SE 122nd Avenue Planning Study
Health Impact Assessment

Prepared By:
Oregon Public Health Institute
Partners:
City of Portland Bureau of Planning and Sustainability

Funded By:
U.S. Centers for Disease Control and Prevention
National Network of Public Health Institutes

ophi
oregon public health institute

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In addition to the BPS Project Team, OPHI staff also received valuable input at various times from the project's Citizen Working Group and Health Partners Working Group, whose members included:

Community Working Group

- **Mark White,** Powellhurst-Gilbert Neighborhood Association
- **John McDonald,** Powellhurst-Gilbert Neighborhood Association
- **Lauree Carlson,** Powellhurst-Gilbert Neighborhood Association
- **Annette Mattson,** David Douglas School Board
- **David Edwards,** Midway Business Association
- **Jose Pinomesa,** East Portland Chamber of Commerce
- **Jennifer Will-Thapa,** R.O.S.E. CDC
- **Han Tran,** R.O.S.E. CDC
- **Jean DeMaster,** Human Solutions
- **Jill Kuehler,** Friends of Zenger Farm
- **Kevin O'Dell,** OPAL Environmental Justice Oregon
- **Erin Kendrick,** At Large—Neighbor
- **Rhonda Richardson,** At Large—Neighbor
- **Sue Gillean,** At Large—Neighbor
- **Michelle Lohn,** At Large—Neighbor
- **Jim Braet,** At Large—Neighbor/Business Owner
- **Sue Stahl,** At Large—Public Health Impacts
- **Pascal Maboko,** At Large—Immigrant Refugee Community Org/Africa House
- **Oscar Campos,** At Large—Architecture & Design

Health Partners Working Group

- **Sharon Baggett,** Portland State University Institute on Aging
- **Alan DeLaTorre,** Portland State University Institute on Aging

- **Gretchen Luhr,** Portland State University Institute on Aging
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- **Laura Boswell,** Oregon Public Health Division
- **Raquel Bournhenesque,** Upstream Public Health
- **Betsy Boyd-Flynn,** Oregon Medical Association
- **Mark Gilbert,** Oregon Medical Association
- **Stephanie Farquar,** Portland State University School of Community Health
- **Noelle Dobson,** OPHI
- **Steve White,** OPHI
- **Beth Gebstadt,** American Heart Association
- **Molly Haynes,** Kaiser Permanente
- **Meg Merrick,** Portland State University Institute for Metropolitan Studies
- **Amy Rose,** Metro—Transportation Planning
- **Tammy VanderWoude,** Oregon Food Bank

As part of the HIA, OPHI contracted with two local community groups: OPAL Environmental Justice and Russian Speaking Network of Oregon to conduct community-based surveys that would inform the HIA. OPAL staff, **Joseph Santos-Lyons** and **Lisa Serrano**, helped engage the community on transit issues. Russian Speaking Network staff helped engage the area's Russian speaking population.

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Cover photos are from a 2011 PhotoVoice project conducted by residents at R.O.S.E. Community Development Corporation's Leander Court.

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Introduction

In 2010, Oregon Public Health Institute (OPHI) partnered with Portland Bureau of Planning & Sustainability (BPS) and many other stakeholders to conduct a Health Impact Assessment (HIA) of the SE 122nd Avenue Pilot Study, a neighborhood planning study led by BPS. The purpose of the Pilot Study was to explore ways to help create a 20 minute neighborhood by addressing land use, transportation, connectivity, and development design issues in the study area along SE 122nd Avenue between SE Division Street and SE Foster Road (Map 1). The pilot project was not meant to lead to an adopted plan, but to help inform the city's current efforts to develop the Portland Plan and guide the city's update of its comprehensive plan. The study produced a set of recommendations ranging from aspirational goals to specific actions that are designed to move the community closer to its goals. While some of these recommendations will wait for consideration during the comprehensive plan update process, others are actionable in the short term, depending on continued political and stakeholder support and involvement, and availability of resources.

The overarching goal of an HIA is to make more explicit the health impacts of social decisions and help shape them to improve a population's health. Given the central role that the city is giving to the 20 minute neighborhood form as a greenhouse gas reduction strategy and a social and economic improvement tool, and given the substantial changes to the built environment in East Portland that would come with a conversion to a 20 minute neighborhood model, it is worth considering how this urban form, and the transition to it that is being explored in the SE 122nd Ave Pilot Study, would likely impact the health of neighborhood residents.

HIA is based on a comprehensive approach to health which emphasizes that multiple physical and mental health outcomes are influenced by factors from all aspects of the physical, social, and economic environment (see Table 1). It considers a policy's, plan's, or project's direct impacts on health outcomes—for example increased exposure to toxins or other environmental hazards—as well as its indirect impacts—for example, making a neighborhood less supportive of healthy eating and active living. Consideration of such indirect impacts is important for assessing proposed community plans because such although they might have minimal direct health impacts, they will likely affect health indirectly through impacts on social or environmental conditions that are now known to impact a community's health. HIA also focuses on vulnerable populations and includes analysis of a proposal's potential impacts on health inequalities within the affected population. To assess health impacts, HIA relies upon a variety of sources of knowledge including lay and professional expertise and experience.

