - Equity Analysis Report Including Title VI, Environmental Justice and Equity Analysis. *Bay Area Plan: A Strategy for a Sustainable Region.* July 2013.	Combined housing and transportation index evaluates impacts based on income. Combined with displacement risk metric to evaluate impacts on communities of color specifically.
Southern California Association of Governments - Environmental Justice Appendix. (RTP) (FY2012-2035).	No metric for affordability, but does have displacement risk measure that highlights areas with a high percentage of minority population, poverty rate, share of 65+ population, percentage of households without a car, percentage of non-English speakers, population without a high school diploma, and percentage of renters.
Metro (Portland) Regional Government. - 2014 Regional Transportation Plan.	Combined housing and transportation performance target for system-wide impacts on affordability. Not comparative spatially.
San Diego Association of Governments (SANDAG) – San Diego Forward: The Regional Plan (2050) (RTP) (Appendix S)	Percent of households with housing costs greater than 35% of income. Annual income needed to afford fair market rent.

The SCAG methodology measured differences in the percentage of minority population, poverty rate, share of 65+ population, percentage of households without a car, percentage of non-English speakers, population without a high school diploma, and percentage of renters. SCAG also used a Gentrification Index developed by the University of Chicago, which applies a more robust set of measures including female-headed households, youth and adults with college degrees. According to the analysis, Hispanics and seniors have seen less growth in TOCs during the 2000-2013 period, while median gross rent has increased and median gross income has decreased in these TOCs compared to the greater region. SCAG recognizes these different

growth patterns as possible evidence of gentrification and displacement – but acknowledges the limits of its statistical testing and the need for continued monitoring.

1.5.6 Determining Distributional Equity of Investments

The simplest way that MPOs address the concern of distributional equity is by mapping the spatial distribution of projects or project spending and determining if they are proportionally distributed between COCs and non-COCs, whether in terms of dollar investments per capita, total number of projects, or other measures. The Delaware Valley Regional Planning Commission, for example, measures whether areas determined to have high "degrees of disadvantage" (above average populations of COCs) have equal spatial distributions of proposed number of projects in the transportation improvement program compared to the region as a whole (VRPC, 2013).

A shortcoming of this approach is that transportation investments in disadvantaged communities may not necessarily benefit those communities in proportion to benefits accrued by other populations (Marcantonio, 2015). For example, a commuter rail project through a low-income minority neighborhood may be a major investment, but the benefits would not accrue to that neighborhood if little or no transit station access is provided. To address this issue, some MPOs are beginning to use more nuanced approaches to determine whether or to what extent COCs benefit from the project investments in their area. These approaches include those mentioned below in relation to accessibility, health, safety and related issues.

For example, the Southern California Association of Governments (SCAG) goes beyond the geographic distribution of projects to examine the specific impact of that distribution on COCs. One component of this analysis is the distribution of travel time and distance savings from implementing the proposed transportation plan. Demographic data and mode usage statistics for each transportation analysis zone (TAZ) are used to compare time savings per trip for both car and transit options. Time savings are calculated based on each group's usage of the system, so that adjustments can be made to address any disproportionate burdens or benefits (SCAG, 2012)

SCAG further evaluates jobs-housing imbalance, as well as accessibility to jobs and employment, to determine the impacts of project distribution. The jobs-housing imbalance metric examines the extent to which lower-income workers are disproportionately impacted by congestion and high transportation costs. The accessibility metric examines what amenities and places of employment are feasible to get to as a result of the planned improvements. Both of these measures are calculated for different COCs, in comparison to the average for the region as a whole. Table 12 includes these examples of MPO distributional equity analysis.

Table 12. Distributional Equity of Investments

MPO	Methods
Delaware Valley Regional Planning Commission (2013) Transportation Improvement Program (TIP) (FY2013–2016)	• Spatial distribution of transportation projects between census tracts with high and low "Degrees of Disadvantage."
Southern California Association of Governments (2012) - Environmental Justice Appendix. (RTP) (FY2012-2035)	• Analyzes distribution of time and distance travel savings, jobs-housing imbalance implications, and accessibility of employment for EJ communities compared with that of the general population.
North Jersey Transportation Planning Authority (2005) - NJTPA Environmental Justice Regional Analysis, Proportional Distribution of Benefits of Transportation Projects in the NJTPA Region	• Overlaid map of transportation investments with EJ community maps to determine the spatial distribution of investments.

The Atlanta Regional Commission mapped the per capita transportation investments in Equitable Target Areas (ETAs) compared to non-ETAs to determine whether the levels and types of investments in COCs were appropriate (ARC, 2014). Transportation investments were examined on a per capita basis for transit, roadway, bike and pedestrian projects for ETAs versus non-ETAs on a dollar basis, as shown in Figure 2.

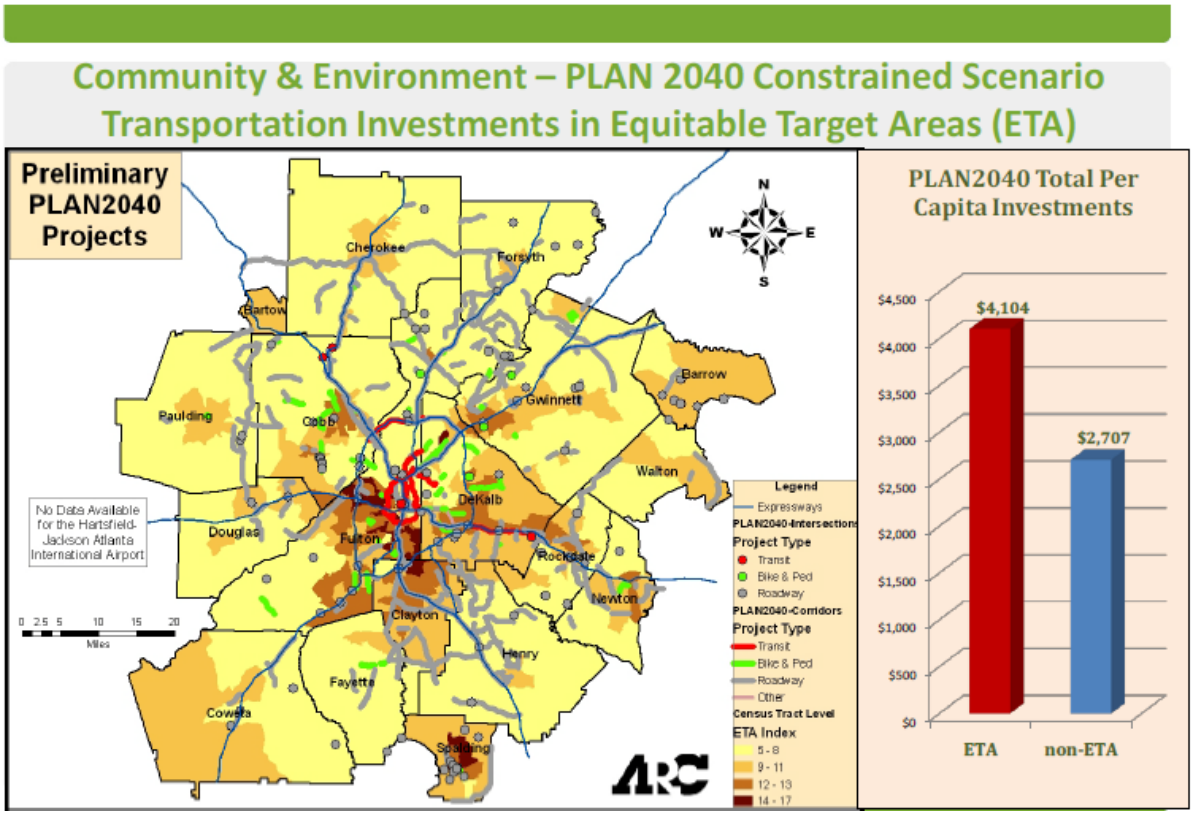

Figure 2. Transportation investments in equitable target areas (ETAs).

Source: ARC, 2014, pg. 33

1.5.7 Performance Measurement

Adoption of performance measures or indicators guides the evaluation of transportation plans in relation to plan policies and objectives and is essential to the systematic integration of equity into the MPO planning and project prioritization process. As the saying goes, "What gets measured gets done." Performance measures are used in evaluating the who, what, where, when, why, and how of the impacts of transportation plans and projects, and serve to inform transportation agencies and decision-makers. The adoption of equity-based performance targets allows transportation agencies to measure their progress, and allows the community to hold them accountable. Therefore, these indicators and targets should be developed through direct involvement of the affected communities.

MPOs evaluated transportation system performance, as well as equity, in a multitude of ways, both qualitative and quantitative. Some MPOs provide explicit equity objectives in their plan and others integrate equity considerations into some or all of their planning objectives. The above sections describe the variety of possible lenses through which performance indicators and targets are created—public involvement, accessibility, health, safety, affordability, and distribution of investment. Additional examples of performance indicators used by MPOs relative to their equity goals are shown in Table 13.

Table 13: MPO Equity-Related Indicators and Benchmarks

MPO	Performance Indicator	Measurement	Targets or Benchmarks
Atlanta Regional Commission (ARC)	Access to jobs via multiple travel modes.	Access to jobs via three travel modes: 45-minute transit, 30-minute drive, & 15-minute walk.	Sets a base index to compare to multiple scenarios and 2040 aspirations
Miami-Dade MPO	Reverse commute opportunities for disadvantaged communities. Projects that support redevelopment areas.	Transit service route miles from cities and central areas in the AM peak period. Transit service route miles and highway lane to centerline miles within .5 miles of redevelopment areas.	No targets set
Plan Bay Area (MTC)	Affordable Housing and Transportation Choices. Equitable Growth Healthy Communities Making the Jobs-Housing Connection Equitable Mobility	Estimates produced at neighborhood TAZ level of certain socioeconomic and travel characteristics for 2010 base year and 2040 forecasts: • Housing and Transportation Affordability • Potential for Displacement • Vehicle Miles Traveled Density • Average Commute Time • Average Non-Commute Travel Time	No targets set
Southern California Association of Governments	Accessibility (parks and employment services)	Percentage of parks/employment services reachable within a 30-minute off-peak travel time via automobile, bus/rail via automobile, bus/rail via walking.	No targets set

Ideally, performance indicators and targets are developed for each key stage of the transportation process, beginning with community engagement. A balance must be struck between goals and objectives that are easily operationalized, but costly or time-consuming to measure. MPOs looking to methodically prioritize their objectives to address social equity must recognize the inherent trade-offs between social equity and other objectives (Manaugh, 2014).

Table 14 illustrates example performance measures for equity and community engagement in the transportation planning process, as developed by Skeo Solutions, a firm specializing in collaborative equity planning. Additional example performance indicators and targets are provided in the case study analyses summarized in Section 2.

Table 14. Example Equity and Community Engagement Performance Measures

Action Measures		**Results Measures**	
Inputs ***What's invested***	**Outputs** ***What's created***	**Outcomes** ***What happens***	**Impact** ***What changes***
Number of low-income, people of color and LEP community members who participate during planning Number of community organizations who participate during planning	Dollar amount of community-based transportation investments prioritized for low-income, people of color, and LEP neighborhoods Measure of growth in community member trust in transportation agency Measure of community knowledge related to transportation plans, alternatives, impacts and benefits Measure of growth of agency knowledge related to community stakeholders, goals and issues Description of regulatory or policy changes related to community input	Number of community-prioritized intersection safety improvements in low-income, people of color, and LEP neighborhoods Miles of community-prioritized bike lane and sidewalk improvements in low-income, people of color, and LEP neighborhoods that improve access to key destinations such as jobs, educational opportunities, health or social service destinations, and/or healthy food outlets. Hours of reduced idling due to community-prioritized traffic light optimization in low-income neighborhoods Number of modal options available to access key destinations of a neighborhood within a given timeframe Number of households and schoolchildren protected from community-prioritized truck route realignment	Increase in number of residents walking and biking as a primary means to access key destinations Reduced bike and pedestrian accidents/deaths Improved air quality monitoring results Reduced asthma incidents Decrease in amount of time it takes to access jobs centers or other destinations via transit

Source: SKEO, 2016, www.skeo.com.

2.0 CASE STUDY ANALYSIS

This section describes exploratory case study applications of equity analysis conducted by the University of South Florida (CUTR) and Portland State University research teams in collaboration with their respective MPO partners – Hillsborough MPO (Tampa) and Metro (Portland). Below is a summary of the results of those applications and technical assistance efforts.

2.1 HILLSBOROUGH MPO - TAMPA, FL

2.1.1 Introduction and Background

Hillsborough County is a major economic and cultural center in the state of Florida. It is home to the cities of Tampa, Temple Terrace and Plant City (Hillsborough County, 2016). At a 2015 population of approximately 1.35 million people, Hillsborough County is the fourth most populous county in Florida. The population continues to increase, with nearly 10% growth between April 2010 and June 2015. Other than the downtown core areas and a few activity centers, the county is characterized by large areas of relatively low density and residential development, with commercial development focused in strips on major roadways. The region has no fixed rail transit service (other than a streetcar system with limited service connecting a couple neighborhoods around downtown Tampa), a limited bus transit network and relatively infrequent bus service.

Historically, Hillsborough MPO has not systematically addressed equity in its regional transportation planning process. Rather, the MPO has worked to identify and address the needs of transportation-disadvantaged populations within the context of specific plans and studies. These efforts included those reflected in the Tri-County Area Regional Mobility Needs study, the Transportation Disadvantaged Service Plan, and the MPO long-range transportation plan, as discussed below.

2.1.1.1 Planning Context

The county's Transportation Disadvantaged Service Plan (TDSP) has been the primary venue for addressing the transportation needs of historically disadvantaged communities in Hillsborough County. Using 2010 census data, a demographic profile was prepared to identify potential transportation-disadvantaged populations (HMPO, 2015a). Variables included: population density for ages 60 and above; census tracts with median income less than 80% of the county median; density of households with an income to poverty ratio of less than 125%; density of zero-vehicle households; disabled people and all OASDI beneficiaries; and total employment by Traffic Analysis Zone (TAZ). A trip factor was applied to the number of severely disabled (0.049) and the number of low-income who were not disabled with no access to vehicle or transit (1.899), resulting in a total number of needed trips for these populations.

The last countywide needs assessment conducted for the transportation-disadvantaged population indicated that 32% of the Hillsborough County population qualified as transportation disadvantaged, 15% were living in poverty, 29,000 children were defined as disabled, and residents ages 60 and above were scattered about the county. The unmet trip need in Hillsborough County was estimated at 12,123 trips on a given day or 4,424,941 trips for the year of 2011.

The analysis further revealed that the needs of the transportation-disadvantaged population relative to access to employment and education, healthcare, shopping and recreation are often not met due to a lack of funding, limited fixed-route services, gaps in bicycle and pedestrian infrastructure, land use and bodies of water (the bay), and a long history of low-density development. The plan also outlined regional needs within and beyond Hillsborough County, such as the need for regional fixed-route/express services, infrastructure improvements, and regional paratransit services.

Another equity-related planning study was the Tri-County Area Regional Mobility Needs study conducted in 2007 to meet funding criteria for the Special needs of the Elderly and Individuals with Disabilities, Job Access and Reverse Commute, and New Freedom programs under SAFETEA-LU. Census data was used to identify and map concentrations of persons living below the poverty line, other low-income households, population density, persons with disabilities, and elderly populations (persons 65 years of age or older) (HMPO, 2014b). One-quarter-mile and three-quarter-mile buffers were placed around all fixed and paratransit routes to determine accessibility to transit in these areas.

A 2014 update of the Tri-County Area Regional Mobility Needs study further identified key healthcare and long-term care facilities outside of the transit service area. A Transit-Orientation Index was also created to identify transit-dependent segments of the population or those historically more likely to use public transportation, such as older adults, youth, and low-income or no vehicle households. The Transit-Orientation Index was calculated using block group data from the 2011 American Community Survey. Demographic characteristics, including population density per square mile, proportion of population ages 60 and above, proportion of population ages 16 and below, and proportion of population living below the poverty line were mapped to identify concentrations of transit-oriented persons, as defined by the index (HMPO, 2014b).

Concentrations of transit-oriented persons were compared to existing transit routes to determine if the routes were serving populations in the region most likely to need public transit. The analysis revealed that although Hillsborough and Pasco counties have underserved areas with high or very high transit orientation, many existing routes serve areas identified as high or very high transit-orientation index areas (HMPO, 2014b). The transit agencies did not make any substantial changes to service based on the findings of the report or the transit-orientation index.

The 2040 long-range transportation plan has addressed equity in the context of safety and access to jobs and services. The development of the LRTP began with asking the public, through online surveys and MPO meeting surveys, about preferred growth scenarios termed Bustling Metro, New Corporate Centers and Suburban Dream. Each growth pattern was evaluated with a set of standardized performance measures to give the public an idea of how these types of growth would impact a variety of indicators. Among these performance indicators was “Access to Jobs from Under-Employed Communities,” the average home-to-work trip length for environmental justice communities, and the percentage with access to transit service that operates at 30-minute frequencies as forecasted using the regional travel demand model (HMPO, 2014a, p. 33).

The 2040 Long-Range Transportation Plan (LRTP) estimated the size of the population unserved by the fixed-route transit system in 2040, and used existing census data to estimate the potential 2040 transportation-disadvantaged population. The LRTP recognized that fixed-route bus service serves 52% of the county's population, leaving 48% without access to the fixed-route bus system, though paratransit service (Sunshine Line) is available for eligible transportation disadvantaged residents with needs-based transit. Paratransit will pick up and drop off transportation disadvantaged residents at their destination, or take them to an accessible fixed-route bus stop depending on the needs of the passenger.

The LRTP makes investment-level projections (low-high) for bus routes, with each level identifying the transportation disadvantaged population unserved by transit in 2040 and the annual paratransit trips needed in 2040. The plan evaluates eight financial scenarios and expenditures based on those scenarios. Transportation-disadvantaged services remain constant regardless of increases in revenue (HMPO, 2014a). Although under these different scenarios fixed-route bus service is anticipated to increase in frequency and spatial coverage, which will naturally provide accessibility to transportation disadvantaged populations, the funds are not specifically targeted at addressing these populations.

An additional performance indicator in the LRTP includes reducing crashes and addressing vulnerable road users. Hillsborough County, at the time of the LRTP's adoption, ranked 12th in the nation for traffic fatalities per 100,000 residents. The Hillsborough MPO developed the Congestion Management/Crash Mitigation Process: Crash Severity Reduction Report in 2012 to identify the most common types of severe and fatal crashes. The LRTP outlines the goal of reducing injuries and crashes per 100 million vehicle miles traveled, and improving safety for all road users through a multitude of safety enhancement project strategies (e.g., roundabouts, medians, bike lanes, sidewalks, pedestrian islands, etc.) (HMPO, 2014a).

Hillsborough County's LRTP is updated on a five-year cycle and the Transportation Disadvantaged Service Plan is updated annually. The 2040 LRTP was adopted at the end of 2014, and the adoption of the 2045 LRTP update can be expected in 2019. Since the Transportation Disadvantaged Service Plan is updated on an annual basis, its update will be adopted in mid-2017.

2.1.1.2 Methods to Involve Communities of Concern

Throughout the development of the Tri-County Area Regional Mobility Needs report (HMPO, 2014b), Long Range Transportation Plan (HMPO, 2014a), and the Transportation Disadvantaged Service Plan (HMPO, 2015a), there were notable efforts to engage COCS in the planning process. The primary method in Hillsborough County has been through public meetings, presentations, surveys and workshops in specific planning activities.

The most concerted effort to involve COCS occurred during development of the Hillsborough County Transportation Disadvantaged Service Plan (TDSP) (HMPO, 2015a). The public was encouraged to attend and provide input regarding the plan at Transportation Disadvantaged Coordinating Board meetings. A major part of the TDSP public involvement effort included a survey and the first Hillsborough County Human Services Transportation Forum, where social service providers were invited to engage in a conversation on unmet client transportation needs and potential solutions to address these needs. The online survey was distributed to these social service providers to determine unmet needs of the transportation disadvantaged clients served by these agencies (HMPO, 2015a).

During the Tri-County Area Regional Mobility Needs study, extensive outreach was performed through public workshops in Hillsborough, Pasco and Pinellas counties in coordination with the Florida Department of Transportation. Participants were asked to respond to a series of questions through electronic polling or open discussion related to mobility needs (HMPO, 2014b). An online survey was also made available to the public through Survey Monkey in an effort to reach as many people as possible.

Presentations were given to Transportation Disadvantaged Local Coordinating Boards (LCBs) to update board members on the findings from the public outreach process and results of the mapping analysis. The LCBs facilitated discussion regarding ways to gather additional input on the needs of the elderly and disabled populations (HMPO, 2014b). The Hillsborough County Transportation Disadvantaged Coordinating Board also took public comment at the beginning of each board meeting for the Transportation Disadvantaged Service Plan (HMPO, 2015a).