Map 1: Combined Study Area, and Area of Influence

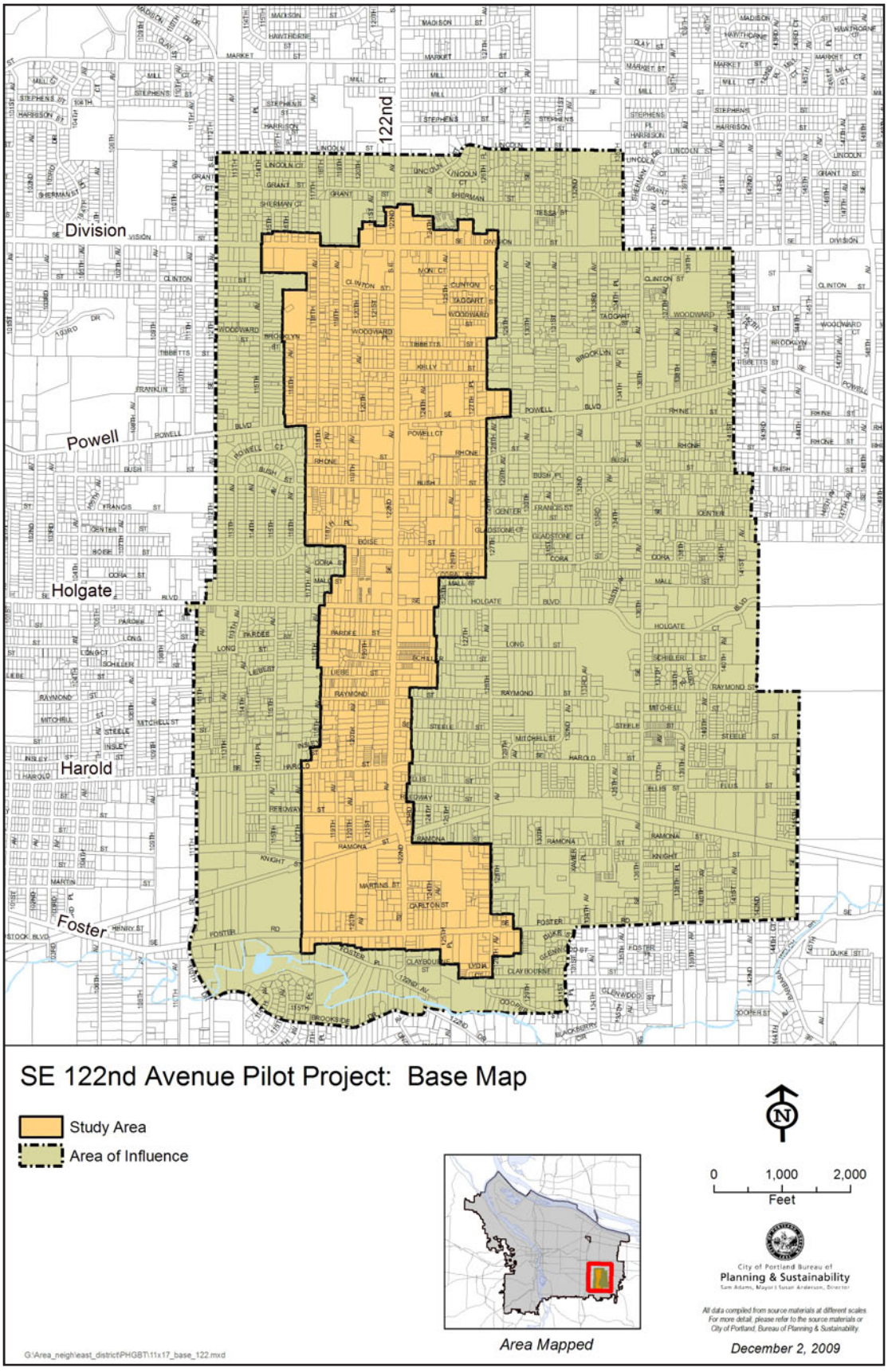


Table 1: Factors Responsible for Population Health *

Fixed Individual Factors	Individual Health Behaviors	Public Services and Infrastructure	Environmental Conditions	Social, Economic, and Political Factors
Genetic Makeup	Diet	Transportation	Air, Soil & Water Quality	Poverty
Gender	Physical Activity	Education	CommunityNoise	Inequality
Age	Addictions	Public Transportation	Disease vectors	Social Cohesion & Inclusion
Existing Health Conditions and Disabilities	Coping	Health Care		Political Participation
		Parks		
		Community Centers		
		Economic Development		
		Housing Adequacy		

*Source: Human Impact Partners

This HIA has four primary purposes. The first is to evaluate the health impacts of the Pilot Study's specific recommendations. Second, it also offers additional recommendations that, if implemented, would further improve many of the combined study area's health determinants. Third, since these recommendations are meant to implement the 20 minute neighborhood concept, this HIA also addresses the potential health impacts of this particular type of neighborhood form that is being promoted in Portland and in many other cities throughout the country as a way to combat climate change and improve livability and public health. Finally, because this Pilot Study is being conducted in the context of the city's comprehensive plan update and other citywide initiatives, including the Portland/Multnomah County Climate Action Plan, it will provide an example of how health can be integrated into plans and policies, and support advocacy efforts for a more health-conscious set of policies, plans, and projects to be implemented not just in the SE 122nd Avenue neighborhood, but throughout the city.

The SE 122nd Ave Pilot Study: Background and Scope

The impetus and scope from the Pilot Study came primarily from three sources: conversations about 20 minute neighborhoods in the context of the Portland Plan; recommendations contained in the East Portland Action Plan; and input from community members in the study area.

20 Minute Neighborhoods and The Portland Plan Context

For the past three years city planners have been working to develop a 20 minute neighborhood framework as part of multiple local planning and sustainability efforts, including the Portland/Multnomah County Climate Action Plan and the Portland Plan, a 20 year strategic plan for the city the is currently being developed by BPS. The term "20 minute neighborhood" is, in many ways, simply a new name for the "neo-traditional" or "complete" community form which has been promoted by American planners and real estate developers over the past 20-30 years as an attractive, more livable alternative to post-war suburbia. The three main components of this type of community are:

The Portland Plan's nine action areas are:

1. Human Health, Food and Public Safety
2. Prosperity and Business Success
3. Transportation, Technology and Access
4. Neighborhoods and Housing
5. Equity, Quality of Life and Civic Engagement
6. Sustainability and the Natural Environment
7. Education and Skill Development
8. Art, Culture and Innovation
9. Design, Planning and Public Spaces.

- a safe and enjoyable pedestrian environment,
- a mix of destinations that provide residents with most of their daily wants and needs, and;
- residential density sufficient to support a variety of neighborhood commercial establishments.

According to research on pedestrian behavior, 20 minutes is about the average maximum amount of time most people would be willing to walk to access goods and services, so the term 20 minute neighborhood is meant to emphasize both the

pedestrian and destination components of this type of neighborhood form.

What sets the 20 minute neighborhood apart from the neo-traditional or complete community concepts is the rationale for its support at a citywide policy level. While the neo-traditional or complete community has been touted for its livability or lifestyle features that set it apart from suburban sprawl, the motivation for promoting this particular urban form in Portland has come from its ability to address a number of sustainability and livability goals. Objective 5 of the Portland/Multnomah County Climate Action Plan identifies 20 minute neighborhoods as a "critical and basic step to reduce automobile dependence", and tasks the city with both making 20 minute complete neighborhoods "a core component of the Portland Plan," and with identifying "the land use planning changes and infrastructure investments, including public-private partnerships, that are needed to achieve a highly walkable and bikeable neighborhood and develop an implementation action plan." (p. 39)[1]. In part because of this directive, but also because the 20 minute neighborhood concept has been identified as a particular urban form that would convey numerous social and economic benefits in addition to climate protection, BPS has kept the 20 minute neighborhood concept at the center of Portland Plan discussions.

In November 2010, BPS created a set of indicators to measure the location and degree of 20 minute neighborhoods throughout Portland based on a variety of neighborhood attributes, which include:

- Grocery Stores
- Commercial, Type 1 (convenience stores, beer, wine, and liquor stores)
- Commercial, Type 2 (restaurants and bars, coffee shops, brew pubs, specialty foods, bakeries, health and personal services, dry cleaners)
- Intersection Density
- Sidewalk Coverage
- Frequent Transit
- Parks Access
- Elementary Schools

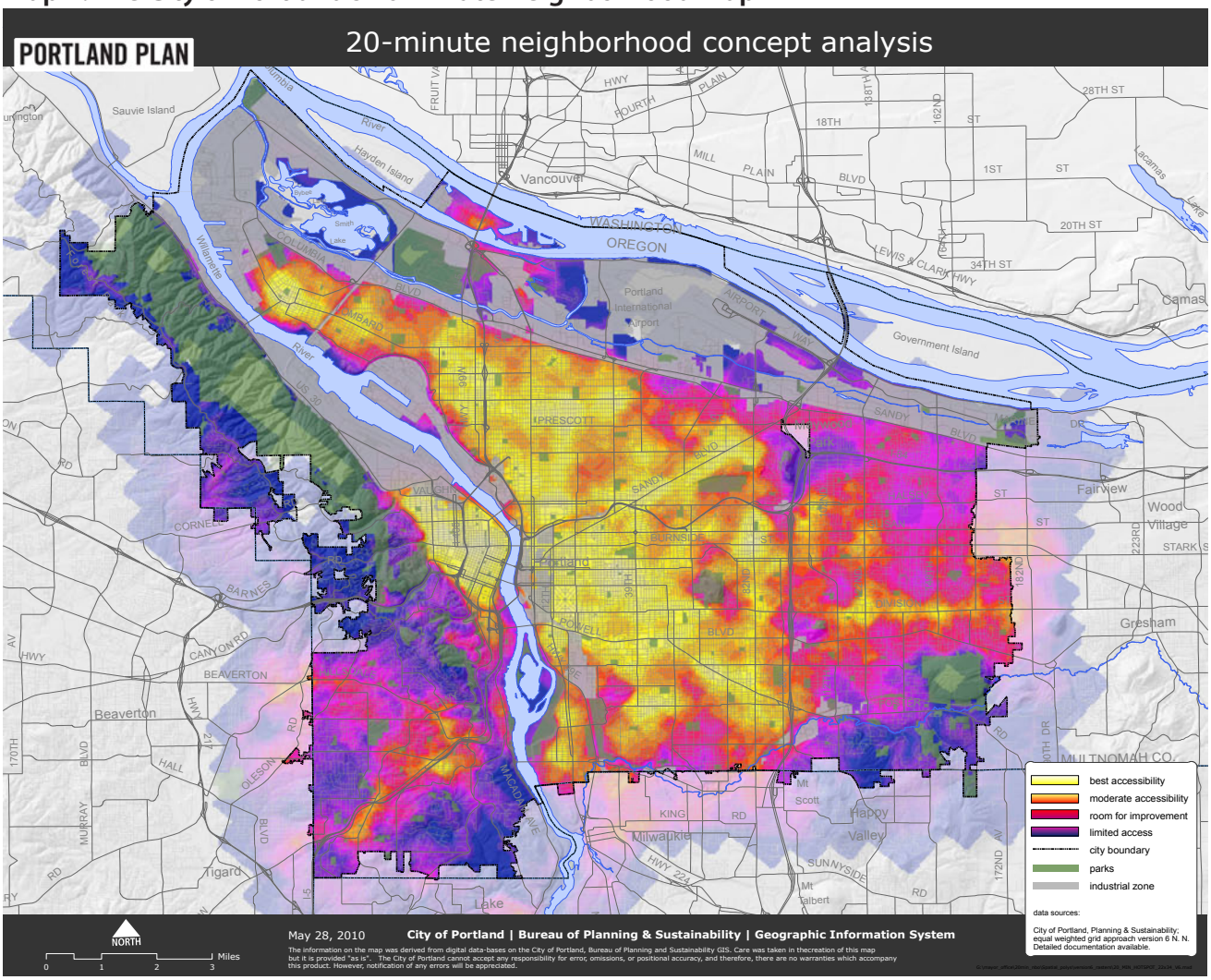
The resulting map (Map 2) shows that neighborhoods closest to the central city are the most complete 20 minute neighborhoods whereas neighborhoods in East, Southwest, and North Portland lack some or many of these attributes.