In developing "Imagine Hillsborough," the 2040 LRTP, Hillsborough MPO used online and paper surveys, interactive kiosks placed throughout the county, and public meetings and presentations asking participants to select their preferred growth scenarios. As a method to involve COCs, kiosks were placed in areas that were heavily populated by low-income populations and placed in locations that low-income populations frequented, such as clinics (HMPO, 2014a).

The previous efforts to engage low-income and minority populations and other COCs have been largely part of broader public involvement activities. This study of equity in regional planning assisted the MPO in further defining and locating concentrations of the various populations identified as COC. The map and data could be used by the county in future planning efforts to better target their public involvement and outreach activities. Through that process, and the results of the accessibility, affordability and safety analysis, COCs could be engaged in identifying priority projects in their area.

2.1.2 Priority Issues

For its LRTP update, scheduled for completion in 2019, the Hillsborough MPO is interested in expanding its approach to identifying and addressing the transportation needs of COCs in the region. The MPO staff, through their previous planning and public involvement efforts, indicated a need for a greater variety of analysis measures and methods to better define and locate COCs, as well as accessibility of pedestrians, cyclists and transit-users to jobs and services. The MPO further indicated interest in methods to evaluate public health, safety and the distributional equity of investments. The research team added an assessment of housing plus transportation costs to the analysis for additional insight into affordability issues in the region as a whole. Below is a discussion of methods used to examine these measures and examples of the GIS analysis for selected measures. Also included are example performance indicators for consideration by the MPO in future long-range planning and transportation-disadvantaged service planning.

2.1.3 Methodology

2.1.3.1 Identifying Communities of Concern

The first step of the analysis was to provide the MPO with a systematic method of defining and locating COC for future equity analysis. The research team worked with MPO staff to establish a methodology and set of variables for this purpose. A goal of the MPO for the regional analysis was to be as inclusive as possible of the various populations that are or could be transportation disadvantaged. One way the team addressed this goal was to expand the definition of low income beyond the very poor to include those at or below 185% of the federal poverty level. A threshold methodology was selected for use in locating COCs.

The data for the variables was obtained from the American Community Survey (ACS, 2010-2014). Relative concentrations of each population were then identified and mapped on the block group level based on whether a variable met or exceeded the countywide average by one standard deviation. The specific ACS variables and thresholds used in the analysis are listed in Table 15.

Table 15: Identifying Communities of Concern

Equity Dimension	Data Source	Metric	Comments
Low-Income Communities	U.S. Census Bureau and American Community Survey (ACS). Households Living In Poverty • B17017 - POVERTY STATUS IN THE PAST 12 MONTHS BY HOUSEHOLD TYPE BY AGE OF HOUSEHOLDER Link to Table Description	Block groups with percentage of households living at or below 185% of poverty line	185% of the poverty line is used to include a broader population of economically disadvantaged persons. At or below the poverty line includes only the very poor.
Zero-Vehicle Households	U.S. Census Bureau and American Community Survey (ACS). Households with Zero Vehicles Available • B25044 - TENURE BY VEHICLES AVAILABLE Link to Table Description	Block groups with percentage of zero vehicle households more than 1 standard deviation above the countywide average (average = 2%).	
Minorities	U.S. Census Bureau and American Community Survey (ACS). Minority Population - African American, Hispanic, Asian, American Indian, and or Alaskan Native. • B03002 - HISPANIC OR LATINO ORIGIN BY RACE Link to Table Description	Block groups with percentage of minority population more than 1 standard deviation above the countywide average (average = 46.8%).	Census information designates table as only Hispanic or Latino origin by race, but includes all other races and ethnicities.

Elderly	U.S. Census Bureau and American Community Survey (ACS). Over 65 • B01001 - SEX BY AGE Link to Table Description	Block groups with percentage of population ≥65 years old more than 1 standard deviation above the countywide average (average = 14.02%).	
Youth	U.S. Census Bureau and American Community Survey (ACS). Under 18 • B01001 - SEX BY AGE Link to Table Description	Block groups with percentage of population <18 years old more than 1 standard deviation above the countywide average (average = 21.7%).	
Limited English Proficiency (LEP)	U.S. Census Bureau and American Community Survey (ACS). Limited English Proficiency • B16002 - HOUSEHOLD LANGUAGE BY HOUSEHOLD LIMITED ENGLISH SPEAKING STATUS Link to Table Description	Block groups with percentage of LEP population more than 1 standard deviation above the countywide average (Average = 5.9%).	
Disability	U.S. Census Bureau and American Community Survey (ACS). • C23023 - SEX BY DISABILITY STATUS BY FULL-TIME WORK STATUS IN THE PAST 12 MONTHS FOR THE POPULATION 16 TO 64 YEARS Universe: Population 16 to 64 years Link to Table Description	Block groups with percentage of disabled full-time workers in past 12 months more than 1 standard deviation above the countywide average (average = 10.8%).	
Communities of Concern	U.S. Census Bureau and American Community Survey (ACS) -All previous data	Block groups that contain 2 or more of the variables listed above	Use of 2 or more variables helps to identify greatest concentrations of communities of concern. Given that the majority of the county has census tracts with 1 community of concern, using 2 highlights those areas or potentially greatest need.

A composite map of all block groups with one or more variables that exceeded the countywide average by at least one standard deviation was then prepared. The resulting map included a majority of the county, largely due to low-income populations meeting our definition. To further identify relative concentrations of transportation-disadvantaged persons in the region, and because nearly the entire county was identified as containing at least one of these COCs, a second map was produced including only those block groups where any two or more variables exceeded the countywide average by one standard deviation (see Figure 3). This approach was

selected by the MPO and research team as being both inclusive and appropriate for use in the regional planning equity analysis. The lighter gradation depicts areas where two of the variables overlap, and the darker gradation depicts areas which contain three or more variables. Maps of each COC variable were also provided to the MPO for further analysis of transportation needs of each specific population.

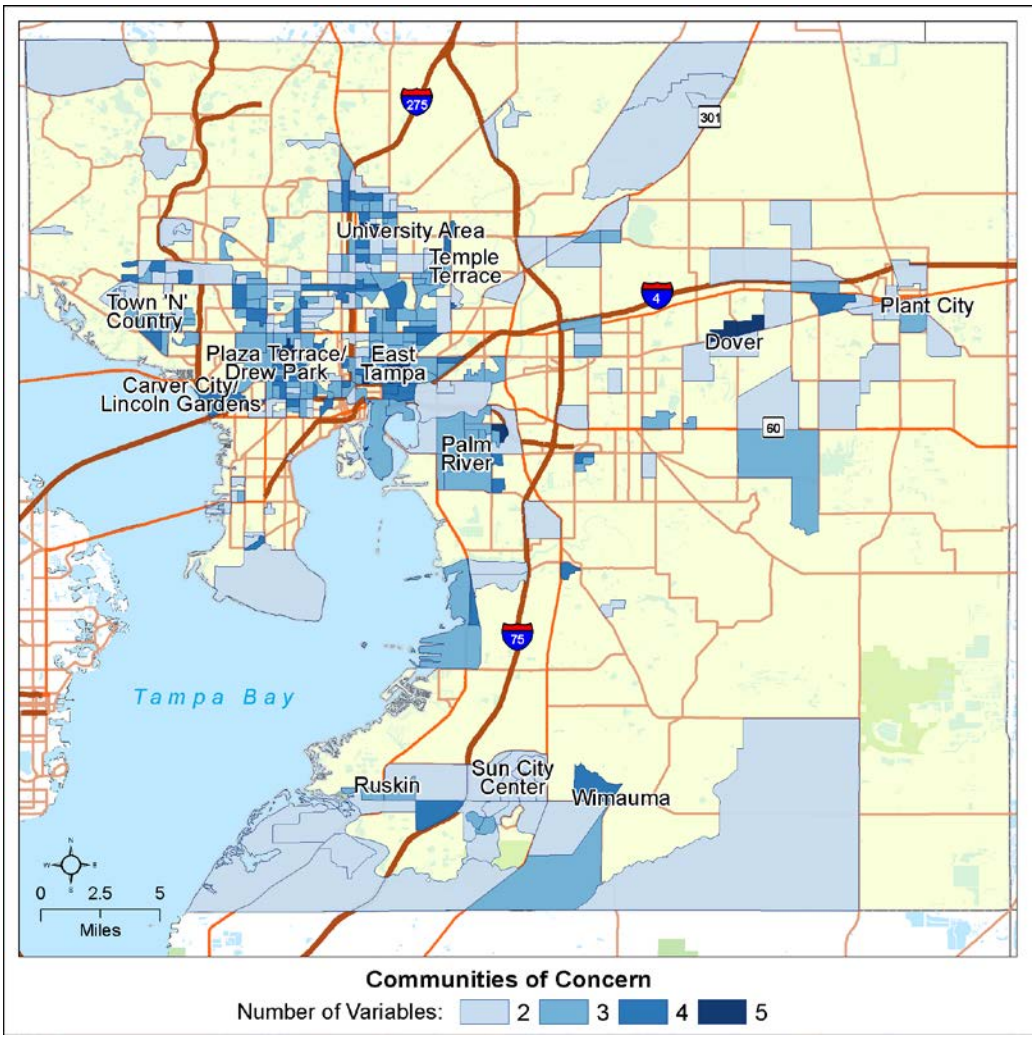

Figure 3. Hillsborough communities of concern.

2.1.3.2 Identifying Essential Destinations

The next step of the analysis aimed to identify where these populations were likely to travel. Identifying essential destinations provides insight as to priority areas for investment in infrastructure and services that support non-auto travel by COC, as well as the broader population. For this step, the team used Census LEHD Origin-Destination Employment Statistics by the NAICS employment codes listed in Table 16. This employment data was used as a proxy to determine where essential services and destinations are located.

The countywide employment density for these jobs and services was calculated, and Census block groups in the top 15% of blockgroups based on employment density were identified as essential destinations. The results are illustrated in Figure 4.

Table 16: Identifying Essential Destinations

Dimension	Data Source	Indicator
Essential Destinations	United States Census Bureau: LEHD Origin-Destination Employment Statistics (LODES) 6 employment NAICS codes used include: 1. Educational services 2. Health care and social administration 3. Arts, entertainment, and recreation 4. Accommodation and food services 5. Public administration 6. All other services (except public administration)	Selection method: 1) Rank based Index of Blockgroups based on the number of jobs per square mile 2) selecting the top 15% blockgroups

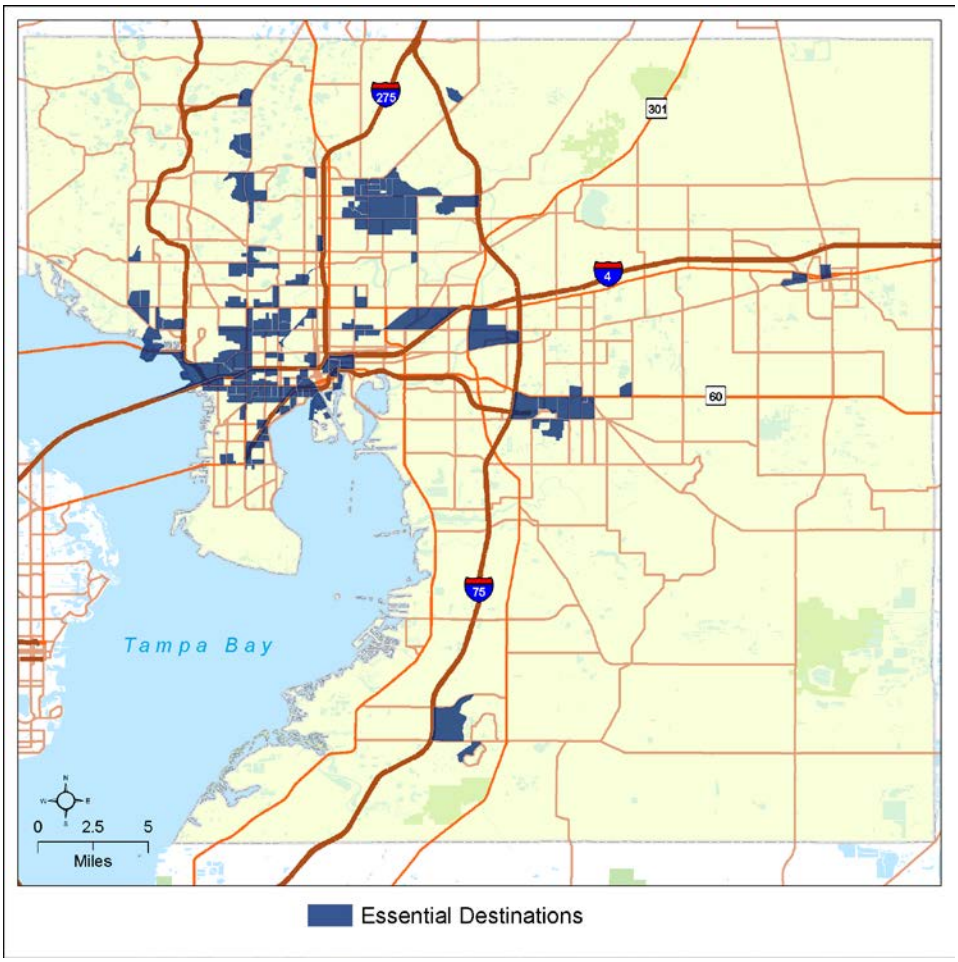

Figure 4: Essential destinations in Hillsborough County.

2.1.3.3 Exploring Accessibility

Accessibility was measured for pedestrians, cyclists and transit users. Accessibility dimensions, data sources, and example indicators and targets are provided in Table 17. To begin, areas of relative underinvestment in bicycle and pedestrian facilities were identified using data on sidewalk and bicycle facility coverage from the Hillsborough MPO. The countywide average of centerline miles to bicycle or pedestrian facilities was calculated with only arterial and collector roadways used for the bicycle facility analysis. The available data was slightly out of date in this rapidly growing region, but was deemed by the research team and MPO to be of high enough fidelity for the analysis.

Block groups with a sidewalk to centerline mile ratio of <1 or bicycle facility to centerline mile ratio of <1 (excluding block groups with less than 500 persons per square mile) were identified to locate populated areas with low sidewalk and bicycle facility coverage. A sidewalk or bicycle facility to centerline mile ratio of 1 represents a sidewalk or bicycle facility on at least one side of every included road in the block group. For bicycle facility coverage, local roads were excluded from the analysis, as bicycle facilities are typically reserved for arterial and collector streets.

To measure accessibility, COC block groups identified as having low pedestrian (Figure 5) and bicycle (Figure 6) facility coverage that are located within one mile of essential destinations were identified. This methodology provides insight as to priority areas for future investment – that is, areas with high concentrations of COC that have low bicycle and pedestrian accessibility to essential destinations.

Table 17: Accessibility Metrics for Consideration by Hillsborough MPO

<table>
<tr><th rowspan="2">Accessibility Dimension</th><th rowspan="2">Data Sources</th><th rowspan="2">Indicator</th><th colspan="2">Example Performance Targets</th></tr>
<tr><th>Countywide</th><th>Communities of Concern</th></tr>
<tr><td rowspan="2">Pedestrian Accessibility to Essential Destinations/Sidewalk Coverage</td><td rowspan="2">Hillsborough MPO sidewalk cover data. U.S. Census Bureau for block group boundary data</td><td rowspan="2">Identified block groups with a sidewalk to centerline mile of <1. Communities of Concern with low sidewalk coverage within 1 mile of Essential Destinations.</td><td>By 2040, increase the ratio of centerline miles to sidewalk miles by [25%] compared to 2014.</td><td>By 2040, increase the ratio of centerline miles to sidewalk miles in communities of concern by [50%] compared to 2014.</td></tr>
<tr><td colspan="2">By 2040, achieve a ratio of centerline miles to sidewalk miles of 2 within 1 mile of all essential destinations.</td></tr>
<tr><td rowspan="2">Bicyclist Accessibility to Essential Destinations/Bicycle Facility Coverage</td><td rowspan="2">Hillsborough County MPO for Bike Lane information. U.S. Census Bureau for block group boundary data.</td><td rowspan="2">Identified block groups with a bicycle facility to centerline mile ratio of <1 excluding local roads. Communities of Concern with low bicycle facility coverage within 1 mile of Essential Destinations.</td><td>By 2040, increase the ratio of centerline miles to bicycle facility miles by [25%] compared to 2014.</td><td>By 2040, increase the ratio of centerline miles to bicycle facility miles in communities of concern by [50%] compared to 2014.</td></tr>
<tr><td colspan="2">By 2040, achieve a ratio of centerline miles to bicycle facility miles of 2 on all collectors and arterials within 1 mile of all essential destinations.</td></tr>
</table>

Transit Access to Jobs access to jobs within 45 minutes by bus	Smart Location Database www.epa.gov/smartgrowth/smart-location-mapping#SLD	Rank based index of transit block groups based on number of jobs within 45-minute transit commute (As per the Smart Location Database). Worst (lowest 15%) transit served COC block groups	By 2040, Increase percentage of jobs accessible via 45 minute transit commute by [25%] compared to 2014.	By 2040, increase the percentage of jobs accessible via 45-minute transit commute from COC block groups by [50%] compared to 2014.

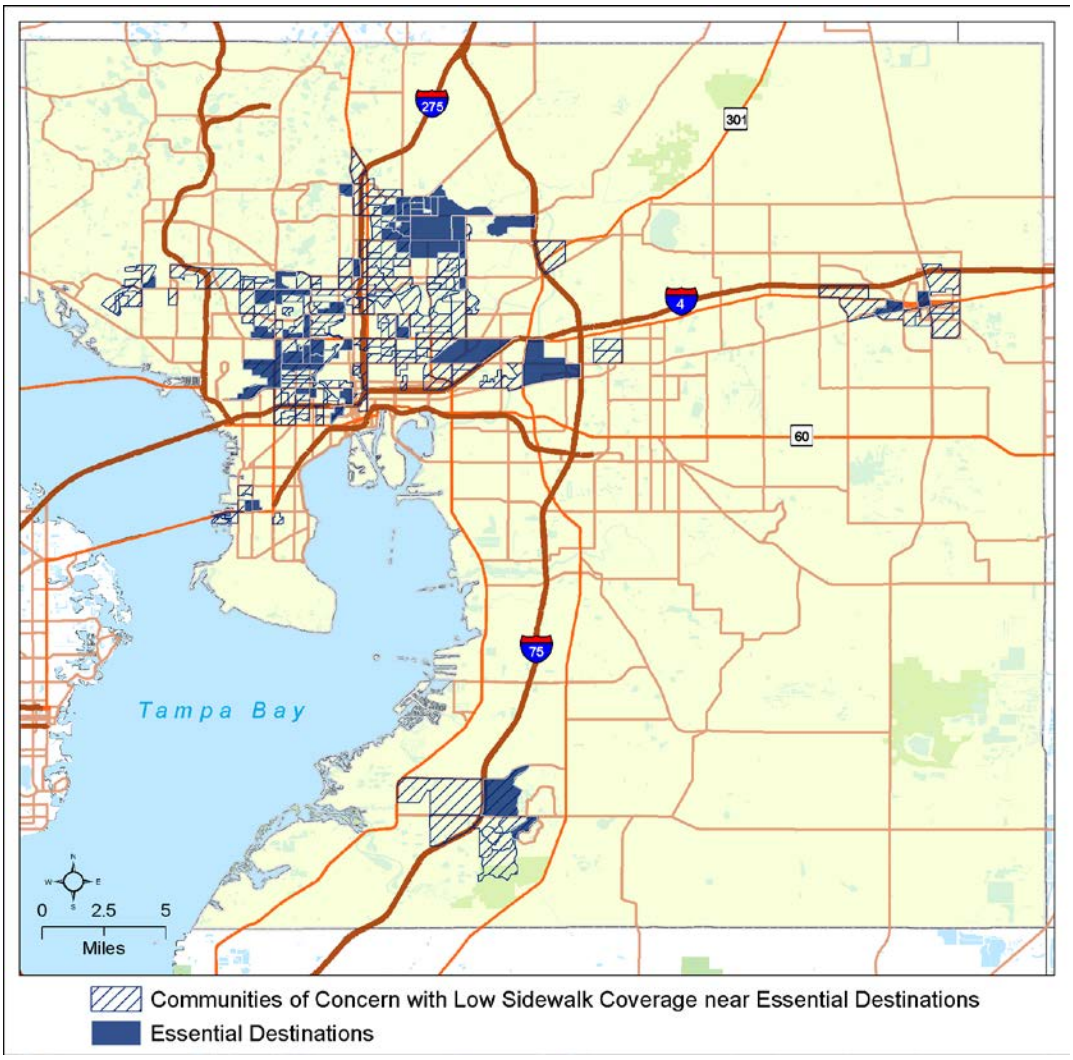

Figure 5: Communities of concern with low pedestrian accessibility to essential destinations.