Map 3 displays the 20 minute map with outlines of the study area and three comparably sized comparison areas—each centered on main arterial, but with differing degrees of commercial development—along with each area's average 20

minute score to give a sense of how the study area compares with areas in other parts of the city. As these scores indicate, the study area is lower than the closer-in SE and N/NE neighborhoods, and the city as a whole, but is slightly higher than the SW neighborhood comparison area.

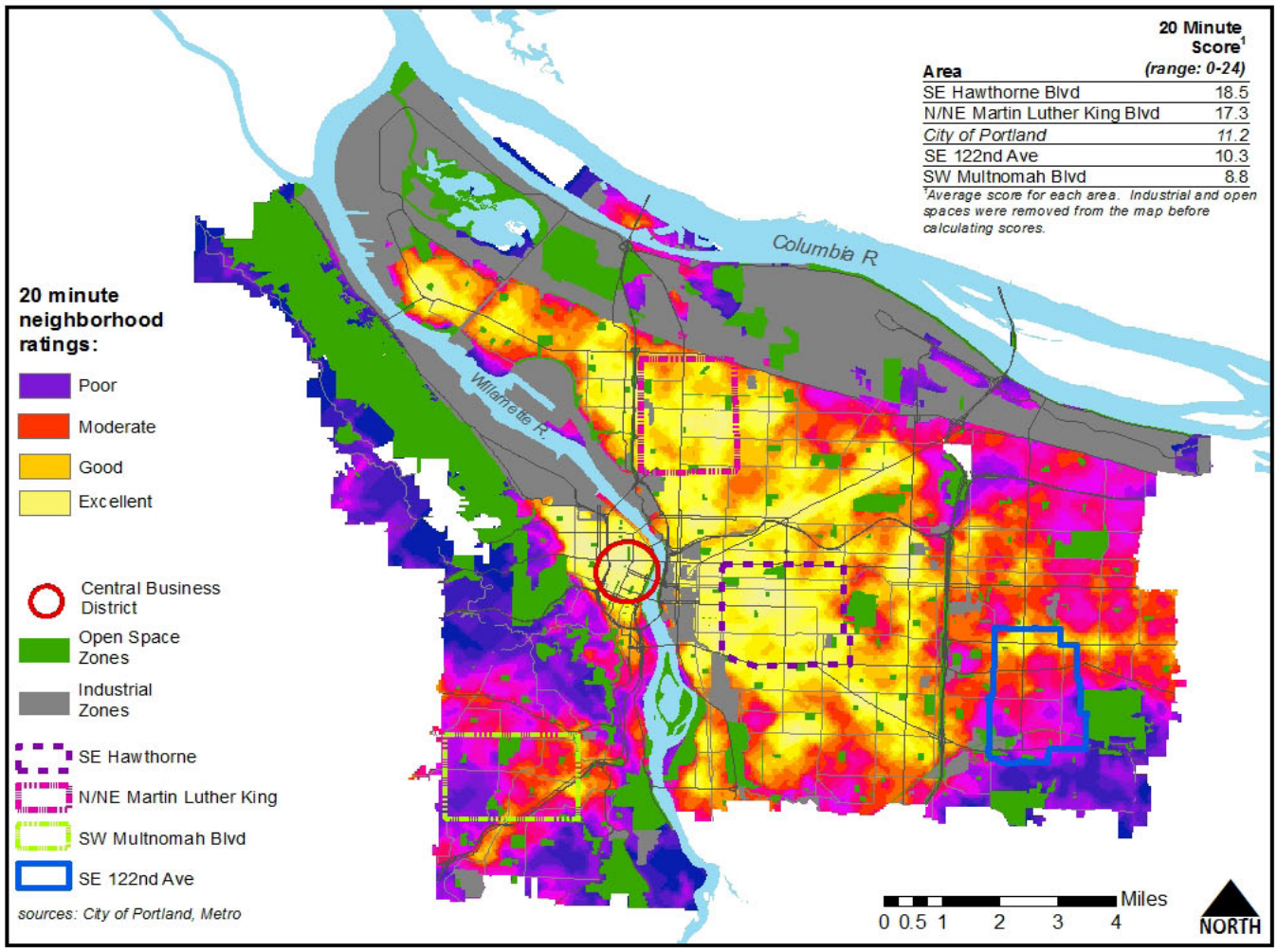
One of the primary issues that has emerged in Portland Plan discussions about developing 20 minute communities across Portland is the fact that the existing infrastructure and development patterns in certain parts of the city don't lend themselves to easy transition to 20 minute neighborhoods. As the 20 minute neighborhood maps indicates, while many neighborhoods in inner Portland, particularly on the east side of the Willamette River, could be described as nearing,

Map 2: The City of Portland's 20 Minute Neighborhood Map



[1]This 20 minute neighborhood analysis was produced by the City of Portland's Bureau of Planning and Sustainability (BPS) (equal grid approach version 6, equal 45, N.N.) It includes data analyzed 1 mile outside city boundary. The 20 minute neighborhood information on the map was derived from digital data-bases for the variables listed on page 13. Each variable received equal weight in the development of the composite scores on which the color scheme is based. Possible scores for each ¼ square mile cell range from 0-24. This map and its underlying databases are maintained by BPS GIS department. Additional information on this map available on request.

Map 3: 20 Minute Neighborhood Comparison Areas



or already having achieved, 20 minute neighborhood status, other parts of the city have, for a variety of reasons, not given rise to this type of development. In Southwest Portland, the primary challenges come from the area's hilly topography which has constrained dense development. In East Portland, the primary barriers stem from the area's historical development patterns and lack of infrastructure investments made by Multnomah County prior to the area's annexation by Portland in the late 1980s and early 1990s.