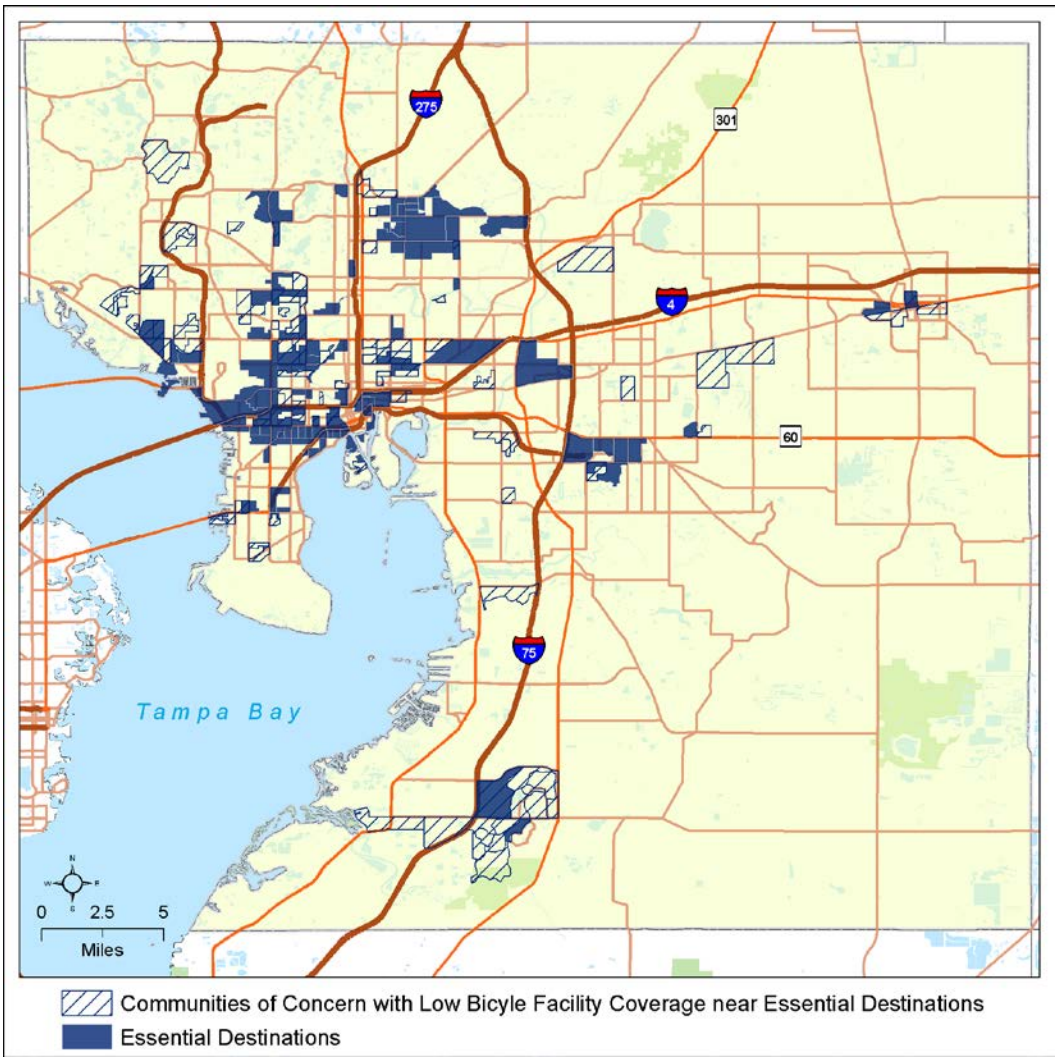

Figure 6: Communities of concern with low bicycle accessibility to essential destinations.

Transit access to jobs was analyzed using the Smart Location Database. These data, available from the U.S. Environment Protection Agency, rely on General Transit Feed Specification (GTFS) data from transit agencies that includes stops, routes and schedules. Most transit agencies that provide service within MPOs provide GTFS data, which captures about 95% of all ridership nationally. Given its widespread availability, this data is an excellent way for MPOs and other regional agencies to explore transit accessibility to employment. At the time of this study, this data was current through 2012-2013.

Hillsborough County is characterized by a lack of "premium" transit service (e.g., light rail, high-quality bus rapid transit) and low bus service frequency. Therefore, most workers in the region find it necessary to commute to work by single occupant automobile. To evaluate transit access to jobs in Hillsborough County, a rank-based index was created of the total number of jobs accessible via transit within 45 minutes in transit-served block groups. The lowest 15% of block groups (representing about one standard deviation) were identified as areas that offer the least access to employment via bus transit (Figure 7). Block groups with the poorest transit access to employment that also contain two or more COC were identified (Figure 8).

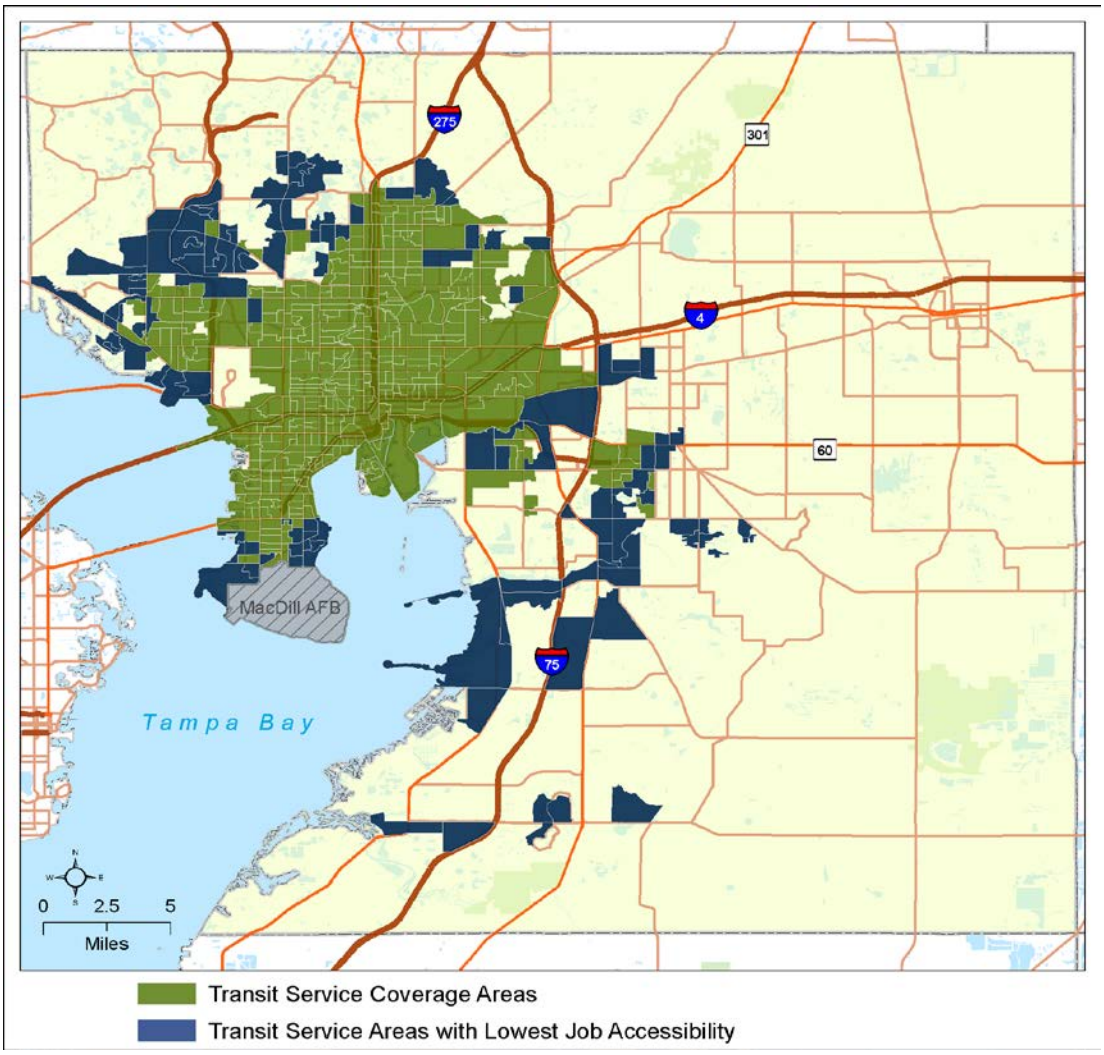

Figure 7: Areas with the least job accessibility within 45 minutes via transit.

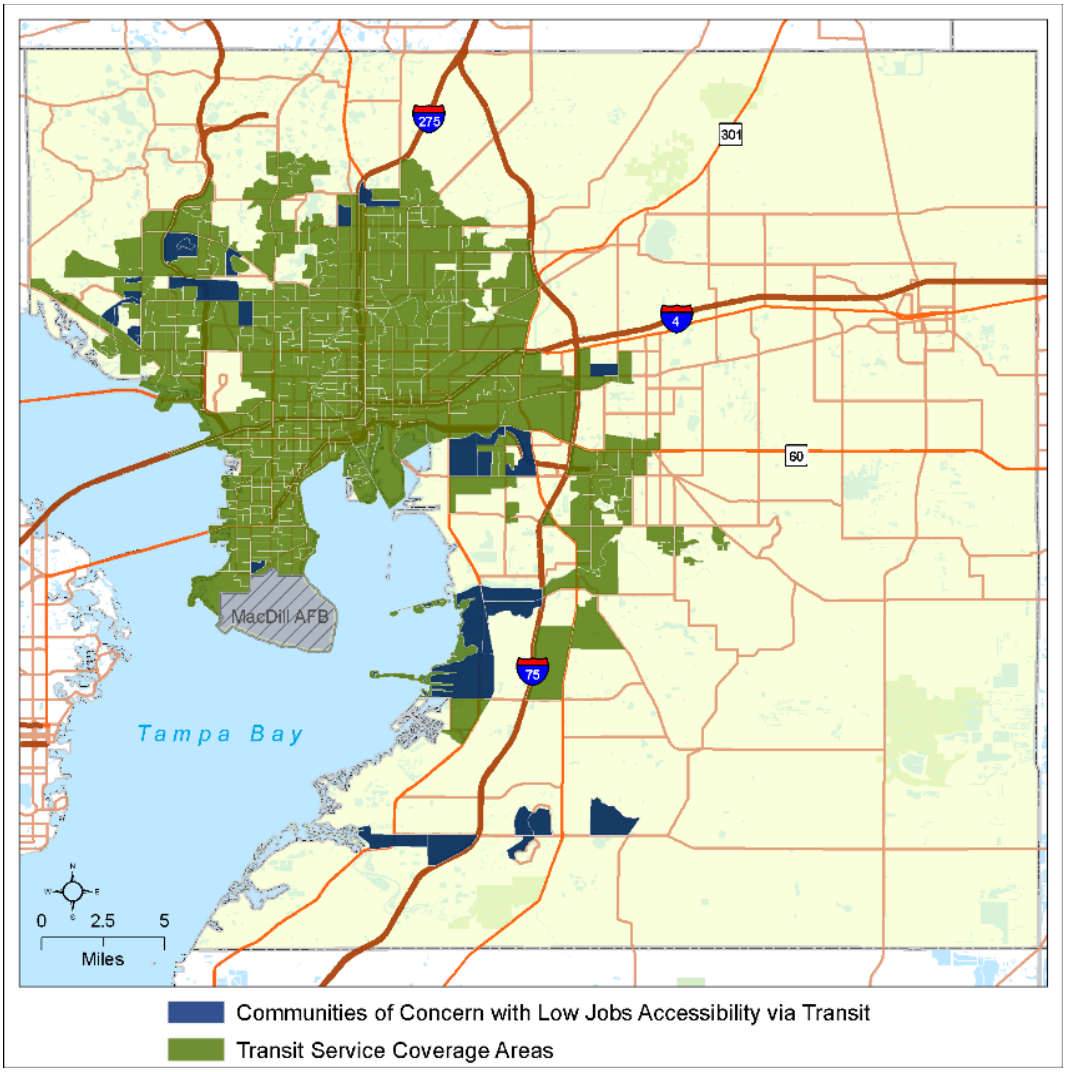

Figure 8: Communities of concern with the least job accessibility within 45 minutes via transit.

2.1.3.4 Housing + Transportation Affordability

The Housing + Transportation index database from the Center for Neighborhood Technology was used to measure affordability. It is recommended that housing and transportation costs are mapped separately to give a better indication of the spatial difference of costs across communities. Table 18 provides an overview of dimensions of affordability examined in Hillsborough County, as well as example indicators and performance targets for use in monitoring implications of the regional transportation plan.

Housing is conventionally deemed affordable when it consumes no more than 30% of household income. Transportation costs are usually the second-largest expense for households. Typically, the combined costs should be <40% of total income to be considered affordable. Figure 9 shows the overall H+T analysis results in Hillsborough County, highlighting areas where block groups spend more than 77%, or households greater than 1 standard deviation above the county average, of their total income on housing and transportation. These results may overstate the case somewhat, in light of assumptions and limitations of the database. However,

they do reveal the auto-dependent nature of the region and exemplify both high housing costs in certain downtown neighborhoods, as well as relatively lengthy commutes on average.

While the H+T Index is not a measure of equity per se, the analysis can be used to identify COC block groups with housing and transportation costs significantly higher than the countywide average. Furthermore, transportation costs across COC can be mapped using the H+T Index, giving an idea of spatial differences in costs across these communities and providing a method of measuring transportation affordability over time (Figure 10).

Table 18: Affordability Measures and Methodology

Affordability Dimension	**Data Source**	**Indicator**	**Example Performance Targets**	
			Countywide	Communities of Concern
Combined housing and transportation costs as a percentage of household income	Center for Neighborhood Technology - H+T Index http://htaindex.cnt.org/	Block groups with combined housing and transportation costs greater than 1 standard deviation above countywide average (average = 61%).	By 2040, decrease average household combined cost of housing and transportation by [25%] compared to 2014.	By 2040, decrease the average cost of transportation for communities of concern by [50%] compared to 2014.
Transportation costs across COC	Center for Neighborhood Technology - H+T Index htaindex.cnt.org/	Range of transportation costs across COC.	By 2040, decrease the average household costs of transportation by [25%] compared to 2014.	By 2040, decrease the average household cost of transportation for communities of concern by [50%] compared to 2014.

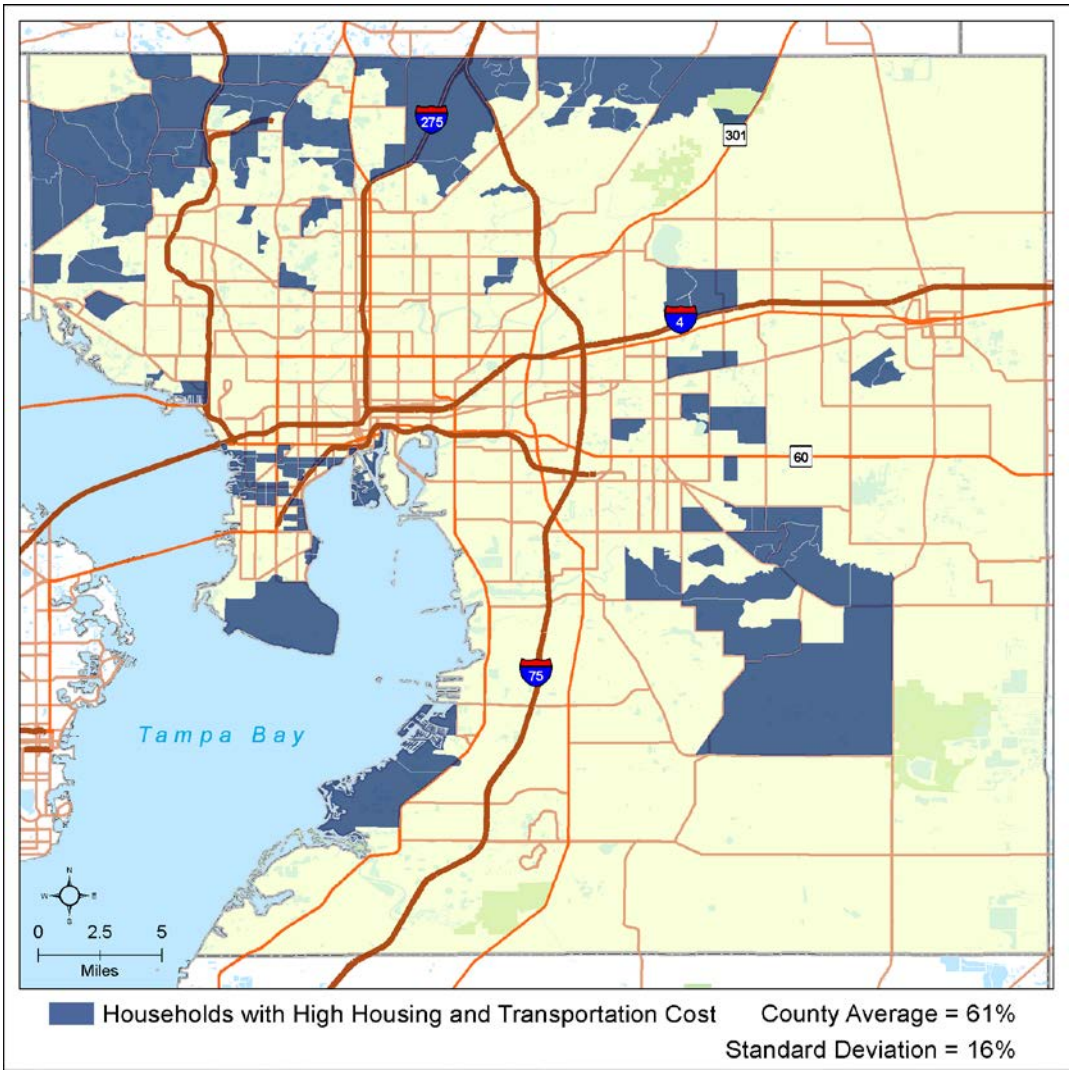

Figure 9: Housing plus transportation affordability in Hillsborough County.

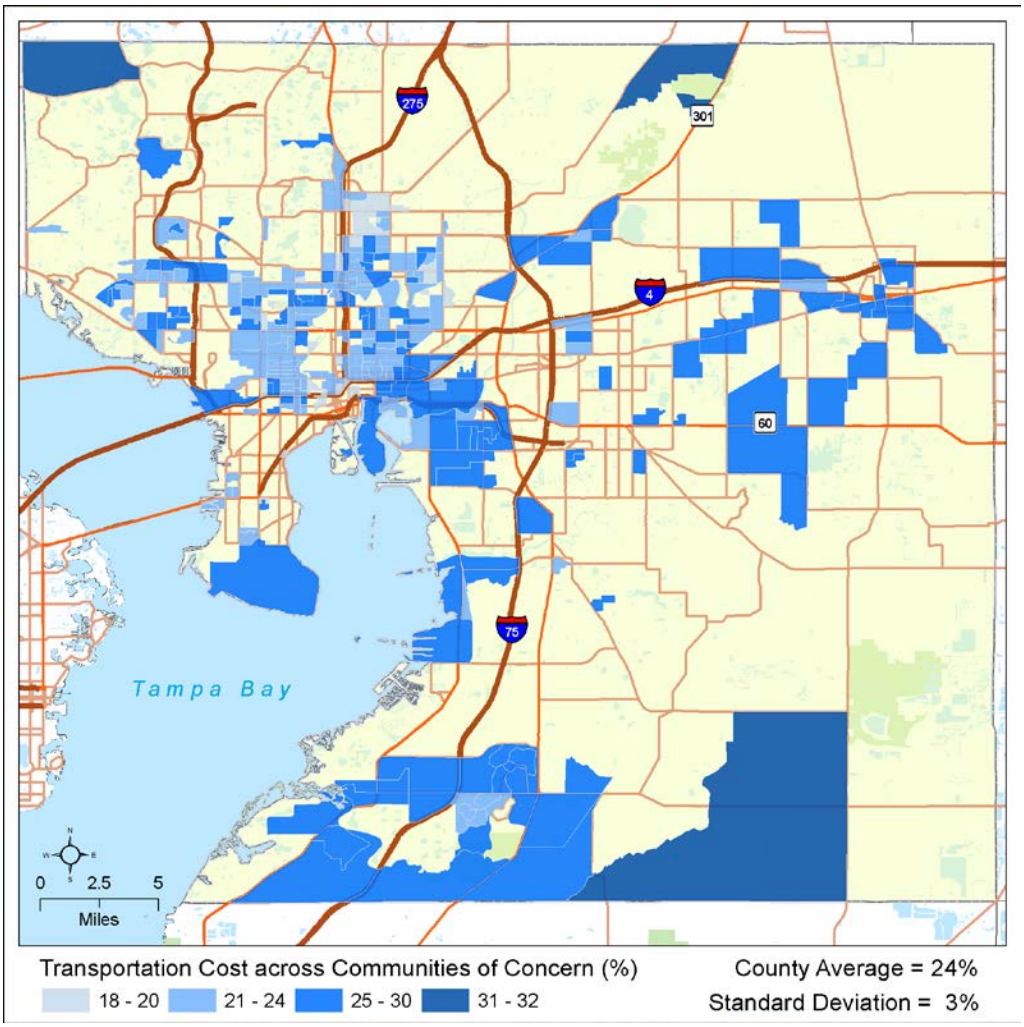

Figure 10: Average transportation costs of communities of concern in Hillsborough County.

2.1.3.5 Health and Safety

A variety of measures of health and safety may be used for regional planning and equity analysis. For this analysis, the research team focused primarily on pedestrian and bicycle per capita crash rates in light of the high levels of bicycle and pedestrian crashes in the Tampa Bay region generally.

Table 19 reviews the measures and methods used to examine bicycle and pedestrian safety in the region, and provides example indicators and performance targets.

The average pedestrian and bicyclist crash rate per capita was calculated countywide, and block groups greater than one standard deviation above the countywide average were identified as having a relatively high crash rate. Block groups that have a high number of pedestrian (Figure 11) and bicycle (Figure 12) crashes per capita and are also COC were identified.

Table 19: Bicycle and Pedestrian Safety Measures and Methodology

Health Dimension	Data Source	Indicators	Example Performance Targets	
			Countywide	Communities of Concern
Pedestrian Safety: Pedestrian crash rates per capita	Hillsborough MPO	Percentile of per capita pedestrian crash rate by block group. COC within these block groups are identified.	By 2040, decrease the per capita pedestrian crash rate by [50%] compared to 2014.	By 2040, decrease the per capita pedestrian crash rate in COC by [75%] compared to 2014.
Bicycle Safety: Bicycle crash rates per capita	Hillsborough MPO	Percentile of per capita bicycle crash rate by block group. COC within these block groups are identified.	By 2040, decrease the per capita bicycle crash rate by 50% compared to 2014.	By 2040, decrease the per capita bicycle crash rate in COC by [75%] compared to 2014.

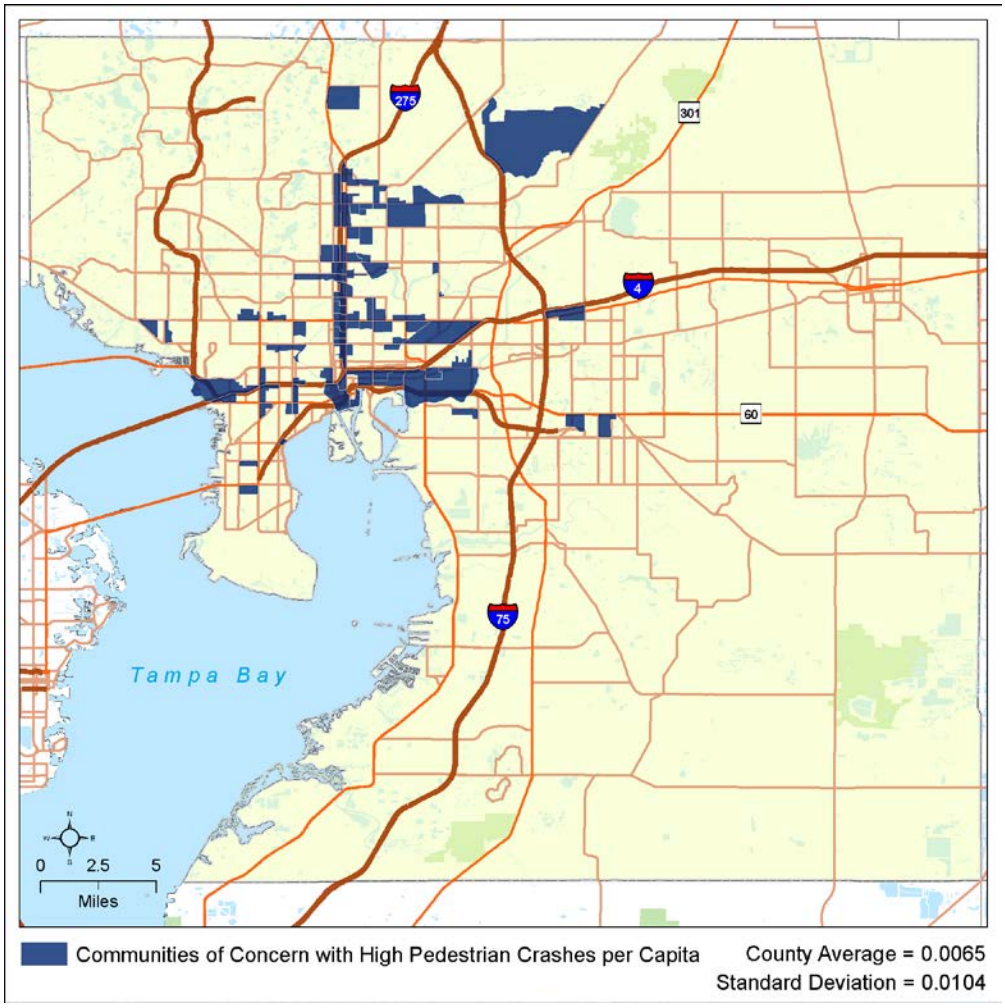

Figure 11: Communities of concern with high pedestrian crashes per capita.

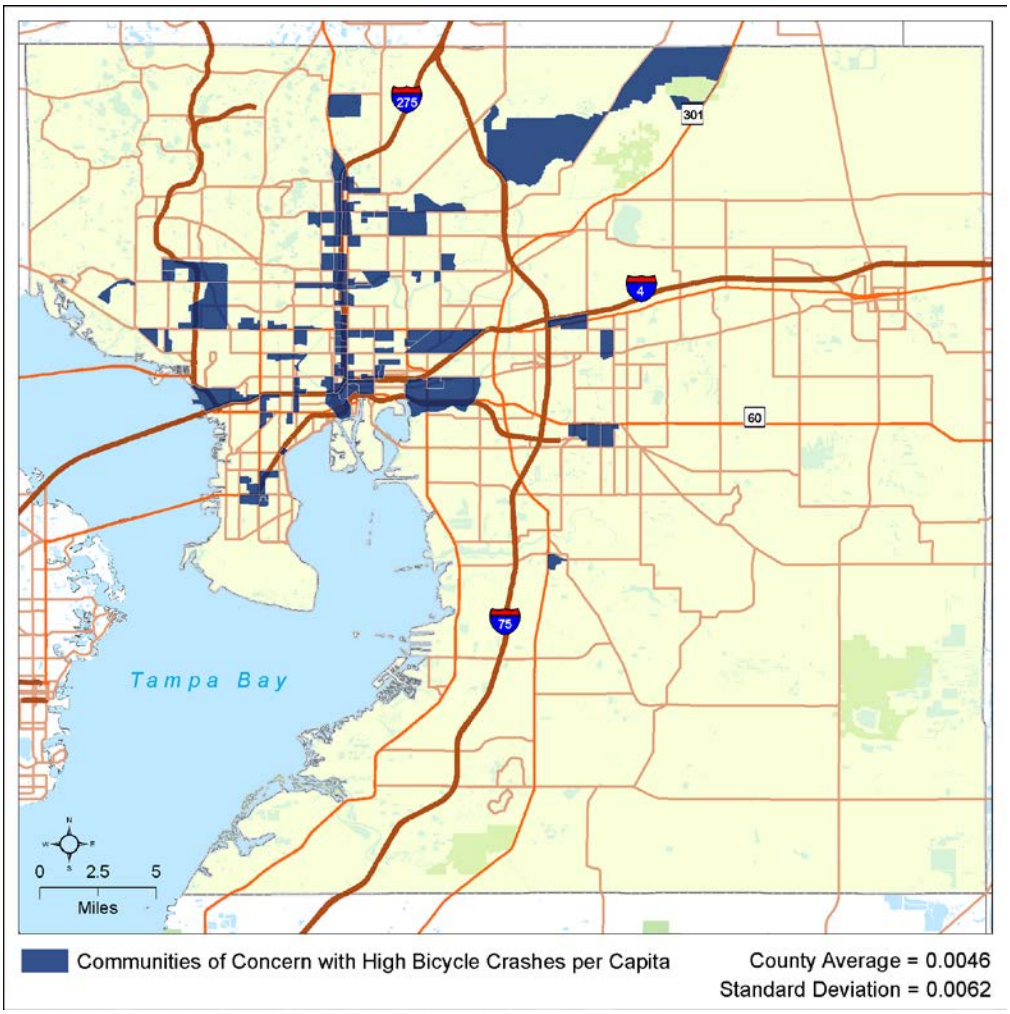

Figure 12: Communities of concern with high bicycle crashes per capita.

2.1.3.6 Distributional Equity of Investments

Total project investment (regardless of type or mode) is a common, but rather weak measure of equity, as projects in an area do not always benefit area COC. It is best to disaggregate project costs by type/mode, and also to prioritize investments that address identified accessibility, affordability and health deficiencies for COC in the project prioritization process.

Table 20 provides a simple example of how one might examine and monitor distributional equity of investments in a region. Per capita investment in COCs is compared to per capita investment in non-COCs as whole, and can be further stratified by the mode or type of investment in that community. For example, per capita safety investments for bicycle facilities can be examined between COCs and non-COCs to determine the distributional equity of investment. Unfortunately, the distributional equity of investments for Hillsborough currently cannot be evaluated using GIS, as the MPO does not currently disaggregate project investment

data by type and mode. It is recommended that data be disaggregated by type and mode for use in future analysis.

Table 20: Distributional Equity of Investments Measure and Methodology

Distributional Dimension	Data Source	Metric	Example Performance Targets	
			Countywide	COCS
Distributional Equity	MPO Transportation Improvement Program and LRTP	Proportionate per capita investment for COC vs. non-COC communities, disaggregated by project type and mode.	NA	Increase per capita investment in deficient COC areas by 10% annually over countywide per capita investment.

2.1.4 Conclusions

As with many MPOs across the nation, the Hillsborough MPO's approach to equity has not been a systematic and integral part of the long-range planning and prioritization process. Rather, efforts to date have been in the context of specific studies and transportation-disadvantaged service planning activities. This study provides the MPO with potential methods and measures for identifying COCs and more systematically monitoring the long-term impacts of the regional plan and projects, using indicators related to affordability, accessibility and safety. Results of the study were presented to various MPO committees and the MPO Board to help inform future planning efforts.

The Hillsborough MPO is now using this equity analysis to screen TIP projects for impacts and benefits to COCs. In particular, the MPO is identifying areas with low access to food and other services, such as healthcare, and using additional tools, such as health impact assessments, to prioritize projects to help COCs facing these challenges. The 2045 update to the MPO Long Range Transportation Plan and Title VI plan will include details from, and expansion of, this equity analysis. Other projects include a recently concluded Transportation Disadvantaged Summit, which brought together providers and recipients to discuss transportation disadvantaged needs.

2.2 METRO - PORTLAND, OR

2.2.1 Introduction and Background

The Portland metro area, governed by a unique elected regional government called Oregon Metro, has a population approaching 1.6 million (out of 2.4 million in the greater 7-county metropolitan area including parts of southwest Washington State) (Christensen, 2015). The region is located in the shadow of Mount Hood on the banks of the Columbia and Willamette rivers. The largest city is Portland, followed by Gresham, Hillsboro and Beaverton. The Portland metro area grew 1.72 percent from 2014 to 2015, ranking it among the fastest-growing places in the country (Beebe, 2016). Oregon Metro has prioritized equity as a key planning objective and seeks to engage historically marginalized communities within the region and develop plans that invest more equitably across the region.

Metro has been in the process of developing the 2018 Regional Transportation Plan (RTP) and the 2018-2021 Metropolitan Transportation Investment Program (MTIP). These planning efforts include a robust stakeholder engagement process with a strong emphasis on gathering input from historically marginalized groups such as communities of color and lower-income residents. The Transportation Equity Working Group is one of several groups that bring together community members, Metro staff, and representatives of other relevant organizations in the public and private sector to evaluate and modify relevant RTP performance targets and system evaluation measures.

Through the current project, Metro and Portland State University partnered to study national best practices for measuring transportation equity in a scenario-planning context and are using them to guide the RTP update and inform the working group. Metro adopted an outcomes-based approach in 2010 with a set of performance targets to measure the progress of implementing the plan. The two equity-oriented performance targets are:

- *Affordability.* By 2040, reduce the average household combined cost of housing and transportation by 25 percent compared to 2010.
- *Access to Daily Needs.* By 2040, increase by 50 percent the number of essential destinations accessible within 30 minutes by bicycling and public transit for low-income, minority, senior and disabled populations compared to 2005.

In 2010, the outcomes-based RTP did not establish a formal method to measure and track these equity performance targets and the RTP tasked that effort to future RTP cycles. In the development of the 2014 RTP, forecasting data limitations and a streamlined 2014 RTP process, did not include in the work plan capacity to develop a measurement of the two equity-oriented performance targets. Therefore, the charge of the 2018 RTP update process is to simplify these targets and develop ways to measure successful implementation of the plan over time (Cho, 2016).

2.2.2 Priority Issues

A key element of Metro's equity evaluation work has been to measure what historically marginalized communities value. Through an extensive review of previously collected feedback from historically marginalized communities and project-specific community meetings, Metro

staff and the working group have determined a list of priority issues for long-range transportation planning. These issues included, but are not limited to:

- Housing and transportation affordability
- Access to essential destinations and jobs via automobile and transit
- Distribution of infrastructure investments
- Safety
- Environmental and health impacts of air pollution and environmental degradation
- Gentrification and displacement

2.2.3 Methodology

Metro's strategies for distributional equity analysis includes both qualitative and quantitative analysis. Focus groups, surveys and community meetings will provide details and context. Mapping and modeling according to predetermined definitions and thresholds for the locations of historically marginalized communities will be overlaid with the locations of various types of projects and forecastable project impacts. Different RTP scenarios will be compared to the base-year option before a final RTP package is selected. Metro does consider previous inequities and seeks to invest more heavily in those areas going forward. Further details are outlined in the sections that follow.

2.2.3.1 Identifying Historically Marginalized Communities

To determine definitions and thresholds for historically marginalized communities in the region, Metro conducted extensive background research and presented options to the community in an online survey. People of color, those with limited English proficiency, and low-income individuals are required to be considered under Title VI. Metro expanded its scope to include older adults and young persons because of feedback provided during the 2014 RTP and to comply with the Age Discrimination Act of 1975. Metro defines historically marginalized communities as:

- *People of Color.* Those who identify as any of the following races: Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, some other race or multiple races AND persons who identify ethnically as Hispanic or Latino in the 2010 U.S. decennial census.
- *People with Limited English Proficiency.* Persons who identify in the U.S. Census Bureau's American Community Survey as speaking English "less than very well."
- *Older adults.* Persons who are 65 years of age or older as of the U.S. Census Bureau's 2010 census.
- *Young People.* Persons who are 17 years of age or younger as of the U.S. Census Bureau's 2010 census.
- *People with Low Income.* Persons in a household living 200% of the federal poverty guidelines (2016).

Metro uses two different thresholds census data – a Tier 1 analysis, and a Tier II Focused Analysis. These thresholds help to define the locations of historically marginalized communities for the assessment. The Tier 1 thresholds vary by community and are as follows:

- *People of Color.* Census blocks where the total population of people of color (by percent) is greater than the regional rate of people of color population (by percent). The regional rate is estimated at 27% region-wide.
- *People with Limited English Proficiency.* Regardless of language, census tracts that have more than an 8.71% LEP population. The 8.71% represents the regional rate of over-5 years of age population who "do not speak English very well" regardless of native language.
- *Older Adults.* Census blocks where the total older adult population (by percent) is greater than the regional rate of older adult population (by percent). The regional rate is estimated at 10.2%.
- *Young People.* Census blocks where the total young-person population (by percent) is greater than the regional rate of young person population (by percent). The regional rate is estimated at 23%.
- *People with Low Income.* Census tracts where the total low-income population (by percent) is greater than the regional rate of low-income population (31.8%).

In addition, by request of the work group, a second demographic evaluation Tier II has been added as part of the assessment to focus more closely on people of color, people with lower-incomes, and limited English proficiency populations. The work group had requested evaluation of areas with high concentrations of these three communities or hidden pockets of language isolation as well. Descriptions of thresholds used to identify these areas are provided in Table 21.

Table 21: Metro Tier II Thresholds for Identifying Historically Marginalized Communities

Historically Marginalized Community	Geographic Threshold
People of Color	Census tracts above the regional rate for people of color AND census tract has twice (2x) the population density of the regional average (.48 person per acre).
Low-Income	Census tracts above the regional rate for low-income households AND census tract has twice (2x) the population density of the regional average (.58 person per acre).
Limited English Proficiency	Census tracts above the regional rate for low-income households AND those census tracts identified as "safe harbor" tracts for language isolation AND the census tract has twice (2x) the population density of the regional average (.15 person per acre).[1]

[1] Safe harbor, a provision of Title VI, addresses agency language assistance to LEP persons to ensure access to public resources. For analysis, safe harbor may help to identify areas where additional attention is warranted because of a concentration of language isolation. Safe harbor applies when a language isolated group constitutes 5% or 1,000 persons of the total population in the given area.

2.2.3.2 Public Participation

Metro uses a "wide net" approach to involving stakeholders agency-wide and in each of its long-range transportation plans. Public engagement activities include public comment periods and open, well-publicized meetings to weigh in on proposed policy. The agency also takes a more targeted approach to engaging historically marginalized communities involving language and community-specific workshops held in partnership with community-based organizations.

During the 2014 Regional Transportation Plan, the outreach process involved a public opinion research poll conducted online, five targeted community workshops, including one in Spanish, and events in collaboration with Elders in Action and the Environmental Action Group. Several public comment opportunities were available at different stages in the process. Since the 2014 RTP, Metro had expanded its public participation tools, by more actively utilizing social media, news publications, mailings and its website to circulate information about the process and encourage people to participate.

For the 2018 RTP process, similar techniques are being utilized, with the addition of technical work groups and Regional Leadership Forums. For example, the transportation equity working group is gathering technical and policy input from various stakeholders. The 2018 RTP Regional Leadership Forums are bringing together community leaders to sit at the same table as elected officials having policy discussions related to the 2018 RTP.

2.2.4 Applications

2.2.4.1 Proposed Equity Measures and Methods

At the time of this study, methods for analyzing achievement and progress towards the 2018 RTP equity goals were still being developed by Metro and the stakeholder working group.[2] Research from the PSU NITC grant-funded team was used to identify a longer list of transportation equity system evaluation measures that address the issues identified by historically marginalized communities (information presented in Section 3.0). From that longer list, the proposed equity measures for the 2018 regional plan were developed. Table 22: Proposed Equity Measures for METRO 2018 Regional Transportation Plan lists the system evaluation measures that correspond with identified priority issues and contains a brief description of each of the measures considered for the final plan evaluation.

[2] For up to date information about these equity measures and the status of the plan, visit the website for the equity work group: http://www.oregonmetro.gov/public-projects/2018-regional-transportation-plan/equity

Table 22: Proposed Equity Measures for METRO 2018 Regional Transportation Plan[3]

Measure	Key research questions used to define the measure
Priority: Housing and transportation affordability	
Housing and Transportation Costs	The exact technical definition was not final as of the time of this report
Priority: Access to essential destinations and jobs via automobile and transit	
Access to Jobs by wage profile	1) How many low and middle-wage jobs can be reached in a given time window by different travel modes? 2) What are differences in low and middle-wage job access for the region and specifically for historically marginalized communities? 3) Is the difference in low and middle-wage job access between automobile and transit? Is there a difference that extends beyond a reasonable threshold and creates a "transit access disadvantage" to low and middle-wage jobs in certain areas? If so, do those "transit access disadvantage" areas overlap with areas with high concentrations of historically marginalized communities? 4) Is the access to low and middle-wage jobs proportionate, or providing greater access to jobs, in light of anticipated future population and employment growth?
Access to Community Places	1) What are the differences between the number of community places accessible by historically marginalized communities relative to the entire region? Are there large differences in access seen between travel modes? 2) Are there significant differences (or lack of differences) seen between historically marginalized communities and the region once the proposed transportation investments are added?
Access to Travel Options - Completeness and Connectivity of the Active Transportation Network -	1) How many miles of the regional pedestrian, bicycle, trail and street networks are completed? How many miles are left to complete? 2) What percentage of bicycle and pedestrian gaps within ½ mile of transit stops and stations are completed? 3) Has connectivity and density of the regional walking, bicycling and roadway networks increased? 4) What time-frame are the pedestrian, bicycle, trail and new street investments being proposed for, compared to other investments in the RTP?