Unlike Portland's inner neighborhoods that developed in the early 20th century as compact streetcar-oriented neighborhoods with small blocks laid out on a uniform 200' grid to facilitate pedestrian access to streetcar lines, East Portland started to experience development after World War II. This resulted in an auto-oriented development pattern characterized by a few large arterials and highways that serviced low-density, primarily residential neighborhoods. In addition, development pressure

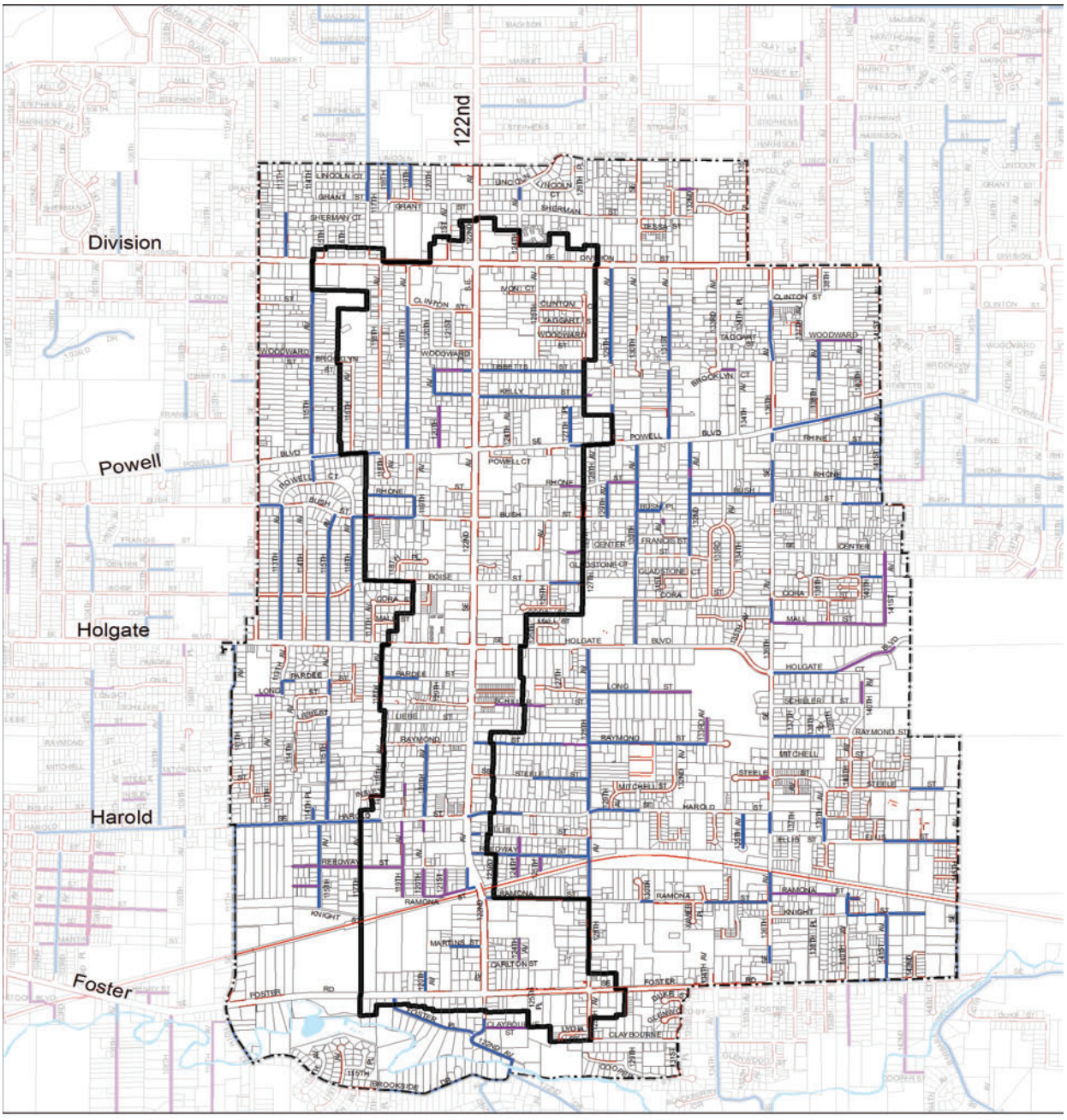
in East Portland remained low until after annexation, so the area's infrastructure and development patterns emerged, if at all, in a very piecemeal and uncoordinated fashion. As a result, East Portland contains diverse lot sizes and block patterns, along with a lack of improved or connected streets and sidewalks (see Map 4). Connectivity with one's immediate neighborhood, on foot or by car, is thus low, and few opportunities exist for commercial development that is not oriented to the cars travelling on the area's major arterials. These inherited challenges help explain why there are so few existing or even nascent 20 minute neighborhoods currently in East Portland, despite the fact that the area's relatively rapid population growth over the past decade has begun to create in certain places the residential density necessary to support this urban form.

East Portland Action Plan

In addition to the challenges posed by the lack of infrastructure and large, irregular block sizes, East Portland has also experienced numerous demographic changes in the past 20 years. Driven in large part by the relative affordability and availability of real estate, East Portland's population grew by almost 50% between 1990 and 2010, with a large influx of families of immigrants, racial minority groups, low-income households, and children (detailed demographics Tables can be found in Appendix B). As a result, the area's median household income has dropped relative to the rest of the city and average household size has risen, producing a relatively small growth in the amount of disposable income in the area that has not been sufficient for inducing developers to try to overcome the area's development barriers and attracting the sorts of neighborhood retail developments necessary for supporting a more complete 20 minute neighborhood.

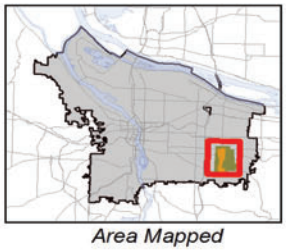
In 2008, BPS produced the East Portland Action Plan (EPAP) in an effort to begin to address many of the challenges in East Portland that have appeared in the area as a result of the population growth and demographic shifts that have occurred since annexation in the mid-1990s. EPAP lays out a series of short term action items for addressing many of this area's most pressing concerns, including a recommendation to conduct a pilot study to assess the feasibility of establishing 20 minute neighborhoods in East Portland and their utility in addressing some of the area's more pressing needs. The SE 122nd Ave study area was eventually chosen for the pilot study because of the similarities to other areas in East Portland.

Map 4: Combined Study Area Sidewalk and Street Conditions



SE 122nd Avenue Pilot Project: Sidewalks and Street Condition

- Study Area
- Area of Influence
- Substandard Street (PBOT)
- Unimproved/Gravel Street (PBOT)
- Sidewalks (PBOT)



Area Mapped

N

0 1,000 2,000
Feet

City of Portland Bureau of
Planning & Sustainability

All data compiled from source materials at different scales. For more detail, please refer to the source materials or City of Portland, Bureau of Planning & Sustainability.

December 2, 2009

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Pilot Study Scope

After reviewing previous previous plans and studies, meeting with the Community Working Group (CWG), and conducting some neighborhood walks with area residents and stakeholders in the spring and summer, BPS staff began focusing the Pilot Study on four topic areas that would need to be addressed in order to move the community towards a more complete 20 minute neighborhood:

- Accessibility, connections, pedestrian comfort and safety
- Convenience and availability of services
- Residential infill development and design
- Community amenities and livability

These four topic areas served as the framework for discussions with the community and the development of final recommendations.

The study area itself—the area in which possible changes might be made – is relatively narrow, encompassing the lands with about ¼ mile of the section of the SE 122nd Avenue running between SE Division Street to the north and SE Foster Road to the south. This area was chosen largely because of the multi-dwelling and commercial zoning designations that BPS identified as needing to be addressed in order to move the neighborhood toward a 20 minute neighborhood.

However, since changes in this area would likely significantly impact a wider area, BPS also identified an "area of influence" to consider as well, and many of the study's final recommendations address this broader area as well as the actual study area. Throughout this report, the term "combined study area" will be used to refer the combination of the study area and area of influence.

Planning and Health

Early in the process BPS determined that the pilot study would also be a good opportunity to expand its emerging partnerships with public health stakeholders and pilot activities aimed at integrating health considerations into the BPS and community planning process. A large factor in this decision was an increased understanding amongst planners, other city officials and agencies, and the general public in recent years that there are numerous links between the built and social environments and health that have not been routinely considered in the city's urban planning and development practices. OPHI has been working since 2005 promoting healthy urban planning and community development in other southeast neighborhoods, and in

2009 received funding from the Northwest Health Foundation and Kaiser Permanente to become formal partners in the Pilot Study.