[3] Oregon Metro staff memo "2018 RTP System Evaluation Measures Methodologies" Note that "historically marginalized communities" will mean both a tier 1 and tier 2 analysis.

Table 23: Proposed Equity Measures for METRO 2018 Regional Transportation Plan (cont.)

Priority: Safety	
Share of safety projects	1) How many and what percentage of the region's proposed transportation projects are identified as safety projects? 2) What percentage of the total transportation investment package (cost) is attributed to safety projects? 3) What percentage of the total number of transportation safety investments are located in historically marginalized communities/ focused historically marginalized communities? 4) Is there a difference of transportation safety investment levels (cost) in areas with historically marginalized communities/ focused historically marginalized communities? 5) What is the per-person expenditure of transportation safety investments region-wide and for historically marginalized communities/ focused historically marginalized communities?
Exposure to Non-Interstate Vehicles Miles Traveled Exposure	1) What is the region's vehicle miles traveled (VMT) in each TAZ and how does it change above a certain threshold with the proposed package of transportation investments? 2) Is there a difference in exposure to VMT in TAZ's with high concentrations of historically marginalized communities?
Priority: Environmental and health impacts of air pollution and environmental degradation	
Intersection of Transportation Investments, Resource Habitats, and Communities	1) What percentage of resource habitats overlap with areas with high concentrations of historically marginalized communities? 2) Are these resource habitats seeing a greater percentage of proposed roadway transportation investments that may have a potential conflict with the region's resource habitats? 3) Is the percentage in historically marginalized communities greater than the region?

2.2.4.2 Methods of Analysis

The equity measures presented in the table above for the 2018 RTP Metro will rely on outputs from both the travel demand model and "off model" inventories and assessment using geographic information systems (GIS). The regional travel model will predict system outcomes such as a total travel (VMT) as well as performance measures like travel times used for the accessibility measures, for example. It can do this for each travel analysis zone and therefore allow measures to differentiate between historically marginalized communities and other geographies. "Off model" measures will inventory and map project counts and funding and project locations and enable an analysis of their impact on historically marginalized communities. All the equity measures, in the end, attempt to compare benefits and burdens on historically marginalized communities with other communities in the region. Where disparities

appear especially egregious, specific projects can be further investigated to understand if they can be reconfigured to improve equity between communities.

2.2.5 Conclusions

The 2014 RTP equity analysis found that Metro is investing at a higher rate in historically marginalized communities in both the short and long term, but recognized there are nuances to those transportation investments and how they truly benefit historically marginalized communities. For the 2018 RTP process, with an outcomes-based emphasis, Metro is developing and testing methods to measure and forecast the benefits and impacts of its short and long-term transportation investments package for historically marginalized groups.

3.0 OVERVIEW OF KEY METHODS AND MEASURES

The major outcomes of this research included a national scan of best practice methods and measures for equity analysis. These findings are provided below to serve as an initial resource to MPOs interested in creating and updating their equity analysis methods. Additional methods for examining accessibility to essential destinations, using GIS and readily available data, are provided in the Hillsborough MPO case study.

3.1 AFFORDABILITY: HOUSING AND TRANSPORTATION COSTS

Measure	**Housing plus transportation costs**
How it is calculated	The total housing and transportation costs can consume a substantial portion of a household budget. A regional plan can affect the availability and level of service for different transportation modes and thus affect the way people travel and therefore their cost of travel. Housing costs are projected using a different model based on projections of housing supply and demand in each neighborhood. This measure will estimate the total housing and transportation costs for households living in different neighborhoods. The measure can be made at the TAZ or block group scale and so can be used to compare the cost burdens for different communities. The measure illustrates where investments help to reduce costs. The measure can be presented as an average cost per household, cost-saving compared to the base year, or a cost burden (share of household income). Data is available from the Center for Neighborhood Technology
Why this is an equity measure	The regional plan will affect how people travel and the cost of that travel to their household. Different neighborhoods then will experience different changes in their travel and housing costs. This measure will compare cost changes between communities. Costs for communities of concern can be tracked over time.
Key assumptions	Housing and transportation costs are estimated based on location, and thus rely heavily on modeling assumptions about vehicle ownership, travel mode choice, and housing costs for different neighborhoods.
Measurement type and timeframe	This measure can be made for any sub-region and relies on modeled travel data. Because of uncertainties in the housing cost model it may be best suited over the short term.
Special considerations	This is a commonly used measure to understand equity.

3.2 AFFORDABILITY: TRANSPORTATION COSTS

Measure	Travel time savings
How it is calculated	A regional plan can affect the availability and level of service for different transportation modes and thus affect the speed and travel time needed for residents to travel throughout the day. These speeds are modeled and can be translated into a time savings compared to the base year. So, as transportation investments improve speed, travel times are reduced. The measure is made at the TAZ or other sub-region scale and so can be used to compare the time savings for different communities. The measure can be presented as time saved per household, compared to the base year.
Why this is an equity measure	This measure will tell us how time savings are distributed among different communities and allow us to compare communities.
Key assumptions	None.
Measurement type and timeframe	This measure can be made for any sub-region and is made for the future RTP investment year. This measure relies on modeled travel times in future years.
Special considerations	Time savings may be problematic because as people move from automobile to other modes their travel times may increase, even as other transportation costs decrease. Additionally, this measure prioritizes travel speed, which may reward investments in roadways and traffic improvements and that may not correspond with other regional goals.

Measure	Transportation costs (travel time plus out-of-pocket costs)
How it is calculated	This is similar to the previous measure, but here out-of-pocket costs are added. These include estimates of parking, tolls, transit fare, gasoline or other costs incurred for each trip.
Why this is an equity measure	The regional plan will make investments that save travelers time, but also may allow some travelers to switch to lower-cost modes. These time savings and changes in out-of-pocket costs will vary by neighborhood depending on the proximity of investments and the changes in travel choices. This measure will tell us how travel times and out-of-pocket costs are distributed among different communities and allow us to compare communities.
Key assumptions	This measure relies on modeled travel times in future years, along with assumptions about future transportation costs like fuel prices and transit fares.
Measurement type and timeframe	This measure can be made for any sub-region, and is made for the future RTP investment year. Since fuel prices and transit fares may be hard to

	predict in the long term, this may be a measure best suited for near-term evaluations.
Special considerations	Time savings may be problematic because as people move from automobiles to other modes their travel times may increase, even as other transportation costs decrease. Additionally, this measure prioritizes travel speed, which may reward investments in roadways and traffic improvements and that may not correspond with other regional goals.

3.3 ACCESSIBILITY: ACCESS TO PLACES

Measure	**Access to essential destinations and jobs[4]**
How it is calculated	Accessibility here is defined as the ability to reach essential destinations and jobs. The transportation network affords users the ability to move about in space. Depending on how well the transportation system works, that person can reach more things within a given time window. Accessibility calculations sum the total number of destinations reachable within a given time window. This calculation depends on the mode chosen and so the measure would need to be presented separately as access by auto, transit and bike (as these are modeled modes). Typically, a time window of 30 or 45 minutes is used to represent a typical commute trip or reasonable amount of time to reach destinations. A set distance such as one mile or three miles from essential destinations is also another method.
Why this is an equity measure	Access is the main goal of a land use and transportation system. Therefore, improvements in access which result from the regional plan are an important component of the plan's success. Access is improved for each mode (auto, transit and bike) and thus this measure is calculated separately for each mode. Similarly, access is improved differently in different areas depending on the proximity of those areas to investments. This measure will tell us how improvements in access (for each mode) are distributed among different communities and allow us to compare communities.
Key assumptions	Destinations just beyond the travel time window or completely out of reach. (While this is an unrealistic assumption, the measure is easy to understand when a simple cutoff time is used instead of a decaying function.)

[4] Academics have worked to improve this measure by varying the travel time window by demographic group according to how the group actually travels. The travel time window is estimated using the actual travel information from a survey of residents. This generally means that low-income households, for example, travel less and are already less accessible to destinations even before investments in the regional plan are made. This would suggest a need for even more investment in low-income communities to overcome the fact that they are already mobility challenged. Unfortunately, the analysis needed to develop these travel time windows is quite complex.

Measurement type and timeframe	This measure can be made for any TAZ or sub-region, and is made for the future RTP investment year using modeled travel times and other methods.
Special considerations	This is a commonly used measure in other regions. While it is sometimes complicated to understand because each TAZ or sub-region has a different number of reachable destinations, it may be worth the complexity. The measure's results will be very sensitive to the length of the travel time window.

Measure	**Transit access disadvantage**
How it is calculated	This measure is based on the defining "essential destinations" and calculating the sum of what is accessible by auto and transit. Here the transit access number is divided by the auto access number for each TAZ or sub-region. A low ratio is produced in areas where transit is lacking. Then we map historically underrepresented communities within those transit deficient areas. This creates a sub-region of concern in which we look at RTP investments, or we can measure improvements in access due to the RTP investments in these areas.
Why this is an equity measure	Access to destinations by public transit is especially important for households dependent on transit. This measure compares transit access to auto access and highlights historically underrepresented communities in areas where transit performs poorly. These areas can be used as sub-regions for mapping investments or to measure improvements in access from the RTP investments. This measure will tell us whether improvements in access by transit are happening in the places where they are most needed.
Key assumptions	Assumptions here are similar to the **Access to essential destinations and jobs** measure. Furthermore, we are assuming that transit is especially important to historically underrepresented communities.
Measurement type and timeframe	This measure can be made for any sub-region, and can be made for the base year or future RTP investment year. If used with the base year it can make a map of the sub-region of concern ,which can then be used to investigate the location of RTP projects or calculate improvements in access for the future RTP investment year.
Special considerations	This is an important measure as historical patterns illustrate low-income communities moving to outer areas with less transit access.

Measure	Affordable housing in locations of accessibility
How it is calculated	Measuring accessibility near affordable housing is similar to calculating the essential destination access measure presented above. Here, we would look at accessibility to essential destinations within a travel time window from TAZs or sub-regions with good housing affordability. In essence, housing affordability defines the sub-region. For local access to nearby services, we could develop a scoring system like bikescore, transitscore or walkscore. Alternatively, we can measure the amount of affordable housing in areas known to have good access, for example near high capacity transit or in job-rich areas (for all jobs or specific job types), or in areas with good local access (e.g., with high bikescore, transitscore or walkscore).
Why is this an equity measure	Similar to other access measures, but focuses on affordable housing instead of specific community characteristics as the comparison dimension. This measure can be calculated in two ways: measuring accessibility near affordable housing, or measuring affordable housing near accessibility.
Key assumptions	This measure uses similar assumptions to those used in the essential destination access measure above. It also assumes we know the location of affordable housing in the future, which is less reliable. It would also require an agreed upon definition for affordable housing (renter vs. owner)
Measurement type and timeframe	This measure can be made for any sub-region, and is made for the future RTP investment year. As a mapping exercise it is off-model.
Special considerations	

3.4 ACCESSIBILITY: INFRASTRUCTURE

Measure	Intersection of investments with community geographies
How it is calculated	Projects in the RTP are mapped to show which investments overlap with our sub-geographies. From there, we could then sum investments as a total project number or total project value (investment dollars), and compare these as per capita, or per area.
Why this is an equity measure	This measure identifies and sums investments made in sub-geographies (containing historically underrepresented communities) and looks at the level of investment among these communities and the entire region.
Key assumptions	The key assumption here is that projects located in a place directly benefit the people living in that place.

Measurement type and timeframe	This measure can be made for any sub-region, and is made for the RTP investment. As a mapping exercise it is off–model.
Special considerations	This measure is a weak measure of equity because of the assumption that projects located in an area benefit people living in that area. Typically, project benefits accrue to those living "downstream" of a project and having an investment go through a community doesn't necessarily mean it benefits that community.

3.5 TRANSIT: TRANSIT ACCESS

Measure	**Measures of transit supply**
How it is calculated	There are various measures of transit supply, including total service-hours or service-miles, or transit vehicle trips within a given timeframe such as a day, week, month, etc. For the RTP, transit service can be calculated within sub-geographies and then used to get a per-capita or per-area measure.
Why this is an equity measure	Transit supply distribution among different communities. For this measure, therefore, we would look for equal supply per capita, or per area, for different communities.
Key assumptions	
Measurement type and timeframe	This measure relies on projections of transit service for the RTP year. It can be made for any sub-region, and as a mapping exercise it is off-model.
Special considerations	

Measure	**Gaps between transit need and supply**
How it is calculated	See the **Measures of transit supply** measure for a description of calculation. For transit need, measures typically look at factors such as vehicle ownership and income to predict transit dependency. A combination of these factors could be used to create a need index, and this can be calculated based on existing travel survey data. One can then calculate the transit supply for high- and low-need areas.
Why this is an equity measure	This measure looks at transit supply distributed towards communities which need services more than others. For this measure, therefore, we would look for a match between transit supply and measures of transit need.

Key assumptions	Assumptions about need based on the demographic factors are important.
Measurement type and timeframe	This measure relies on projections of transit service and transit need for the future RTP investment year. It can be made for any sub-region, and as a mapping exercise it is off-model.
Special considerations	

Measure	**Gaps between transit need and level of service (LOS)**
How it is calculated	This measure is similar to the **Gaps between transit need and supply** measure, except that transit speed or travel times are used instead of basic measures of supply. Speed or travel times can be calculated from the transit trips taken from each TAZ for the RTP model. Higher speed, or lower travel times, would indicate a better performing transit system for that TAZ. For transit need, measures typically look at factors such as vehicle ownership and income to predict transit dependency. A combination of these factors could be used to create a need index, and this can be calculated based on existing travel survey data. One can then calculate the transit LOS for high- and low-need areas.
Why this is an equity measure	This measures looks at transit LOS distribution with an emphasis on communities with higher needs. For this measure, therefore, we would look for a match between transit LOS and measures of transit need.
Key assumptions	Assumptions about need based on the demographic factors are important.
Measurement type and timeframe	This measure relies on projections of transit service and transit need for the future RTP investment year. It can be made for any sub-region, and uses modeled transit LOS.
Special considerations	LOS measure (which reflects service speed) may be problematic because suburban services may operate at higher speeds but not offer additional accessibility to destinations. Likewise, core urban services may be slower but offer better connectivity. Additionally, this measure prioritizes travel speed, which may reward investments in roadways and traffic improvements and that may not correspond with other regional goals.

Measure	**Transit service deficiencies in areas of high need**
How it is calculated	Projections of transit service levels can reveal times of the day or days of the week when service is minimal or nonexistent for certain TAZs or sub-regions (for example: hours per week with headways greater or equal to 30 minutes). This measure would tally those hours for each TAZ within sub-geographies. Transit need would be calculated similarly to the measures **Gaps between transit need and supply** and **Gaps between transit need and level of service (LOS)**. Absent or minimal transit

	service can then be calculated for high- and low-need TAZs or sub-regions to pinpoint where services are needed.
Why this is an equity measure	Variations, especially major absences, in transit services can be harmful to transit-dependent populations. Investments to reduce the amount of time where transit services are minimal or absent will support populations who use transit. Thus, reductions in gaps and improvements in off-peak service will be important to measure.
Key assumptions	None.
Measurement type and timeframe	This measure relies on projections of transit service for the future RTP investment year. It can be made for any sub-region, and uses mapped service projections which are off-model.
Special considerations	

3.6 SAFETY: INFRASTRUCTURE / DISPARITIES

Measure	**Safety-related project locations**
How it is calculated	Safety-related projects in the RTP are mapped to show which investments overlap with our sub-geographies. From there, we could then sum investments as a total project number or total project value (in terms of investment dollars), and compare these as per capita, or per area.
Why this is an equity measure	This measure would look at the distribution of safety-related investments among different communities.
Key assumptions	The key assumption here is that projects located in a place directly benefit the people living in that place.
Measurement type and timeframe	This measure can be made for any sub-region, and is made for the future RTP investment. As a mapping exercise it is off-model.
Special considerations	Safety-related projects probably do correspond with local benefits better than general transportation investments (an issue mentioned in an earlier mapping- based measure above). The question here, however, is what is a fair distribution of safety improvements? Do communities which typically experience higher traffic danger burdens deserve more investment? These questions should be addressed alongside the choice between a per capita or per area measure.

Measure	**Safety investments on the high-injury network**

How it is calculated	Safety-related projects in the RTP are mapped to show which investments overlap with the high-injury network. This would create some kind of proportional measure where higher proportions of projects in high-injury locations are better.
Why this is an equity measure	This measure would look at safety-related investments on the high-injury network. The measure would compare this rate of investment with the rate of investment overall. Presumably the investment in the high-injury network would be higher than the average investment overall. Particular focus is on high-injury network investments that correspond to locations of importance to historically underrepresented communities.
Key assumptions	We assume that historically underrepresented communities travel often in high-injury parts of the network.
Measurement type and timeframe	This measure can be made for the RTP investment. As a mapping exercise it is off-model.
Special considerations	

Measure	**Safe Routes to School (SRTS) investments**
How it is calculated	This measure identifies and sums SRTS investments made in sub-regions or, alternatively, schools with high representation of low-income students (with high representation of students who qualify for meal assistance). We could then compare overall investment (per school or per pupil) between the schools and all schools.
Why this is an equity measure	The measure would compare this rate of investment in schools of concern with the rate of investment overall.
Key assumptions	This measure assumes we have an accurate inventory of SRTS investments into the future.
Measurement type and timeframe	This measure can be made for any sub-region or set of schools, and is made for the future RTP investment. As a mapping exercise it is off-model.
Special considerations	

3.7 SAFETY: EXPOSURE

Measure	**Total Vehicle Miles Traveled (VMT)/square mile in residential and commercial areas**

How it is calculated	All vehicle travel (measured as vehicle-miles traveled (VMT)) is modeled for the RTP and can be summed within any given TAZ or sub-region. This VMT per square mile is calculated for the sub-region and compared with the measure for the rest of the region and for future RTP investment years.
Why this is an equity measure	This measure would look at VMT exposure by particular communities and how that may change with future RTP investments. It would allow us to identify areas with a much higher exposure than others.
Key assumptions	VMT is a proxy for traffic danger and emissions exposure.
Measurement type and timeframe	This measure can be made for any sub-region, and is made for the future RTP investment year. This measure relies on modeled travel data.
Special considerations	

3.8 PUBLIC HEALTH: ENVIRONMENTAL AND HEALTH IMPACTS

Measure	**Proximity to roadways**
How it is calculated	This measure calculates the share of housing within a certain distance buffer from high-volume roadways which is affordable. Using a mapping tool, affordable housing resources and all housing resources within distance buffers (e.g., 500 feet) of high-volume roadways are summed. This is used to create a share of housing which is affordable within these buffers.
Why this is an equity measure	The share of housing which is affordable within this distance buffer should be similar to the share of other housing. An overrepresentation of affordable housing means that those households are overburdened with exposure to the impacts of roadways.
Key assumptions	Proximity to high-volume roadways is proxy for emissions exposure.
Measurement type and timeframe	This measure is made for the future RTP investment year, and as a mapping exercise is off-model.
Special considerations	The buffer distance and the definition of “high-volume” will be important for this measure. The definition of affordable housing will also be important for this measure.

Measure	Measures of active travel
How it is calculated	The regional model will predict non-motorized travel mode share, and this can be modeled for any sub-region and compared with the rest of the region.
Why this is an equity measure	The choice of non-motorized travel (walking or cycling) is assumed to be a benefit of RTP investments. Thus, increases in non-motorized travel should be shared equally between communities if the RTP is equitable.
Key assumptions	
Measurement type and timeframe	This measure can be made for any sub-region, and is made for the future RTP investment year. This measure relies on modeled travel data.
Special considerations	While non-motorized travel is held up as a benefit of progressive planning, many transportation-disadvantaged communities bike and walk not out of choice but out of necessity. This measure may overstate the benefits of increases in non-motorized travel in some communities.