As part of this partnership, OPHI became part of the lead project team to advise BPS on strategies to integrate health information and stakeholders in the process. In June 2009, BPS and OPHI formed a Health Partners Working Group (HPWG), an advisory group consisting of medical and public health practitioners and advocates tasked with helping project staff identify and assess project-specific health issues, and help evaluate and inform the study's outcomes. Members of the HPWG included the local and state health departments, non-profit health advocacy groups, health system representatives, physicians, and health researchers from Portland State University. Throughout the project, OPHI also participated on the Community Working Group (CWG) and the study's three community workshops, presenting information on the relationships between health and the built and social environments and on the possible health impacts of different design and development options as they were considered, as well as on the study's recommendations. In addition, OPHI also used these venues to get input from community residents and stakeholders about their community-related health concerns and priorities.

In 2010, OPHI received funding from Centers for Disease Control and Prevention and National Network of Public Health Institutes to develop a Health Impact Assessment (HIA) report on the study findings, which allowed OPHI to more formally assess the positive and negative health impacts of the study recommendations and produce this HIA report. As part of the HIA, OPHI contracted with two local community groups: OPAL Environmental Justice and Russian Speaking Network of Oregon to conduct community-based surveys that would inform the HIA.

Assessing the Health Impacts of the SE 122nd Avenue Pilot Study's Recommendations

The assessment component of an HIA involves making judgments about a project's, plan's, or policy's probable impacts on the health of the affected population. It builds on the project's scoping phase which involves delineating the affected population, identifying which health determinants and outcomes to analyze, and determining which analytic methods will be employed in the analyses.

Scoping

Scoping for an HIA relies on input from as many participants as possible: public health experts to help identify all potential direct and indirect health impacts of a project, and community and stakeholder input to help determine which impacts are most relevant and in need of analysis. In many cases, an HIA steering committee consisting of experts and stakeholders will be assembled to help with the scoping process. In the case of the SE 122nd Ave Pilot Project, however, BPS had already pulled together a Citizen Working Group (CWG) and a Health Partners Working Group (HPWG) for the project. Since an HIA steering committee would pull from these two groups and place additional time demands on the participants, OPHI, in conjunction with BPS, decided to not establish a separate HIA steering committee. Instead, OPHI regularly met with both groups to complete the scoping process by presenting information on the combined study area's existing conditions and research relating the built and social environments to health. Based on the existing conditions of the combined study area's health determinants, the scope of the pilot project, feedback from the study's four community workshops, previous community engagement efforts, and suggestions and advice from the CWG and HPWG, OPHI decided to focus on assessing the study outcome's potential for impacting the following five health determinants:

- Opportunities for physical activity
- Opportunities for accessing healthful foods
- Opportunities for social engagement/cohesion
- Bicycle and pedestrian traffic safety
- Exposure to outdoor air pollutants

Assessment

The methods used for gathering and analyzing relevant information for an HIA vary from project to project and are determined by staff and stakeholder capacity and resources. Assessment of the SE 122nd Ave Pilot Study's health impacts employed the following methods:

- Collection and analysis of demographic, land use, and urban form data
- Review of health research literature establishing links between the built environment and health
- Soliciting community input on neighborhood health issues at project workshops and workgroup meetings
- Review of recent previous local efforts to gather community input related to a wide variety of livability and health-related issues
- Field visits and site observations of the combined study area
- Partnering with local community-based organizations to solicit input from the combined study area's under-represented groups, including renters, low-income residents, transit riders, immigrants, and communities of color

The key outcomes of the assessment component of this HIA include an assessment of the existing conditions of the scoped health determinants in the combined study area as well as qualitative estimates of the positive and negative, and direct and indirect, impacts of the proposed Pilot Study recommendations on the scoped determinants. These impacts are summarized in Table 2, which includes a complete list of the Pilot Study's recommendations, as well as the area-specific challenges that the recommendations are meant to address. In addition to assessing how health determinants in the combined study area would likely be impacted by the Pilot Study's recommendations, the HIA will also offer additional recommendations for either mitigating negative impacts on health determinants, or for further improving positive impacts. These additional recommendations are based on known best practices or existing research documenting their likely effectiveness.

It is important to note that, in assessing the Pilot Study recommendations' impacts, this HIA assumes that the study's recommendations will be implemented and have their desired impact. It does not attempt to gauge the likelihood of a Pilot Study recommendation actually being implemented. Implementation of Pilot Study recommendations, even if adopted by resolution by Portland City council, invariably depends on hard-to-predict future availability of resources and political and stakeholder support. The suitability of the Pilot Study recommendations as means for achieving their desired ends, if properly implemented,

is assumed to be sufficiently ensured because they were all vetted by a technical advisory committee consisting of representatives of all relevant city bureaus that would be involved in implementing the various recommendations.

Following Table 2, each of the five determinants will be addressed in turn with a summary of the research literature linking the determinant to specific health outcomes, a description of the existing conditions of the determinant in the combined study area, a qualitative assessment of the nature of the study recommendations' positive and negative impacts on each health determinant, and additional recommendations for either mitigating negative impacts on health determinants, or for further improving positive impacts.

Each section will also address the likely impact to vulnerable populations within the study area. Vulnerable populations for the report include children, older adults, immigrants, communities of color, low income individuals, and people with disabilities that have demonstrated higher levels of various poor health outcomes. As previously indicated, the combined study area has relatively large proportions of children, older adults, immigrants, Latinos, and low income individuals, as well as a number of disabled residents. Studies that have controlled for these populations generally indicate that these sub-groups would respond to changes in their built environment in ways similar to the general population. Due to the comprehensive. nature of the study's recommendations it is difficult to fully assess how specific impacts to vulnerable populations may differ from the general population in Powellhurst-Gilbert. It is important to note however that any increased investment and planning in the Powellhurst-Gilbert neighborhood will disproportionately benefit vulnerable populations throughout the Portland area because of the large proportions of children, older adults, immigrants, Latinos, and low income individuals in Powellhurst-Gilbert and East Portland.

The reader will note that the first section, Opportunities for Physical Activity, is significantly longer than the other sections. There are two reasons for this. First, many of the existing conditions described in this section apply to the other four sections, so these descriptions are simply referenced, but not duplicated, in the other sections. Second, there is a good deal more research literature on how neighborhood-scale elements such as those that the Pilot Study proposes to change impact opportunities for physical activity than on how such elements impact the other determinants. Not only is there more literature to review, but this literature makes it possible to take a more detailed look at multiple factors known to influence physical activity levels at a neighborhood scale.

Table 2A: Impacts of Pilot Study Topic 1 (Accessibility, Connections, Pedestrian Comfort and Safety) Recommendations on Health Determinants in the SE 122nd Ave Combined Study Area

= intended/likely **direct** ***positive*** impact

= intended/likely **indirect** ***positive*** impact

N = intended/likely **direct** ***negative*** impact

N = intended/likely **indirect** ***negative*** impact

Challenges		Recommendations	Physical Activity Factors						Air Pollutant Exposure	Traffic Safety	Social Cohesion	Food Access
			Retail Mix	Connectivity	Ped. Realm	Bike Facilities	Transit	Parks & OS				
Pedestrian Routes • SE 122nd Avenue lacks consistent sidewalks making it an unsafe and unpleasant environment in which to walk • Lack of sidewalks on arterial streets • Sidewalks lacking to key amenities (schools, parks) • Difficult pedestrian crossings, especially on SE 122nd Avenue • The lack of a connected street grid is a barrier to efficient, safe travel by walking • Sidewalks lacking on most local streets	1A	Conduct a streetsca pe study for SE 122nd Avenue, develop a project for inclusion in the Transportation System Plan (TSP), and pursue funding.		■	■					■		
	1B	Add to the TSP locations on SE 122nd Avenue for pedestrian safety crossing improvements (such as median crossing refuge and curb extensions), and pursue funding for construction. Proposed locations: SE Clinton, SE Tibbets, SE Bush, SE Boise, SE Schiller, SE Raymond, SE Carlton.		■	■	■				■		
	1C	Study and Implement ways to further improve pedestrian crossing safety at SE 122nd at SE Division and at SE Powell.		■	■					■		
	1D	Explore and develop new policies, designations, and/or mechanisms of key local streets that serve public schools, parks, and other major public facilities.		■	■					■		
	1E	Explore more cost effective and context sensitive standards for local and arterial street design and sidewalk improvements that provide multiple benefits for human and watershed health.		■	■					■		
	1F	Review how sidewalk construction is funded citywide, and recommend ways that sidewalks in East Portland can be improved to catch up with the rest of the city.		■	■					■		
Bike Paths • SE 122nd Ave bike lane is unsafe and unpleasant environment due to high traffic speeds and volume • Lack of alternatives to bike lanes on arterial streets • Street grid is a barrier to efficient, safe travel by bike	1G	Seek funding to implement the Bicycle Master Plan for the SE 122nd Avenue study area.				■				■		
	1H	Coordinate project recommendations with local Safe Routes To School (SR2S) improvement plans.			■	■				■		