3.9 OTHER: TIMING OF INVESTMENTS

Measure	Displacement risk
How it is calculated	The RTP investments would be phased into several periods, and the distribution of these projects in each phase would be mapped. The projects in sub-geographies would then be summed, and a share of the total would be calculated to confirm that all communities are receiving some projects during all phases of the RTP.
Why this is an equity measure	Look at the share of investment during the initial stages of the RTP in historically underrepresented communities.
Key assumptions	Timeframe of when an RTP investment plans for its completion.
Measurement type and timeframe	This is a mapping exercise and would not involve the model. The timeframe would depend on the phasing used in the measurement and what is indicated as the timeframe of when an individual project is completed.
Special considerations	

3.10 MONITORING

Measure	Displacement risk
How it is calculated	There are various types of displacement risk estimations. Most measure compounding factors of housing cost burden, rapid increases in housing prices and rents, and the percent of area residents who rent, among other things. The risk can be calculated for a specific TAZ or sub-region and can be mapped. RTP projects can then be mapped for their correspondence with high displacement-risk areas to signal the need for more attention in those areas.
Why this is an equity measure	Low-income renting populations struggle to remain in areas of the region where rents and sale prices increase rapidly. Measuring displacement risk can inform which investments are in need of additional housing strategies in order to preempt situations where RTP investments could exacerbate existing displacement risks.
Key assumptions	The current geography of displacement risk remains relevant out to the future RTP investment year.
Measurement type and timeframe	This measure relies on projections of the factors which predict displacement risk. These may be less robust out to the future RTP investment year and better as a short-term monitoring measure.
Special considerations	

4.0 CONCLUSIONS

Despite widespread evidence that MPOs are working towards achieving greater equity in regional transportation planning, the lack of clear guidance has led to a patchwork of approaches. In addition, the role of equity analysis in shaping long-range transportation plans and project decisions is often unclear. A more systematic approach to equity in regional transportation planning would not only benefit historically disadvantaged communities. It can lead to a more holistic and comprehensive approach to regional transportation planning that enhances livability, affordability and economic opportunity for the broader population.

Our research found that efforts have gone into better understanding and mapping low-income and minority communities and other communities for whom transportation is a challenge, or those who have been historically excluded from the planning process. Locating and reaching out to these communities of concern is a powerful first step for planning agencies attempting to proactively address equity issues in the planning process.

With advancements in data and mapping techniques, new approaches to evaluating distributional outcomes of plans have also been developed in the consulting and academic communities. These have focused on the performance of the systems in terms of accessibility

and travel times, as well as burden such as air pollution and safety risk. A diverse set of accessibility measures is being used to understand how investments in both transit and roadways increases access to important destinations.

Much of the work we reviewed also recognized that transportation is a significant cost and, along with housing, constitutes a significant financial burden for households. The development of housing and transportation cost measures helps to illustrate how transportation planning can sometimes overlook location efficiency, and that sometimes higher housing costs in high-access areas can be a worthwhile tradeoff. This recognizes that affordable housing near transportation facilities will be an important part of lowering household transportation costs and addressing equity issues. Measures of transportation and housing costs were found to be increasingly important parts of equity analyses across the country.

Alongside advancements in equity analysis, it is vital that affected communities are brought to the table to develop a shared understanding of the key issues, opportunities and project needs illuminated by the analysis. This will help to ensure that project identification and performance monitoring more directly aligns with community needs. The two case studies presented here, while in very different contexts, illustrate the importance of engagement and understanding community needs. They also illustrate how equity analysis can help uncover important community transportation needs that may otherwise be overlooked in long-range planning and investment decisions.

5.0 APPENDIX A: SELECTED EXAMPLES

5.1 SAN FRANCISCO BAY AREA MTC

Identifying Communities of Concern

The Association of Bay Area Governments and the Metropolitan Transportation Commission (MTC) of the San Francisco Bay Area utilized census tracts and transportation analysis zones (TAZ) that had either significant concentrations of both low-income and minority residents or had significant concentrations of any four or more of the following:

- Minority or low-income individuals below 200% of the federal poverty level
- Persons with limited English proficiency (LEP)
- Zero-vehicle households
- Seniors ages 75 or older
- Individuals with a disability
- Single-parent families
- Housing units occupied by renters who spent 50% or more of household income on rent

Minorities were defined as individuals who identified as: Black, Hispanic, Asian, American Indian, and/or Alaskan Native. Using these definitions and comparing against regional averages, it was determined that 20% of the region's population resides in a community of concern (MTC, 2013).

Determining Project Needs

The MTC adopted the Public Participation Plan in December of 2010, which was used to guide agency outreach and public involvement efforts throughout the development of the MTC/ABAG plan for the San Francisco Bay Area. The Public Participation Plan included three rounds of equity analysis to incorporate equity considerations throughout the development of the plan and two rounds of outreach to low-income communities, minority communities and other underrepresented communities through partnerships with community-based groups and organizations. Stakeholder input was also gathered through the Regional Equity Working Group, which brought together representatives for disadvantaged communities and other agencies and organizations.

In addition to the Public Participation Plan and the Regional Equity Working Group, the MTC utilized its Community-Based Transportation Planning program to identify the transportation needs of low-income communities by involving residents, community and faith-based organizations, transit operators, and county congestion management agencies with the MTC. The information gathered was used to identify the needs of low-income, minority and underserved communities, set priorities, and evaluate options for filling gaps in the transportation system (MTC, 2013).

Methods for Evaluating Equity

Table A-1. Methods for Evaluating Equity in the Bay Area

Measures	Methods
Transportation Investment (p. 78)	Population/Use-Based Analysis, Project Mapping, and Title VI Analysis
Housing and Transportation Affordability (p. 85)	Commissioned the Center for Neighborhood Technology to study the current landscape of housing and transportation tradeoffs by the region's low- and moderate-income households in depth. Basic measure represents housing and transportation combined as a percentage of household income.
Risk of Displacement (p. 88)	Overlays households spending 50% or more of income on rent with locations where intensive housing growth is planned by 2040.
VMT and Emissions Density (p. 91)	Measure of total vehicle miles traveled on major roadways within 1,000 feet of commercial and residential areas; measures of specific types of emissions are also utilized.
Commute Time (p. 99)	Measurement of average travel time per commute trip accounting for all modes based on the location of an individual's residence, location of employment and travel mode. Measurements were taken to calculate the average commute time by community type and by density level.
Non-Commute Time (p. 102)	Intended to be a measure of overall equitable mobility; measures average non-commute travel time by community type (Communities of Concern vs. Remainder of the Region).
Data sources: 2000 Bay Area Travel Survey, 2010 Census SF1, 2010 American Community Survey Public Use Microdata Sample 1-Year Estimates	

Methods of Analysis

The Equity Analysis Report of Plan Bay Area includes three "distinct but related" analyses of the Plan Bay Area draft. These methodologies were designed with input from the Regional Equity Working group as well as stakeholders in the plan. These analyses include a Title VI analysis; an environmental justice analysis, which modeled performance measures to determine if the draft had any disproportionately adverse effects on communities of concern and low-income and minority populations; and an equity analysis to examine the distribution of benefits and burdens between the communities of concern and the region as a whole (MTC, 2013).

In addition to the three above analyses, the report also developed a Transportation Investment Analysis, which utilized the population/use-based analysis and the project mapping analysis to measure the distribution of proposed RTP investments relative to identified communities of concern and low-income populations.

Finally, the methodology of the report included Technical Performance Measures comprised of a set of five measures (in the table above): Housing and Transportation Affordability, Potential for Displacement, Density of Vehicle Travel, Average Commute Time, and Average Non-Commute Time.

References

Association of Bay Area Governments, the Metropolitan Transportation Commission. (2013, July). *Bay Area Plan: A Strategy for a Sustainable Region. Equity Analysis Report Including Title VI, Environmental Justice and Equity Analysis for Plan Bay Area*. Retrieved from http://mtc.ca.gov/sites/default/files/A-04_FINAL_PBA_Equity_Analysis_Report.pdf.

5.2 ATLANTA REGIONAL COMMISSION

Identifying Communities of Concern

As noted within its Appendix C-3 document (2011), the Atlanta Regional Commission (ARC) created an Equitable Target Area (ETA) in order to identify its EJ communities. Using census tract-level aggregated data based on SF3 data tables from 2005-2009 American Community Surveys (ACS), it based its index on the following five parameters (Appendix C-3, 2011, p.1):

- Age (Persons $\geq$ 65 years old)
- Education (Persons $\geq$ 25 years old with no H.S. degree)
- Median housing values
- Poverty rates (thresholds based on the size and composition of the household)
- Race (minorities)

Using the raw data from the ACS in Excel, regional averages were calculated for each of the five parameters as well as parameter categories (Appendix C-3, 2011). Each parameter was broken down into four categories using the following matrix (Appendix C-3, 2011:

- One category = Below average areas for that parameter = Low EJ concern
- The three other categories = Above average areas = Increasing levels of EJ concern

A range for the four categories was created, and using GIS each of the five parameters were mapped out based on their regional averages and their calculated categories (Appendix C-3, 2011). The ETA was then calculated in Excel using a series of calculations in Excel, detailed within Appendix C-3, and then mapped using GIS again (2011).

Within Appendix C-3 (2011), the ARC listed two other methodologies that they used to measure and locate other EJ populations (not included within their ETA Index), such as limited English proficiency (LEP) and disabled populations.

Determining Project Needs

The ARC Public Participation Plan set forth strategies to obtain public input on equity issues in the area and to determine project needs (ARC, 2011). These strategies included in-person and online public meetings with the ARC Board and Committee, neighborhood forums, stakeholder group discussions and listening sessions, focus group workshops, polls or surveys, and input from a Social Equity Advisory Committee. The public input obtained was compared against issues already scheduled to be addressed by Plan 2040 and Fifty Forward, a document that included the vision for the region for the next 50 years. This was to ensure that all communities

were involved in the process, and diverse needs, concerns, values and desires were documented and were scheduled to be addressed in the next plan(s).

Measures and Methods of Analysis for Evaluating Equity

The ARC measured the impact of the implementation of Plan 2040 on ETA communities by measuring the following (Table A-2).

Table A-2. Measures and Methods of Analysis for Evaluating Equity in the Atlanta Region

Measures	Methods
Zero-Car Households (Appendix C-3, 2011, p. 4)	The distribution of zero-car households in 2010 vs. 2040 was calculated, mapped in GIS, and overlaid on the ETA Index map. The percentage of zero-car households within ETA communities was calculated and compared using GIS.
Accessibility (Appendix C-3, 2011, p. 5)	A composite multimodal accessibility (MMA) measure was calculated for each TAZ that measured ability to access employment centers by 15 minutes of walking, 30 minutes of driving, or 45 minutes via local transit within the region for both 2010 and 2040. High or medium-high MMA areas offer all three options and low or very low MMA areas require driving. The percentage of ETA communities located in high-accessibility areas was determined using GIS.
Unified Growth Policy Map (UGPM) (Appendix C-3, 2011, p. 5)	The impact of the UGPM on ETA communities was measured by overlaying its elements on top of identified ETA communities using GIS. Regional and local centers identified in the Plan 2040 were also overlaid, and using GIS analysis the percentage of these centers that were located within their ETA communities was determined.
Transportation Investments (Appendix C-3, 2011, p. 5)	Project shapefiles for planned transportation investments by mode were overlaid on the identified ETA communities using GIS. A comparison of the proportionate per capita investment by total projects and project type/mode was calculated for ETA vs. non-ETA communities using GIS.
Jobs-Housing Balance (Appendix C-3, 2011, p. 6)	Examines change in the jobs-housing balance between 2010 and 2040. ARC population and employment estimates and forecasts were used to calculate the total number of jobs and households by TAZ. Using Excel, the balance for each TAZ was calculated and linked to corresponding layers in GIS. GIS analysis was used to create ratios between ETA vs. non-ETA communities for both years.
Livable Centers Initiative (LCI) Projects (Appendix C-3, 2011, p. 6)	GIS was used to calculate the percentage of LCI projects within or adjacent to identified ETA communities by overlaying LCI shapefiles on ETA areas.
Data sources: 2005-2009 American Community Survey and the 2010 U.S. Census	

In measuring these factors and their impacts proposed within the 2040 plan, the ARC ultimately observed per capita investments were proportional, relative to the rest of the non-ETA region; multimodal accessibility would be enhanced; and there would be an improvement in the

jobs-housing balance (Comparative Analysis, n.d.). Additionally, the ARC views these methodologies as a means of providing a way to analyze system-level equity; provide project-level analysis when needed in the evaluation of burdens vs. benefits; and gain additional insight into the needs of ETA communities for decision making or to guide further community analysis.

References

Atlanta Regional Commission (ARC). *Volume I: Plan 2040 Regional Transportation Plan (RTP).* Retrieved from http://documents.atlantaregional.com/plan2040/docs/tp_PLAN2040RTP_072711.pdf.

5.3 POLK TRANSPORTATION PLANNING ORGANIZATION (TPO)

Identifying Communities of Concern

The Polk Transportation Planning Organization (TPO) conducted a neighborhood mobility audit focused on traditionally underserved neighborhoods. These neighborhoods contained notable concentrations of:

- Minorities
- Low-income populations
- Transportation-disadvantaged persons

The transportation disadvantaged were defined as those who were 65 years old or older, persons with disabilities, carless households, or those who were 15 years old or younger who could not legally operate a vehicle.

Census block groups were used to identify concentrations of minority and low-income populations that were well above Polk County averages. Areas were ranked based on concentration levels. Polk TPO staff and Technical Advisory Committee (TAC) members further defined these neighborhood boundaries using elements such as housing type, travel and social patterns.

Determining Project Needs

The Polk TPO actively promotes best practices to advance livable communities in support of the Livable Polk Initiative. To identify ways to enhance multimodal connections to essential services and jobs, the TPO performed a series of neighborhood-level mobility audits. These audits focused on evaluating neighborhood mobility issues in areas with higher concentrations of traditionally underserved populations.

Methods for Evaluating Equity

A combination of six indices were used to describe the overall mobility of each neighborhood studied regarding opportunities to walk, bike or take transit, as well as hindrances to mobility, such as gaps and barriers. The six indices used in the neighborhood-based analysis are listed in Table A-3.

Table A-3. Evaluating Neighborhood Mobility in Polk County

Audit Type	Purpose
Walking Access (p. 8)	Used to measure walking potential, it assesses the potential for quarter-mile walking trips to community services and places.
Biking Access (p. 10)	Used to measure biking potential, it assesses the potential for one-mile biking trips to community services and places.
Transit Connectivity (p. 12)	Used to measure transit connectivity, it assesses the potential to have access to community services and places by looking at the location, intensity and frequency of transit service in the area.
Gaps (p. 14)	Used to determine whether areas within the neighborhood have a higher or lower number of sidewalk gaps in comparison to the location of community services and places. It assesses the presence of transportation network gaps, specifically sidewalk network gaps, which may hinder the potential for walking or biking trips.
Barriers (p. 15)	Used to determine whether areas within the neighborhood have a higher or lower number of barriers in comparison to the location of community services and places. It assesses the presence of three features that may hinder the potential for walking or biking trips.
Mobility (p. 17)	Used to summarize the overall mobility within each neighborhood and the level of mobility assigned based on the cumulative score.
Data source: 2007-2011 American Community Survey,	

Methods of Analysis

For consistency sake, a quarter-mile grid, which was representative of the typical maximum walking distance, was laid over the study areas consisting of neighborhoods with higher than average concentrations of traditionally underserved populations. Under each of the walking and biking access indices, calculations were made based on three walking or biking trip factors (connectivity, dwelling density and diversity in use) respectively; ranked accordingly (from 0-3, with 3 being the highest); and then tallied to produce a cumulative score for each quarter-mile square under each index.

In order to calculate the Transit Connectivity Index (TCI), data was also used from Polk County Transit Services, Citrus Connection, Winter Haven Area Transit (WHAT) fixed-bus routes, and the number of weekly transit trips (by route and frequency) from Polk County, WHAT and Lakeland Area Mass Transit District. The following formula was used: TCI = (Route buffer intersecting quarter-mile square) / (Total Quarter-Mile Square Area). Quarter-mile squares were divided into ranges based on their TCI scores and ranked accordingly (from 0-3, with 3 being the highest and indicates better transit coverage in the area studied).

Since the county did not have an existing sidewalk network GIS file to move forward with its gaps index, sidewalks were digitized using roadway centerline data in GIS. Sidewalk gap calculations were done in order to determine the percent of roadway network that had no

sidewalk (per quarter-mile square) and placed into four ranges (from 0-3, with 0 being a minimal level of gaps being present while three representing no infrastructure were present). Under the barriers index individual calculations were made based on the three features that may have hindered the potential for walking or biking (roadway, railroad and waterway), and then were ranked accordingly (from 0-3, with 3 being the highest).

The mobility index was used to summarize the overall mobility within each neighborhood by looking at all of the accessibility/potential for accessibility and deducting hindrances. Scoring weight for transit was higher because of the importance of transit in serving traditionally underserved communities, and because gaps and barriers have the potential to reduce access or overall mobility by up to 50%. A discount factor up to 25% of the potential access was applied to both indices. The formula Polk TPO used to determine the level of mobility was based on the cumulative score of the mobility index, which consisted of: Mobility Index = Potential Access - Gaps Discount - Barriers Discount.

Application of Findings

Using the results of its mobility audits, the Polk TPO created easy, visual comparisons between levels of mobility across different neighborhoods using neighborhood mobility dashboards. The dashboards are graphical representations of the five individual indices and include a separate one containing the mobility index results. These were created in the attempt to help prioritize neighborhoods for transportation investments.

One of the neighborhoods that the Polk TPO uses as an example within its report was a mobility audit for its East Bartow neighborhood. It allowed them to see that they specifically needed to focus on closing pedestrian/bicycle infrastructure gaps as well as strengthen access across major barriers. Additionally, it provided an opportunity to consider other opportunities to improve access outside of the neighborhood core that would also improve walking, biking and transit access.

Going forward, Polk TPO would like to use the results of these and future audits, and overlay them over improvement recommendations already noted within its planning documents in order to identify if the neighborhoods with the greatest needs are in line to get mobility enhancements. And, if there are few or no overlaps, to use those observations to provide push for additional enhancements as amendments or in future planning documents for those areas.

References

Polk Transportation Planning Organization (PTPO). (2015b). *Neighborhood Mobility Audits*. Retrieved from http://polktpo.com/media/33968/L4-Neighborhood-Mobility-Audits.pdf.

5.4 SAN DIEGO ASSOCIATION OF GOVERNMENTS (SANDAG)

Identifying Communities of Concern

The San Diego Association of Governments (SANDAG) conducted a series of health assessments focused on physical activity and active transportation, injury prevention, nutrition and air quality, and assessed their impact, particularly on communities of concern. These communities of concern were defined as:

- Low-income populations
- Minorities

- Low-mobility populations
- Areas where there is low community engagement

Areas noted as having low-mobility had populations where 25% had a disability, 20% were over 65 years old, and more than 25% did not own a car.

Areas where there was a low community engagement had more than 20% of their population made up of persons with disabilities, 20% of their households do not speak English, and more than 20% of their population did not have a high school diploma.

The 2010 census tract data for the communities of concern was provided by SANDAG and broken down to block groups. It was found that "nearly two-thirds of all Census block groups in the region have one or more Communities of Concern" and "there is a large degree of geographic overlap" between the different populations in these areas (p.6).

Determining Project Needs

SANDAG conducted health assessments to provide guidance to local governments in its planning process.

Methods of Analysis and Findings

Four health assessment categories were used in the assessment of impacts on communities of concern, as shown in Table A-4. For each health assessment, one or more factors were considered to determine its impact on the health of a community. Listed below are the method of analysis for selected factors.

Table A-4. Evaluating Health in Communities

Health Assessment Category	Factors Considered
Physical Activity and Active Transportation (p. 11)	Utilitarian Walkability Sidewalks Access to Transit Stations and Stops Parks and Open Space Access Non-motorized Trails Access Transportation Infrastructure Support Access to Social Support and Amenities Complete Neighborhoods and Community Support Youth Physical Activity Support Physical Disorder and Crime Road Design Physical Activity Inhibitors
Injury Prevention (p. 49)	Traffic Crashes Pedestrian Traffic Safety Cyclist Safety Traffic Safety for Youth
Nutrition (p. 63)	Healthy Foods Access Fast Food Density
Air Quality (p. 69)	Pollution and its Health Risks

Utilitarian Walkability

This analysis used the Walkability Index to determine the walkability of each block group has been vetted by over 20 peer-reviewed journals. The Walkability Index consists of: 1) retail floor area ratio (FAR) used to identify whether sites are oriented for pedestrians; 2) intersection density used to measure street-network connectivity and used to identify the number of intersections in a block group, as the greater the density the better network pedestrians have to walk and have more efficient walking travel times; 3) net residential density used to measure the compactness of residences; and 4) land use mix used to measure the proximity of different land use types to one another, where all standardized values are added and the intersection density is weighted twice that of the others.

A cumulative Walkability Index was used to combine the results of all four walkability components (all four received standardized values and the intersection density was weighted twice more than the others). The information was obtained from 2006 parcel data (i.e., land use categories, area of land dedicated to each land use, parcel boundaries, and the number of housing units in each parcel). As evidenced in Figure 13, they found that the urban core of San Diego had the "largest continuous high-walkability area" (p. 13), there were also several smaller walkable areas that were right outside the urban core boundary, and there were similar patterns in several other cities.

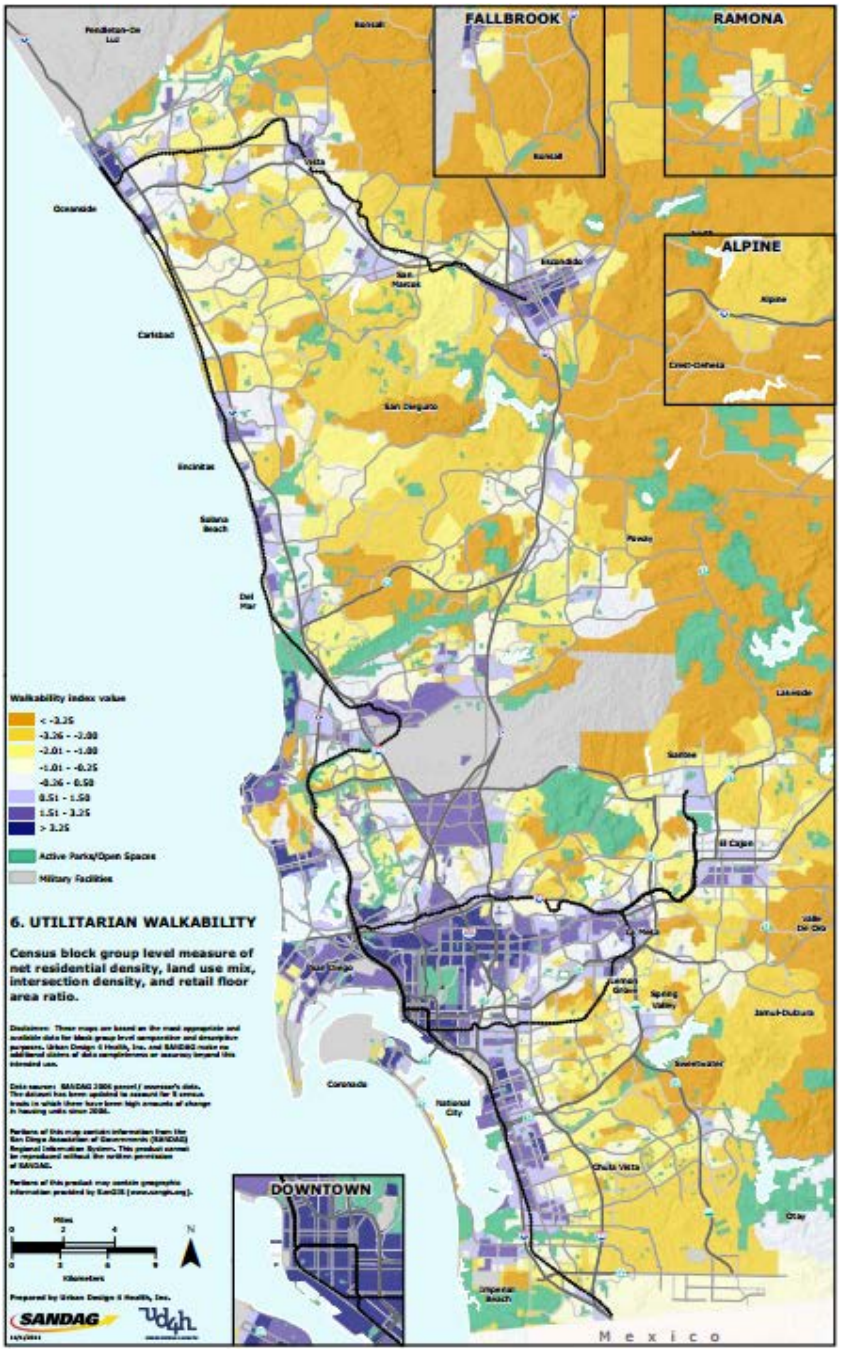

Figure 13. Results from a walkability analysis in San Diego.

Source: SANDAG, 2012

Sidewalks

This analysis focused on the completeness of sidewalk networks in each block group as it enables walking, draws more people to the area, has been associated with lower rates of overweight status, and contributes to safety and a decrease in traffic-induced injuries to pedestrians. “The ratio of total sidewalk miles to the number of total roadway miles in each

Census block" (p.16) was measured. The 2011 regional sidewalk inventory for the urban area was used, so block groups outside of the boundaries were not taken into consideration and classified as "insufficient data." They found that the sidewalk coverage in much of the urban core was high and many of the block groups home to the communities of concern had sidewalk networks that were 73% or more complete.

Access to Transit Stations and Stops

This analysis focused on the proportion of households that were within walking distance of "high-quality" transit in each block group. Transit data was retrieved from 2010 SANDAG data and "pre-established SANDAG transit service criteria were used to identify high-quality transit locations" (p.18) because proximity to them is an important predictor to walking/increased physical activity. They found the distribution of transit accessibility within the block groups was bimodal, meaning that access was either very good or very limited, and largely due to transit services being concentrated along major rail corridors. Nearly 40% of households were within walking distance of a high-quality transit service, including a large portion of the block groups with communities of concern. However, there were substantial portions that had little to no access, and for populations where mobility may already be an issue, the lack of transit access can make mobility for these populations even worse.

Parks and Open Spaces Access: This analysis focused on the percentage of households within walking distance of park entrance points or open space (i.e., areas associated with higher levels of physical activity) in each census block group. Parks data was retrieved from the Neighborhood Quality of Life study and 2004-2005 SANDAG parks and open space data set. Findings were that many have access to open space and parks in the region, with almost 60% of households within walking access of one. However, in the urban areas, access is typically either very high or very low. Nearly half of the block groups with communities of concern had high levels of access to parks; however, a significant portion had very low levels of access.

Non-motorized Trails Access: This analysis focused on measuring access to non-motorized trails because they provide recreational opportunities, serve as active transportation corridors, and can even attract those who would not have otherwise chosen to ride a bicycle. The percentage of housing units within approximately a 12-20 minute walk or 15-16 minute bike ride of non-motorized trails were retrieved from 2009 SANDAG data (used bicycle-network data). They found access to trails is generally low. For communities of concern, almost two-thirds of the block groups had no nearby access and only 10% had very good access. In general, access to non-motorized trails for block groups with communities of concern was similar to that of the rest of the region – either very high or very low.

Transportation Infrastructure Support

This analysis focused on identifying "where the region's network of transportation infrastructure supports physical activity, or where an infrastructure deficit could inhibit physical activity" (p.24). Several factors were considered, including non-motorized trails access, access to transit stations and stops, and sidewalk completeness, of which each was given a standardized value and a composite score was created by averaging them. As evidenced in Figure 14, they found that the highest levels of transportation infrastructure support were in the core neighborhoods. However, the lack of non-motorized trail coverage lowered the support in urban areas. The largest block groups with communities of concern had very high levels of support.

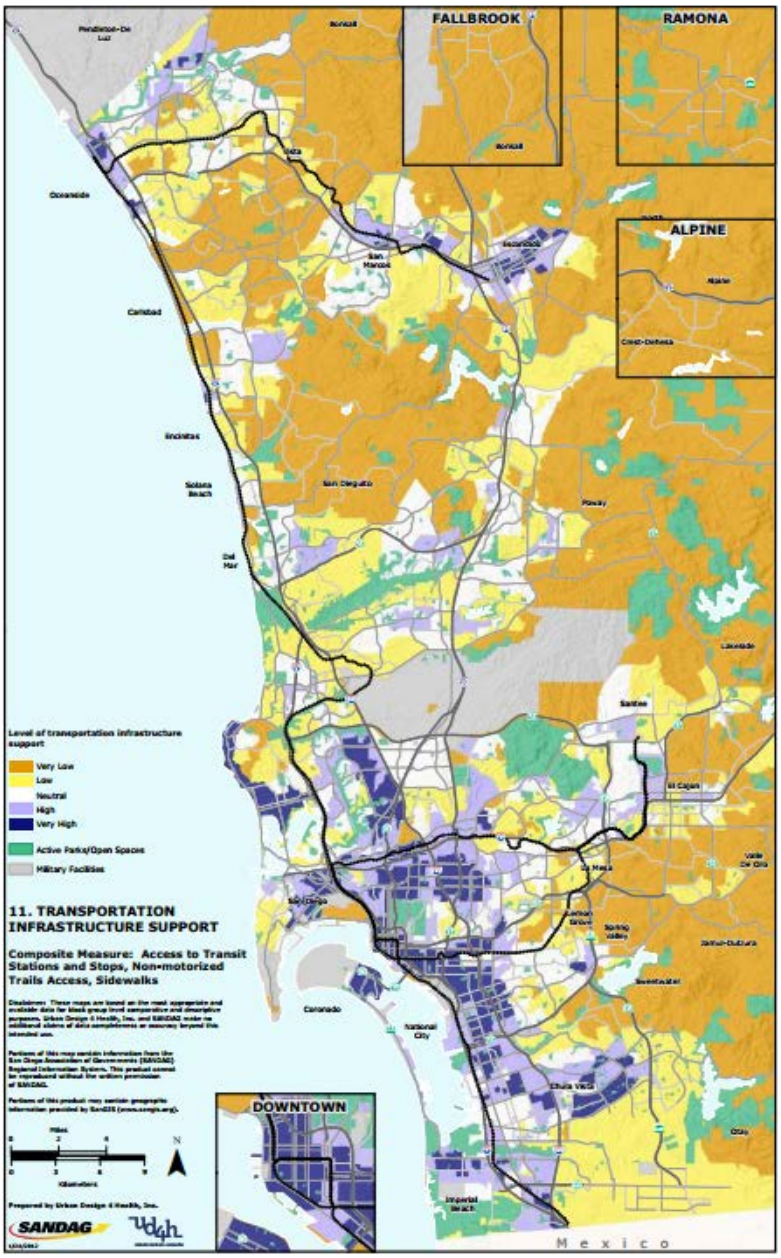

Figure 14. Available transportation infrastructure and support in San Diego.

Source: SANDAG, 2012

Access to Social Support and Amenities

This analysis focused on identifying public amenities and sources for social support within walking distance of households because they are contributors to health and well being overall. Four types of amenities were reviewed (i.e., library access, daycare facility access, healthcare facility access, and elementary school access) to identify the proportion of households that were within walking distance of each in each block group. The 2010 parcel-level land use and dwelling-unit data from SANDAG was used to determine the household counts as well as

2007 SanGIS and 2010 Urban Design 4 Health data was used for the amenities. They found the block groups with the communities of concern generally mimicked that of the broader region, which was that there was good access to daycare facilities in the urban core; lower access to libraries, although more evenly distributed in the urban areas; and with clinics and hospitals being placed primarily in urbanized areas, few outside of the urban centers were within walking distance and so access was low. Lastly, in terms of elementary schools, there was a high level of access throughout the region but especially within urban and some suburban areas.

Complete Neighborhoods and Community Support

This analysis focused on identifying areas that had the best access, within walking distance of households, to different types of destinations because complete neighborhoods provide a variety of amenities and destinations that are walkable or bikeable and/or transit options to access them. The households in each block group that had 50% or more that had access to four or more of these destinations were highlighted when eight base maps were combined. They found there is a good amount of overlap between areas with a substantial amount of community support and communities of concern.

Youth Physical Activity Support

This analysis focused on identifying urban design factors that are specifically associated with being predictors of walking and/or physical activity in youth rather than adults. Several factors were considered, including sidewalk completeness, elementary school access, parks and open space access, and non-motorized trails access, of which each was given a standardized value and a composite score was created by averaging them. They found the block groups with communities of concern were categorized as high and very high in terms of support for physical activity for youth.

Physical Disorder and Crime

This analysis focused on identifying the presence of physical disorder (i.e., vandalism, a large amount of vacant lots, litter on the streets); crime; and the perception of the existence of both as they both can discourage walking, bicycling, and other physical outdoor activities. These discouragements and reductions in physical activities have been associated with obesity and a reduction in physical activity overall. Crime (i.e., in regards to vandalism/malicious mischief, robbery, rape, homicide, simple assault, and aggravated assault) and physical disorder (i.e., vandalism and malicious mischief) data was retrieved from the Automated Regional Justice Information System (ARJIS) for the years 2007-2010 and vacant parcel data was retrieved from 2010 SANDAG data. Using block group level data, they found that the groups with communities of concern mirrored findings found within the entire region overall. They found a distinct pattern of physical disorder and crime, where there is a disproportionate amount of both found in urban areas. However, in regards to the presence of vacant parcels, it was distributed more evenly than when looking at physical disorder and crime.

Road Design

This analysis focused on road design and heavy traffic measures, as the promotion of vehicle use has been at the expense of other travel modes and can compromise pedestrian and cyclist safety. Specific road design measures (i.e., road width, road type) and traffic volumes are associated with higher collision frequencies, pedestrian crash rates, higher motor vehicle speeds

and increases in the number of crashes. The perception of roads being unsafe or unpleasant has also translated into decreases in active transportation. SANDAG looked at two road design measures (i.e., arterial density and traffic volume density), and the data was retrieved from the 2008 SANDAG traffic volume dataset and the 2006 SANDAG road data. Traffic volume density was calculated and then the estimated "vehicle miles traveled (VMT) for each block group was divided by the block group's area, resulting in the final traffic volume density" (p.42). The arterial density was calculated by dividing the total length of arterials (in each block group) by the block group area. And though they found that a large portion of the block groups with communities of concern overlap with the remainder of the region, they recognized that they typically increased along with arterial and traffic volume density. Generally speaking, this observation was seen in all block groups along the region's major roadway network.

Physical Activity Inhibitors

This analysis focused on determining actual or the perception of deterrents to walking and outdoor physical activity, which could include crime, traffic danger, and physical and perceived deterrents. Several factors were considered, including physical disorder, traffic volume density, violent crime, arterial density, and vacant parcels, of which each were given a standardized value. A composite score was created by averaging them.

Traffic Crashes

This analysis focused on assessing the amount of traffic crashes, as they are a serious health threat to both pedestrians and cyclists physically as well as mentally since the perception of danger can deter walking, cycling, and/or any other physical activity, particularly by those who are elderly or young children. Four types of crashes were reviewed including: pedestrian-involved motor vehicle crashes, the cyclist crash rate, cyclist-involved motor vehicle crashes, and the pedestrian crash rate. This data, which focused on data that involved pedestrians and cyclists, was retrieved from the 1998-2007 Statewide Traffic Reporting System (SWTRS). It found that the block groups with communities of concern greatly mimicked what was found across the region, which is that there were high crash rates observed, especially downtown, as well as the centers of other cities and highway corridors. In addition, pedestrian crash rates were only slightly lower than cyclist crash rates. However, they did find with the communities of concern that there was an overlap between these block groups and the areas where crash rates were the highest.

Pedestrian Traffic Safety

This analysis focused on identifying block groups that had high risk potential for pedestrian injury. A composite score was created based on the average of several factors (i.e., sidewalk completeness, traffic volume density, arterial density, and pedestrian crash rate) that each had a standardized value. As evidenced in Figure 15, they found a large portion of block groups with communities of concern were considered to have very low pedestrian traffic safety, and very few had high or very high rankings. SANDAG noted this is indicative that these areas have vulnerable communities, especially in terms of traffic and safety barriers to walking, and addressing them should be beneficial.

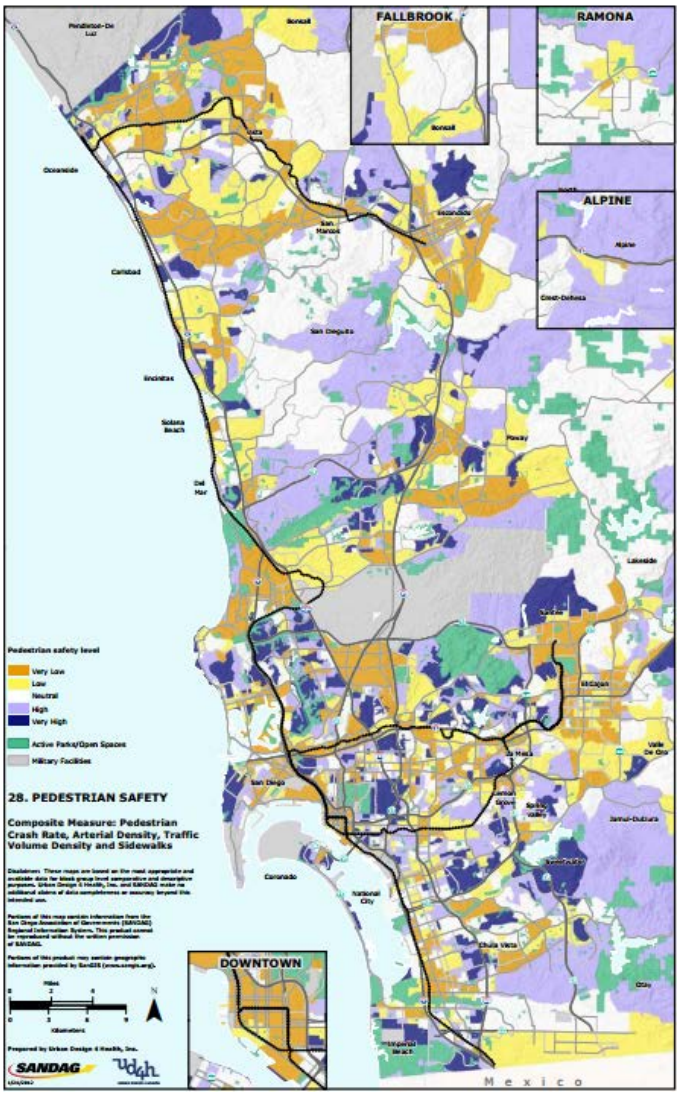

Figure 15. Pedestrian safety in San Diego.

Source: SANDAG, 2012

Cyclist Safety

This analysis focused on the potential high risk for cyclist injury. Several factors were considered, including non-motorized trails access, traffic volume density, arterial density, and cyclist crash rates, of which each was given a standardized value and a composite score was created by averaging them. They found the very low cyclist safety category had the most block groups with communities of concern, and suggested that mitigation and improvements in these areas could provide positive impacts and additional benefits to low-mobility populations and those with low income as well.

Traffic Safety for Youth

This analysis focused on the potential high risk for youths to injure themselves in traffic crashes. Using only block groups that had more than 50% of their households that had access to a

park, elementary school or daycare center, the groups were selected based on the likelihood that young pedestrians or cyclists would be attracted to those areas. They were then given a composite score based on a combination of factors (i.e. sidewalk completeness, traffic volume density, arterial density, pedestrian crash rate, and cyclist crash rate) that were each given a standardized value for each block group and the composite score was the average of those scores. They found almost 85% of the block groups with communities of concern fell under low and/or very low traffic safety for youth categories.

Healthy Foods Access

This analysis focused on the accessibility to healthy foods because it can help contribute to a healthy diet and its associated positive benefits. Using grocery store location data from the Neighborhood Quality of Life Study (NQLS), "the percentage of households in each block group within walking distance of a grocery store or farmers' market" (p.64) was measured based on the distance decay principle, where people are most likely to make trips to nearby destinations. They found the block groups with communities of concern generally mimicked the results found within the region, where healthy food access was particularly high in urban cores and central cities and around major roadway corridors.

Fast-Food Density

This analysis focused on the concentration of fast-food restaurants as they are associated with higher fat intake. Using fast-food data from the Neighborhood Quality of Life Study (NQLS), the density of fast-food restaurants was measured per census block group. They found no immediately apparent relationships between the areas with communities of concern and fast-food density, as it greatly mimicked what occurred throughout the rest of the region. Generally speaking, throughout the region as a whole there was a higher density of fast food along major highway and arterial corridors and/or near interchanges. Interestingly, however, more than 50% of the block groups had a fast-food density of zero.

Air Quality

This analysis focused on several pollutants where proximity and adjacent location were of the greatest concern to community health. Areas were identified as being "at risk to exposure to air pollution based on the percentage of homes in each block group that are within a zone of impact to three types of known transportation-related pollution sources: freeways and high-traffic roads, rail yards, and ports" (p. 69), where the zones of impact were based on the guidelines from the California Air Resources Board (CARB). They found the block groups with communities of concern generally mirrored what was found across the region, where concentrations of air pollution followed major highway corridors. The majority of block groups did not have a significant number of units that were within these impact zones; however, 108 had 50% or more.

Application of Findings

According to Coleen Clementson (2016), the principal regional planner for the San Diego Association of Governments, SANDAG uses these findings as guidance measures in its planning efforts (i.e., in its general plan updates, as well as in its community plans and/or other specific plans) throughout its 19 local jurisdictions.

References

San Diego Association of Governments (SANDAG). (2012). *Healthy Communities Atlas: San Diego Region, California*. Retrieved from http://www.sandag.org/uploads/projectid/projectid_482_17468.pdf.

Clemenston, Coleen. "RE: Inquiring about your Healthy Communities Atlas Findings." Message to Monica Martin. 9 March 2016. E-mail.