Table 2A: Impacts of Pilot Study Topic 1 (Accessibility, Connections, Pedestrian Comfort and Safety) Recommendations on Health Determinants in the SE 122nd Ave Combined Study Area

= intended/likely **direct** ***positive*** impact

= intended/likely **indirect** ***positive*** impact

N = intended/likely **direct** ***negative*** impact

N = intended/likely **indirect** ***negative*** impact

Challenges		Recommendations	Physical Activity Factors						Air Pollutant Exposure	Traffic Safety	Social Cohesion	Food Access
			Retail Mix	Connectivity	Ped. Realm	Bike Facilities	Transit	Parks & OS				
Street Connections • The area's lack of connectivity and complete street improvements makes travel inefficient and circuitous for all travel modes. • The area's irregular lot sizes and land division pattern contribute to a lack of street connectivity and cohesion in development.	1I	Support and ensure the creation of planned local street and pedestrian connections during the land development process.										
	1J	Study and implement a better mechanism to ensure street connections for new development that does not go through the subdivision process.										
	1K	Consider larger minimum lot sizes for residential subdivisions to improve opportunity for connectivity and improve urban form.										
Street Conditions • Substandard and unpaved streets impede connectivity and make it difficult to distinguish public and private space, resulting in haphazard parking and conflicts.	1L	Support and ensure the improvement of streets in the development process.										
	1M	Explore new mechanisms to encourage and facilitate street improvements outside of the real estate development process.										
	1N	Encourage residents to participate in Lents URA Local Improvement District (LID) process.										
Transit Service • Transit service is not frequent on evenings and Sundays. • Safety and comfort is lacking at many bus stops due to limited number of shelters and lack of paving at some stops.	1O	Consider service improvements for TriMet Line 71 to enhance transit use and connections to other East Portland and regional destinations.										
	1P	Improve the condition and amenities of bus stops and ensure that the stops have safe pedestrian connections to residences and services.										
	1Q	Explore ways to enhance east-west transit connections and improve links to Green Line MAX.										

Table 2B: Impacts of Pilot Study Topic 2 (Convenience and Availability of Services; Employment Opportunities) Recommendations on Health Determinants in the SE 122nd Ave Combined study area

= intended/likely **direct** ***positive*** impact

= intended/likely **indirect** ***positive*** impact

N = intended/likely **direct** ***negative*** impact

N = intended/likely **indirect** ***negative*** impact

Challenges		Recommendations	Physical Activity Factors						Air Pollutant Exposure	Traffic Safety	Social Cohesion	Food Access
			Retail Mix	*Connectivity*	*Ped. Realm*	*Bike Facilities*	*Transit*	*Parks & OS*				
Commercial Land Uses • There is a lack of commercial uses and services south of Powell Boulevard, and limited opportunity for creation of new small businesses. • Some large commercial sites are underused, and developed in a low intensity, auto-oriented manner that is not conducive to walking or bicycling. • Potential demand may exist for small scale commercial or mixed use development between intersections, but is limited by zoning.	2A	Explore and develop a regulatory tool that allows small commercial uses and/or mixed use development in areas currently zoned R1. See also Recommendation 3A.							N			
	2B	Explore development opportunity strategies to better use large, underutilized commercial sites at major intersections.							N			
	2C	Consider applying economic development tools such as storefront improvement grants or other business finance products to businesses adjacent to east side of SE 122nd Avenue if commercial uses are allowed in this area.							N			
	2D	Consider changes to zoning to support the desired retail environment, including the potential for grocery store at south end of study area.							N			
Retail and Services • There are vacancies in existing shopping centers in the north part of study area. • The south part of study area lacks retail and services but includes underutilized land at Foster, Harold, and Holgate.	2E	Retain, expand, and attract new businesses to the SE 122nd Avenue corridor by improving business association capacity and highlighting the SE 122nd Avenue area as a focus area in the Lents Urban Renewal Area.							N			
	2F	Target urban renewal funds to support businesses along SE 122nd Avenue within the Lents URA, and improve marketing of programs and services with assistance of local associations.							N			

Table 2B: Impacts of Pilot Study Topic 2 (Convenience and Availability of Services; Employment Opportunities) Recommendations on Health Determinants in the SE 122nd Ave Combined study area

= intended/likely **direct** ***positive*** impact

= intended/likely **indirect** ***positive*** impact

N = intended/likely **direct** ***negative*** impact

N = intended/likely **indirect** ***negative*** impact

Challenges		Recommendations	Physical Activity Factors						Air Pollutant Exposure	Traffic Safety	Social Cohesion	Food Access
			Retail Mix	*Connectivity*	*Ped. Realm*	*Bike Facilities*	*Transit*	*Parks & OS*				
Access to Healthy Food • The area lacks culturally appropriate food stores overall, and lacks full-service grocery options in the south. • There is a waiting list for community gardens in the area.	2G	Explore opportunity to attract and locate a grocery store in the south end of the study area: consider SE Foster at SE 122nd Avenue location.	■						N			■
	2H	Explore opportunities to attract and support small scale and/or culturally appropriate healthy food retailers.	■						N			■
	2I	Support vegetable gardening on underutilized sites and private yards, creation of community gardens, and partnerships with urban farming institutions to enhance availability of healthy foods.										■
Jobs and Employment • The area lacks employment opportunities that provide jobs for area residents. • Transit connections to existing jobs centers are not always direct or provided at times needed.	2J	Encourage quality job creation in industrial and employment areas such as east Lents/Foster Corridor, the Gateway Regional Center, or other nearby sites.							N			
	2K	Improve transit service and connections to nearby job centers (Lents, Gateway, Airport Way) as well as to large retail and service centers.					■					

Table 2C: Impacts of Pilot Study Topic 3 (Residential Infill Development and Design) Recommendations on Health Determinants in the SE 122nd Ave Combined Study Area

= intended/likely **direct** ***positive*** impact

= intended/likely **indirect** ***positive*** impact

N = intended/likely **direct** ***negative*** impact

N = intended/likely **indirect** ***negative*** impact

Challenges		Recommendations	Physical Activity Factors						Air Pollutant	Traffic Safety	Social Cohesion	Food Access
			Retail Mix	*Connectivity*	*Ped. Realm*	*Bike Facilities*	*Transit*	*Parks & OS*				
Residential Land Use • Broad application of the R1 and R2 multi-dwelling residential zones creates significant housing potential that is not well supported by the area's infrastructure and services. • Application of the R1 zone on wide, high volume arterial streets may create livability issues for residents. • The R2 multi-dwelling zone extends deep into developed neighborhoods creating transition and compatibility issues.	3A	Explore alternative site development standards, or consider alternatives to the R1 multi-dwelling residential zone to improve the interface between development and busy streets. See also Recommendation 2A.			■							
	3B	Consider changes to zoning map designations in areas over 400 feet away from arterial streets to reduce development impacts, improve compatibility, and preserve trees in neighborhood areas.			■							
	3C	Explore changes to minimum density and other development standards in R2 and R1 zones to improve compatibility and reduce impact of new development.			■							
Residential Site Design • New developments in multi-dwelling zones often lack play areas and on-site open space for tenants, and may not provide enough parking for residents and visitors. • Multi-dwelling development standards that are used citywide often force buildings close to busy streets. • New development is often not required to preserve tree canopy, and few large trees or Douglas Firs preserved.	3D	Preserve a greater number of large trees in the development process: implement the Tree Code improvement project for this area.			■							
	3E	Develop and test special site development regulations for multi-dwelling residential development that require more usable open space, landscaping, and HEAL (healthy eating/active living) amenities, such as bike storage, connections to larger pedestrian/bicycle network, and gardening opportunities.		■	■	■						
	3F	Consider larger mandatory landscaped building setbacks from major city traffic streets for multi-dwelling residential development.			■							
Residential Building Design • Buildings often turn back or side to street – does not promote "eyes on the street." • Many new multi-family and row house developments lack architectural details, quality design and construction.	3G	Improve residential design: explore use of the design overlay zone or special development design standards appropriate for R1 and R2 zone multi dwelling areas along and near SE 122nd Avenue.			■							