6.0 REFERENCES

Adie Tomer, Jeffrey Gutman, and Adrianna Pita. August 31, 2016. Podcast: Inclusive cities: Transportation and accessibility. Brookings, Accessed: https://www.brookings.edu/podcast-episode/inclusive-cities-transportation-and-accessibility/

Amekudzi, A., Smith, M., Brodie, S., Fischer, J., Ross, C. (2012). *Impact of Environmental Justice on Transportation*. Transportation Research Record: Journal of the Transportation Research Board, No. 2320.

Atlanta Regional Commission (ARC). (2014). *Plan 2040. Appendix C-2: Performance Measures Portfolio.* Retrieved from http://www.atlantaregional.com/plan2040/documents--tools Atlanta Regional Commission (ARC). (2011a) *Plan 2040. Appendix C-3: Equitable Target Areas (ETA) Technical Analysis Methodology*.

Retrieved from http://www.atlantaregional.com/plan2040/documents--tools Atlanta Regional Commission (ARC). (2011b) *Volume I: Plan 2040 Regional Transportation Plan (RTP).* Retrieved from http://documents.atlantaregional.com/plan2040/docs/tp_PLAN2040RTP_072711.pdf

Atlanta Regional Commission Transportation Planning Department (ARC). (n.d.) *Comparative Analysis of PLAN 2040 Investments in Equitable Target Areas (ETA).* Retrieved from http://www.atlantaregional.com/File%20Library/Transportation/Plan%202040/tp_PLAN_2040_ETA_Web.pdf

Association of Bay Area Governments, the Metropolitan Transportation Commission. (2013, July). *Bay Area Plan: A Strategy for a Sustainable Region. Equity Analysis Report Including Title VI, Environmental Justice and Equity Analysis for Plan Bay Area*. Retrieved from http://mtc.ca.gov/sites/default/files/A-04_FINAL_PBA_Equity_Analysis_Report.pdf.

Baltimore Metropolitan Council. (2016). *Maximize 2040.* Retrieved from http://www.baltometro.org/our-work/transportation-plans/long-range-planning/maximize2040-draft-plan#Maximize2040

Beebe, Craig. (2016). *The Portland Metropolitan Area Grew by 111 People a Day from July 2014 to 2015, the Census Bureau Estimates*. Oregon Metro News. Retrieved from: http://www.oregonmetro.gov/news/portland-region-nears-24-million-residents-growing-41000-last-year

Boisjoly, G; El-Geneidy, A. (2017) *How to Get There? A Critical Assessment of Accessibility Objectives and Indicators in Metropolitan Transportation Plans.* Transport Policy. Vol 55 (38-50).

Center for Neighborhood Technology (CNT). (2010). *H + T Index*. Retrieved from http://htaindex.cnt.org/

Center for Neighborhood Technology (CNT). (2006). *Housing and Transportation Cost Trade-offs and Burdens of Working Households in 28 Metros.* Retrieved from: http://www2.nhc.org/media/documents/chp-pub-hl06-cnt-report.pdf

Chakraborty, J. (2006). *Evaluating the Environmental Justice Impacts of Transportation Improvement Projects in the U.S.* Transportation Research Part D, 315-323

Chicago Metropolitan Agency for Planning (CMAP). (2010). *Go To 2040: Comprehensive Regional Plan*. Retrieved from http://www.cmap.illinois.gov/documents/10180/17842/long_plan_FINAL_100610_web.pdf/1e1ff482-7013-4f5f-90d5-90d395087a53

Chicago Metropolitan Agency for Planning (CMAP). (2008). *Updated 2030 Regional Transportation Plan for Northeastern Illinois*. Retrieved from http://www.cmap.illinois.gov/documents/10180/398086/UpdatedCompiledPlan_20080313_v1.pdf/a9b00e55-51cd-41b3-87ad-de26e4d11db4

Cho, Grace. *2018 RTP Performance Targets and System Measures – Overview and Work Group Task*. Memorandum. June 1, 2016

Christensen, Nick. (2016). *Portland Regions Grows to 2.35 Million Residents, Census Estimates, with Newcomers Leading the Way.* Oregon Metro News. Retrieved from: http://www.oregonmetro.gov/news/portland-region-grows-235-million-residents-census-estimates-newcomers-leading-way

Currie, G. (2010). *Quantifying spatial gaps in public transport supply based on social needs.*

Journal of Transport Geography, Vol. 18, No. 1, pp. 31–41.

Delaware Valley Regional Planning Commission (DVRPC). (2013a). *Connections 2040: Plan for Greater Philadelphia.* Retrieved from http://www.dvrpc.org/reports/13042.pdf

Delaware Valley Regional Planning Commission (DVRPC). (2009). *Connections: The Long Range Plan for a Sustainable Future*.

Delaware Valley Regional Planning Commission (DVRPC). (2013b). *Environmental Justice at DVRPC, Fiscal Year 2012.* Retrieved from http://www.dvrpc.org/reports/TM13023.pdf

Delaware Valley Regional Planning Commission (DVRPC). (2013c) *Technical Analysis. Connections 2040: A Long Range Plan for the Greater Philadelphia Region.* Retrieved from http://www.dvrpc.org/reports/13043.pdf

Delaware Valley Regional Planning Commission (DVRPC). (2012). *Transportation Improvement Program (TIP) for New Jersey.* Retrieved from http://www.dvrpc.org/tip/NJfinal/2012/TIP-Doc-NJ2012.pdf

Delaware Valley Regional Planning Commission (DVRPC). *Transportation Improvement Program (TIP) (FY2013-2016).* (2013d).

Federal Transit Administration (FTA). (2014). *Evaluating Transportation Equity: An Intermetropolitan Comparison of Regional Accessibility and Urban Form.* Retrieved from: https://www.transit.dot.gov/sites/fta.dot.gov/files/FTA_Report_No._0066.pdf

Florida Department of Transportation, Office of Policy Planning (FDOT). (2015). *MPO Program Management Handbook, Chapter 9.* Retrieved from http://www.dot.state.fl.us/planning/policy/metrosupport/mpohandbook/ch9.pdf

Hampton Roads Transportation Planning Organization (HRTPO). (2014). *Public Involvement: Environmental Justice Methodology Tool*. Retrieved from http://hrtpo.org/page/ej-methodology-tool/

Hampton Roads Transportation Planning Organization (HRTPO). (2015). *Hampton Roads 2040 Long-Range Transportation Plan: Candidate Project Evaluation, Title VI/Environmental Justice Methodology (Draft).* Retrieved from http://hrtpo.org/uploads/docs/050615TTAC-Enclosure%2012-2040%20LRTP%20Candidate%20Project%20Evaluation%20Title%20VI-Environmental%20Justice%20Methodology%20Draft%20Report2.pdf

Hillsborough Area Regional Transit Authority (HART). (2015). *Transit Development Plan Update FY 2016-2025.* Retrieved from http://www.gohart.org/Style%20Library/goHART/pdfs/board/TDP_final_draft_092515.pdf

Hillsborough County, Florida. (2016). *About the County*. Retrieved from http://www.hillsboroughcounty.org/index.aspx?nid=423

Hillsborough County Metropolitan Planning Organization (2004). *Regional Jobs Access Plan Technical Update (2004)*. Retrieved from http://www.planhillsborough.org/wp-content/uploads/2015/03/Regional-Jobs-Access-Plan-technical-update-2004.pdf

Hillsborough County Metropolitan Planning Organization (HMPO). (2015a). *Hillsborough County Transportation Disadvantaged Service Plan – Final 2015 Update*. Retrieved from http://www.planhillsborough.org/wp-content/uploads/2015/07/TDSP-06-26-2015-ADA-Final-Deliverable.pdf

Hillsborough County Metropolitan Planning Organization (HMPO). (2014a). *Imagine Hillsborough 2040: Long Range Transportation Plan for Tampa, Temple Terrace, Plant City, and Hillsborough County*.

Hillsborough County Metropolitan Planning Organization (HMPO). (2009). *2035 Long Range Transportation Plan*. Retrieved from http://www.planhillsborough.org/mpo-2035-lrtp/

Hillsborough County Metropolitan Planning Organization. (2000). *Regional Jobs Access Plan (2000)*. Retrieved from http://www.planhillsborough.org/wp-content/uploads/2015/03/Regional-Jobs-Access-Plan-final-report-2000.pdf

Hillsborough Area Regional Transit Authority (HART). (2015, September). *Transit Development Plan Update: Fiscal Year 2016 – Fiscal Year 2025.*Retrieved from http://www.gohart.org/Style%20Library/goHART/pdfs/board/TDP_final_draft_092515.pdf

Hillsborough County Metropolitan Planning Organization (HMPO). (2015c). *Hillsborough County Areawide Vision Map.* Retrieved from http://www.planhillsborough.org/wp-content/uploads/2015/09/Hillsborough_County_Areawide_Vision_map_11_x_17_REDUCED.pdf

Hillsborough County Metropolitan Planning Organization (HMPO). (2015b). *Transportation Disadvantaged Program – Community Transportation Coordinator Evaluation for July 1, 2013 – June 30, 2014.* Retrieved from http://www.planhillsborough.org/wp-content/uploads/2015/03/Final-2014-APR_Hillsborough-CTC_Eval_ADA.pdf

Hillsborough County Metropolitan Planning Organization (HMPO). (2014b). *Tri-County Area Regional Mobility Needs*. Retrieved from http://www.planhillsborough.org/wp-content/uploads/2014/06/Regional-Mobility-Needs-Chapter_2.27.14.pdf

Houston-Galveston Area Council (HGAC). (2011). *Bridging Our Communities 2035: The 2035 Houston-Galveston Regional Transportation Plan Update.* Retrieved from http://www.h-gac.com/taq/plan/documents/2035_update/2035%20RTP%20Update%20FINAL%20201 1-01-21.pdf

Karner, A.(2016) *Planning for Transportation Equity in Small Regions: Towards Meaningful Performance Assessment.* Transport Policy, Volume 52.

Karner, A., Niemeier, D. (2013). *Civil Rights Guidance and Equity Analysis Methods for Regional Transportation Plans: A Critical Review of Literature and Practice*. Journal of Transport Geography, 33.

Kramer, J., Williams, K., Seggerman, K., Bond, A. (2011). *The Relationship of Title VI Requirements to Planning Process in Florida*. Center for Urban Transportation Research.

Kjellstrom, T., Friel, S., Dixon, J. et al. *(2007). Urban Environmental Health Hazards and Health Equity. Journal of Urban Health (2007) 84(Suppl 1): 86.* doi:10.1007/s11524-007-9171-9

Litman, T. (2016). *Evaluating accessibility for transportation planning: Measuring people's ability to reach desired goods and activities*. Victoria Transport Policy Institute. Retrieved from http://www.vtpi.org/access.pdf.

Litman, T. (2017) *Evaluating Transportation Equity: Guidance for Incorporating Distributional Impacts in Transportation Planning.* Victoria Transport Policy Institute. Retrieved from http://www.vtpi.org/equity.pdf.

Lowe, K. (2014). *Bypassing Equity? Transit Investments and Regional Transportation Planning*. Journal of Planning Education and Research, Volume 34(I) 30-44.

Mamun, S. A., N. E. Lownes, J. P. Osleeb, and K. Bertolaccini. (2013). *A method to define public transit opportunity space*. Journal of Transport Geography, Vol. 28, pp. 144–154.

Manaugh, K., Badami, M., El-Geneidy, A. (2014). *Integrating Social Equity into Urban Transportation Planning: A Critical Evaluation of Equity Objectives and Measures in Transportation Plans in North America*. Transport Policy. Retrieved from http://www.sciencedirect.com/science/article/pii/S0967070X14002145

Marcantonio, R. and A. Karner (2016). "Social Equity in Transportation Planning: A Community-Based Framework." Progressive Planning 206: 38-41

Martens, K., Golub, A. (2014a). *A Fair Distribution of Transportation Benefits: Interpreting Civil Rights Regulations for Transportation Investment Programs*. Transportation Research Part A.

Martens, K., Golub, A., Robinson, G. (2012). *A Justice-Theoretic Approach to the Distribution of Transportation Benefits: Implications for Transportation Planning Practice in the United States*. Transportation Research Part A.

Martens, K. Justice in Transport as Justice in Accessibility*: Applying Walzer's "Spheres of Justice" to the Transport Sector*. (2012). Transportation, Vol. 39, No. 6, Nov. 2012, pp. 1035–1053.

Martens, K., Golub, A. (2014b). *Using Principles of Justice to Assess the Modal Equity of Regional Transportation Plans*. Journal of Transport Geography, 41.

Maricopa Association of Governments (MAG). (2014). *2035 Regional Transportation Plan (RTP).* Retrieved from https://www.azmag.gov/Documents/RTP_2014-01-30_Final-2035-Regional-Transportation-Plan-(RTP).pdf

McCahill, C, Ebeling, M. (2015). *Tools for Measuring Accessibility in an Equity Framework.* Congress for New Urbanism 23rd Annual Meeting. Retrieved from https://www.cnu.org/sites/default/files/ssti_transpo_equity.pdf

Metro Regional Government. (July 2014). *2014 Regional Transportation Plan*.

Metro Regional Government (July 2014). *2015-2018 Metropolitan Transportation Improvement Program Environmental Justice and Title VI Adoption Draft Report.*

Metropolitan Transportation Commission (MTC). (2005). *2030 Plan Equity Analysis Report*.

Miami-Dade Metropolitan Planning Organization (MDMPO). (2014a). *Mobility Options 2040. Miami-Dade Transportation Plan: Eyes on the Future.* Retrieved from http://www.miamidade2040lrtp.com/wp-content/uploads/2040_LRTP_Plan.pdf

Miami-Dade Metropolitan Planning Organization (MDMPO). (2014b). *Title VI Report 2011 – 2014.* Retrieved from http://miamidadempo.org/library/reports/title-vi-report-2011-2014.pdf

National Center for Transit Research (NCTR). (2016). *Linking Greenways and Transportation in Florida.* Retrieved from http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_PTO/FDOT-BDV26-977-03-rpt.pdf

New York Metropolitan Transportation Council (NYMTC). (2009, June). *Environmental Justice Assessment*. Retrieved from http://www.nymtc.org/rtp/documents/related/nymtc_rtp_ej.pdf

National Institute for Transportation and Communities (NITC). (2016). *Memo to Transportation Equity Work Group and Interested Parties: Review of Federal and State Requirements for Incorporating Social Equity in Regional Transportation Planning*.

North Central Texas Council of Governments (NCTCOG). (2013). *Mobility 2035 – 2013 Update.* Retrieved from http://www.nctcog.org/trans/mtp/2035/index.asp

North Jersey Transportation Planning Authority (NJTPA). (2009). *Appendix C, NJTPA Strategy Evaluation Study Report: Identifying Accessibility, Mobility, and Congestion Needs and Strategies for Northern New Jersey.* Retrieved from http://www.njtpa.org/getattachment/Planning/Plan-Update-to-2040/Plan-2035/Appendix_C_StrategyEval.pdf.aspx

North Jersey Transportation Planning Authority (NJTPA). (2005). *Environmental Justice Regional Analysis Proportional Distribution of Benefits of Transportation Projects in the NJTPA Region.*

North Jersey Transportation Planning Authority (NJTPA). (2011). *Performance Results: Assessing the Implemented Transportation Projects. Guidebook for Project Performance Management*. Retrieved from http://www.njtpa.org/planning/regional-studies/recently-completed-studies/performance-results-assessing-the-impacts-of-imple/performanceresults/njtpa_performanceresults_finalguidebook_complete_0.aspx

North Jersey Transportation Planning Authority (NJTPA). (2013). *Plan 2040 (Draft).* Retrieved from http://www.njtpa.org/planning/plan-update-to-2040/plan2040_draft_for_comment.aspx

Omaha-Council Bluffs Metropolitan Planning Agency (OCBMPA). (2015). *Transportation Improvement Program: FY 2016-2021*. Retrieved from http://mapacog.org/wp-content/uploads/2015/10/MAPA_FY2016_TIP_Final.pdf

Pfeffer, N., Wen, F., Hasan, I. (1998). *Environmental Justice in the Transportation Planning Process: Southern California Perspective*. Transportation Research Record 1792, paper number 02-4099.

Polk Transportation Planning Organization (PTPO). (2015a). *Momentum 2040: Long Range Transportation Adoption Package*. Retrieved from http://polktpo.com/media/36181/Polk-Momentum-2040_11-23-2015_Smaller.pdf

Polk Transportation Planning Organization (PTPO). (2015b). *Neighborhood Mobility Audits*. Retrieved from http://polktpo.com/media/33968/L4-Neighborhood-Mobility-Audits.pdf

Polk Transportation Planning Organization (PTPO). (2015c). *Neighborhood Mobility Audits (Pamphlet).*

Polk Transportation Planning Organization (PTPO), Polk Transit (PT). (2015d). *Public Participation Plan*. Retrieved from http://polktpo.com/media/33421/l1-adopted-public-participation-plan.pdf

Portland Metro Regional Government (PMRG). (2014). *Making a Great Place: Regional Transportation Plan*. Retrieved from http://www.oregonmetro.gov/sites/default/files/RTP-2014-final.PDF

Puget Sound Regional Council (PSRC). (2014). *Transportation 2040 Update Report: Toward a Sustainable Transportation System*. Retrieved from http://www.psrc.org/assets/10550/T2040Update2014.pdf?processed=true

Rowangould, D.; Karner, A.; London, J. (2016).*Identifying Environmental Justice Communities for Transportation Analysis.* Transportation Research Part A: Policy and Practice. Vol. 88 (151-162).

San Diego Association of Governments (SANDAG). (2012). *Healthy Communities Atlas: San Diego Region, California*. Retrieved from http://www.sandag.org/uploads/projectid/projectid_482_17468.pdf

Smart Growth America. (May 2014) *Dangerous by Design 2014*, National Complete Streets Coalition.

Southern California Association of Governments (SCAG). (2016). *Regional Transportation Plan 2016-2040, Environmental Justice Appendix.* Retrieved from http://scagrtpscs.net/Documents/2016/final/f2016RTPSCS_EnvironmentalJustice.pdf

Southern California Association of Governments (SCAG). (2012). *Regional Transportation Plan 2012-2035, Environmental Justice Appendix.* Retrieved from http://rtpscs.scag.ca.gov/Documents/2012/final/SR/2012fRTP_EnvironmentalJustice.pdf

Southern California Association of Governments (SCAG). (2008). *Regional Transportation Plan (RTP): Making the Connections. Environmental Justice Report.* Retrieved from http://rtpscs.scag.ca.gov/Documents/2008/fEnvironmentalJustice.pdf

Together North Jersey (TNJ). (2013). *Regional Fair Housing & Equity Assessment*. Retrieved from http://togethernorthjersey.com/wp-content/uploads/2013/07/FHEA_Maps_Intro_fixed.pdf

United States Department of Transportation (USDOT). (2012a) *Department of Transportation Order 5610.1(a): Final DOT Environmental Justice Order.* Retrieved from http://www.fhwa.dot.gov/environment/environmental_justice/ej_at_dot/orders/order_56102a/index.cfm

United States Department of Transportation (USDOT). (2012b). *Department of Transportation Environmental Justice Order 5610.2(a).* Retrieved from https://www.fhwa.dot.gov/environment/environmental_justice/ej_at_dot/orders/order_56102a/index.cfm

United States Department of Transportation (USDOT). (2016a). *Letter to Colleagues Regarding the National Transit Map.* Anthony Foxx.

United States Department of Transportation (USDOT). (2016b). *Ladders of Opportunity*. Retrieved from https://www.transportation.gov/opportunity

United States Federal Highway Administration (FHWA). (2015a). *Livability in Transportation Guidebook.* http://www.fhwa.dot.gov/livability/case_studies/guidebook/chap01.cfm#ft14

United States Federal Highway Administration (FHWA). (2015b). *Planning Emphasis Areas for Federal Fiscal Year 2015*. Retrieved from https://www.fhwa.dot.gov/planning/processes/metropolitan/mpo/fy_2015/index.cfm

United States Federal Highway Administration (FHWA). (2016). *Planning Emphasis Areas for Federal Fiscal Year 2016.* Retrieved from https://www.fhwa.dot.gov/planning/processes/metropolitan/mpo/fy_2016/index.cfm

United States Federal Highway Administration (FHWA). (2012). *FHWA Environmental Justice Order 6640.23A.* Retrieved from https://www.fhwa.dot.gov/legsregs/directives/orders/664023a.cfm

U.S. DOT FHA. (2015). Livability in Transportation Guidebook. Retrieved from http://www.fhwa.dot.gov/livability/case_studies/guidebook/chap01.cfm#ft14.

Welch, T. F., and S. Mishra. (2013). *A Measure of Equity for Public Transit Connectivity.* Journal of Transport Geography, Vol. 33, pp. 29–41.

Welch, T. F. (2013). *Equity in transport: The distribution of transit access and –connectivity among affordable housing units*. Transport Policy, Vol. 30, pp. 283–293.

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