Table 2D: Impacts of Pilot Study Topic 4 (Community Amenities and Livability) Recommendations on Health Determinants in the SE 122nd Ave Combined Study Area

= intended/likely **direct** ***positive*** impact

= intended/likely **indirect** ***positive*** impact

N = intended/likely **direct** ***negative*** impact

N = intended/likely **indirect** ***negative*** impact

Challenges		Recommendations	Physical Activity Factors						Air Pollutant	Traffic Safety	Social Cohesion	Food Access
			Retail Mix	*Connectivity*	*Ped. Realm*	*Bike Facilities*	*Transit*	*Parks & OS*				
School Capacity • David Douglas School District (DDSD) lacks a diversified tax base and has had difficulty passing a bond measure for development of new schools. • The David Douglas School District currently lacks capacity for additional students.	4A	Strengthen the tax base for school bonds by encouraging commercial development, employment uses, and reviewing the current application of housing tax abatements.							N			
	4B	Consider partnerships with other school districts to balance enrollment between districts and schools.										
	4C	Balance the mix of households in new development by encouraging smaller units as well as family-sized units in future developments.										
Parks/Open Spaces • Many parks are located along substandard streets, or in locations that make access and visibility difficult. • While improvements have been made, some parks still lack recreation facilities and amenities. • Residents feel that parks and community garden space have not kept up with the demand created by new residential development.	4D	Improve access to parks and open space, including Raymond Park, Springwater Corridor, Leach Botanical Garden, Zenger Farm, Beggar's Tick Wildlife Refuge, and Powell Butte.										
	4E	Explore opportunities to acquire and develop, or provide shared space, for additional community gardens: consider unused right-of-way, and other underused sites.										
	4F	Consider opportunities to purchase and develop additional park and open space around the SE 122 Ave and Powell area to serve growing demand.										
	4G	Explore partnerships for greater use of school fields and facilities to meet the area's parks and recreation needs.										
Green Infrastructure • Parts of the study area have a high water table and are subject to flooding. • The area's public stormwater sump depths are close to groundwater and require attention to comply with DEQ standards.	4H	Develop green stormwater management features at key locations along and near SE 122nd Avenue to address sump issues, improve water quality, and create community amenities.										
	4I	Coordinate green infrastructure with planned land uses and future parking needs, as well as pedestrian and bicycle safety plans, in the study area.										
	4J	Conduct additional watershed planning (upland of Johnson Creek including the study area), to identify and prioritize strategies for addressing water quality, hydrology (including flooding), and habitat issues.										

Table 2D: Impacts of Pilot Study Topic 4 (Community Amenities and Livability) Recommendations on Health Determinants in the SE 122nd Ave Combined Study Area

= intended/likely **direct** ***positive*** impact

= intended/likely **indirect** ***positive*** impact

N = intended/likely **direct** ***negative*** impact

N = intended/likely **indirect** ***negative*** impact

Challenges		Recommendations	Physical Activity Factors						Air Pollutant	Traffic Safety	Social Cohesion	Food Access
			Retail Mix	*Connectivity*	*Ped. Realm*	*Bike*	*Transit*	*Parks & OS*				
Amenities/Assets • There is little protection for the area's signature Douglas Fir and other large trees in the development process. • The area has few community gathering places (coffee shops, community spaces, etc.) particularly south of Holgate Boulevard. • Little work has been done by public agencies to research and document the area's historic resources. • Leach Botanical Garden and Zenger Farm are neighborhood amenities that many residents do not know exist.	4K	Identify and inventory mid-century (and prior) historic resources in and near the study area as part of the Oregon State Historic Preservation Grant for East Portland.										
	4L	Continue and expand partnerships with local non-profits such as Friends of Trees and Ed Kerns to increase tree canopy, wildlife habitat, and community livability.										
	4M	Explore opportunity to create a community facility or community space for meetings, gatherings, etc.										
	4N	Encourage Leach Botanical Garden and Zenger Farm to continue to engage the neighbors and community stakeholders as expansion plans for each of these facilities are being developed.										
Social Service Needs • Neighbors are concerned that the area is receiving a disproportionate amount of low-income affordable housing. • Local demand for social services has increased due to demographic changes in the area.	4o	Ensure that affordable housing needs are being addressed on a citywide basis.										
	4P	Ensure that social services exist in areas close to the populations being served.										
Neighborhood Safety and Appearance • There is a perception of higher than average crime in this area, and people feel unsafe in parts of the study area. • Maintenance of private property and public areas is lacking in some places, which may contribute to safety concerns.	4Q	Encourage neighborhood participation in crime prevention programs such as Neighborhood Watch and Foot Patrols.										
	4R	Create a neighborhood "clean team" to periodically spruce-up places that need attention and to assist property owners with clean ups.										
	4S	Develop and focus non-profit and volunteer-based projects to assist with property clean ups and maintenance (ex: REACH paint-a-thon).										
	4T	Support and expand use of Crime Prevention Through Environmental Design (CEPTED) principles adopted by Portland City Council.										

Opportunities for Physical Activity

Summary of Impacts

As Table 2 shows, most of the study's recommendations are anticipated to directly or indirectly improve these six activity-promoting features of the built environment, with street connectivity, the pedestrian realm, and retail mix receiving the most focus. None of the recommendations are anticipated to negatively impact the combined study area's primary environmental supports for physical activity. As noted above, this assessment assumes both that the recommendations will be implemented and that they will achieve their desired ends.

Current research indicates that vulnerable groups would generally share in the positive benefits of increased opportunity for physical activity. As previously indicated, the combined study area has relatively large proportions of children, older adults, immigrants, Latinos, and low income individuals, as well as a number of disabled residents. Studies that have controlled for these populations generally indicate that these sub-groups would respond to changes in their built environment in ways similar to the general population, thus getting more physical activity from walking, biking, and recreation. Children who live in more walkable, bikeable environments walk and bike to school at higher rates regardless of race, ethnicity, or income, and have lower rates of obesity and overweight [2-5]. Older adults who live near parks tend to walk more than those who don't [6-7], and tend to walk more when sidewalks are present and in good condition [8]. Low income individuals walk more in more walkable neighborhoods, although at a slightly lower rate than higher income individuals [9-10]. Disabled residents would also likely experience improved mobility and accessibility from the pedestrian infrastructure being brought up to ADA standards [11]. Importantly, no studies were found indicating that making neighborhoods more supportive of physical activity in the ways discussed above would have any adverse impacts on particular sub-groups.

However, some community input regarding transit service indicates that additional barriers such as the high and rising cost of fares, infrequent and sub-standard service, racial discrimination, and transfer problems should be addressed for low-income and minority residents to fully benefit from changes designed to improve transit use in the area. In addition, research on park use indicates that different cultural groups have different preferences for park amenities [12-13]. In order to ensure that park improvements more fully meet preferences or different cultural groups, these residents need to be involved in the planning of these spaces.

Summary of Plan Impacts and Additional Recommendations

Potential Positive Impacts:

- The Pilot Study's recommendations directly and indirectly address the primary barriers to physical activity in the combined study area.
    - Most of the "Accessibility, Connections, Pedestrian Comfort and Safety" recommendations would directly and positively impact bike facilities, pedestrian network connectivity, the pedestrian realm, and access to open space, and would indirectly impact retail mix, transit use, and park and open space access.
    - Many of the "Convenience and Availability of Services" recommendations would directly encourage physical activity by providing new walking and biking destinations for community residents.
    - Most of the "Residential Infill Development and Design" recommendations would directly improve the pedestrian realm and would produce various indirect positive impacts on other physical activity supports.
    - Many of the "Community Amenities and Livability" recommendations would likely result in direct improvements to the area's pedestrian realm, and would indirectly and positively impact the other physical activity supports as well.
- The Pilot Study's set of recommendations will likely increase walking, biking, and active recreation levels in the area. This change in behavior would improve health outcomes related to physical activity, including lower rates of obesity, type 2 diabetes, heart disease, high blood pressure, colon cancer, and premature death, as well as improved musculoskeletal and mental health.
    - Resulting increases in physical activity would also likely improve the health of community residents by improving social cohesion and reducing accident rates for bicyclists and pedestrians.
- The improvements resulting from these recommendations will likely benefit all neighborhood residents.

Potential Negative Impacts:

None.

Additional Recommendations:

- Prioritize improvements in pedestrian infrastructure and pedestrian network connectivity, particularly near main arterials. This would include Pilot Study recommendations 1A-1F which address improved pedestrian routes; 1I-1K which address street connectivity; 1L-1N which address improved street conditions; and 1P which addresses improvements in pedestrian infrastructure around transit stops. Based on existing research, such improvements are likely to have the greatest impact on physical activity rates in the combined study area.
- Involve the neighborhood's immigrant groups and communities of color in designing and improving public spaces such as parks and community gardens to ensure that these spaces meet their needs and preferences, as well as those of other area residents. Existing research on park use indicates that different cultural groups have different preferences for park amenities [12-15]. In order to ensure that park improvements more fully meet their preferences, they need to be involved in the planning of these spaces.
- Work with Tri-Met to address the concerns of low-income and minority transit riders. Input from low-income and minority residents indicates that these groups face additional barriers to transit use that need to be addressed in order for them to more fully benefit from the study recommendation's proposed improvements to station area conditions, route connections, and service levels.
- Work with developers and development agencies in order to ensure that commercial and multi-dwelling units provide site amenities supportive of physical activity such as adequate storage for bicycles, strollers, and carts, and pedestrian pathways safely linking units with public rights-of-way.

Physical Activity and Health

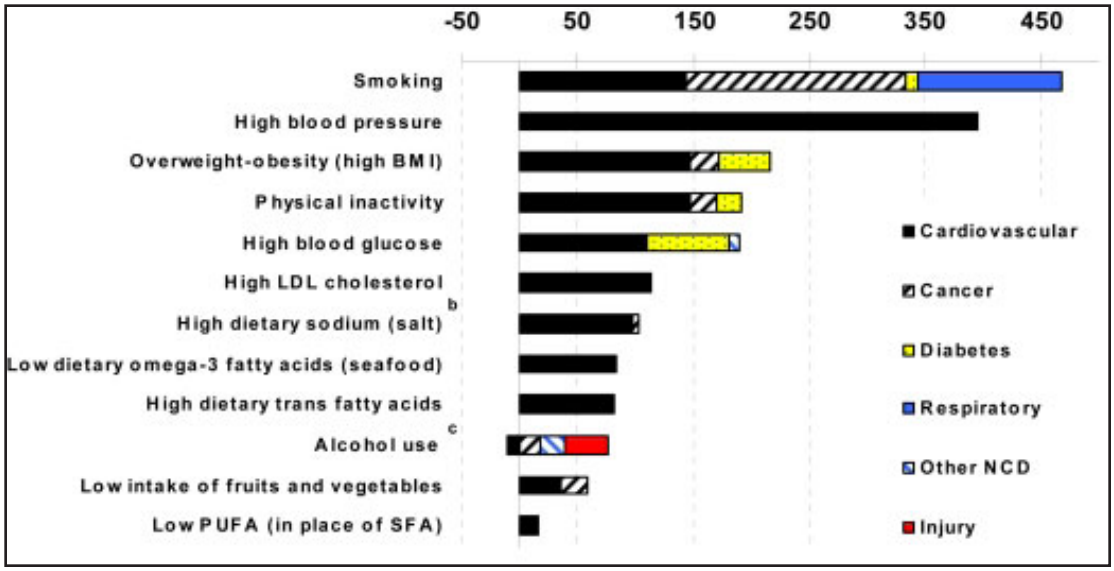
Researchers' understanding of the relationships between physical activity and health has steadily improved since the early 1990s when they expanded the focus of their work from assessing the impacts of intensive vigorous exercise to include a wider range of low or moderate intensity physical activities. In 1996, the US Surgeon General released its first report on physical activity and health which concluded that moderate physical activity (defined as activities that use large muscle groups and are at least equivalent to brisk walking, such as swimming, cycling, dancing, gardening and yard work, and various domestic and occupational activities) can substantially reduce the risk of developing or dying from coronary heart disease, colon cancer, high blood pressure, and diabetes. In addition, physical activity has been demonstrated to improve mental health and, for people with joint or bone problems, improve muscle function, cardiovascular function, and physical performance [16-17]. Since this report was issued, research has built on its conclusions and has also more conclusively demonstrated that for people who are inactive, even small increases in physical activity can yield numerous measurable health benefits. [17]. In addition, physical activity has been solidly linked to improved learning and educational attainment among adolescents [18]. Finally, walking about one's neighborhood and using parks and recreation facilities, has also been demonstrated to improve mental health and social cohesion [19-22]. High levels of social cohesion can contribute to good health outcomes by enabling the dissemination of health-related information such as care options, and establishing, maintaining, and promoting social norms and practices associated with healthful behaviors [22].

This improved understanding of physical activity's positive impact on health has also been accompanied by an increasing awareness of the magnitude of the impact of increasingly sedentary lifestyles on Americans' health. In a recent study that ranked the leading preventable causes of death in the United States [23], physical inactivity ranked 5th on the list, and was estimated to have been responsible for 191,000 premature deaths in 2005 (Figure 1).

The U.S. Centers for Disease Control and Prevention (CDC) currently recommends that adults should either engage in moderate exercise for at least 30 minutes 5 days a week, or in vigorous exercise (defined as rhythmic, repetitive physical activities that use large muscle groups at 70 percent or more of maximum heart rate for age, e.g., jogging, lap swimming, competitive team sports) for at least 20-minutes 3 days a week [17]. For adolescents, CDC recommends at least 60 total minutes of physical activity per day on 5, but preferably all, days of the week [18].

According to the 2005 Oregon Behavioral Risk Factor Surveillance System (BRFSS)

Figure 1. Deaths (thousands) Attributable to Total Effects of individual Risk Factors, by Disease*



*Source: Danaei G, Ding EL, Mozaffarian D, Taylor B, Rehm J, et al. (2009) The Preventable Causes of Death in the United States: Comparative Risk Assessment of Dietary, Lifestyle, and Metabolic Risk

annual survey, 43.6% of Oregon adults aren't meeting the CDC recommendations for physical activity. In the tri-county area around Portland, the number was higher at 44.0%. In Oregon, as elsewhere in the US, adults who are young, affluent, and/or well-educated were more likely to get recommended levels of physical activity. Of the different primary racial/ethnic groups, American Indians (67.0%) were most likely to meet the CDC recommendations for adults, followed by African-Americans (63.9%), White (59.0%), and Asian/Pacific Islanders (54.6%). Latinos posted the lowest rates with only 42.1% meeting the recommended levels of physical activity. Among Oregon adolescents, 57.9% of 8th graders and 49.4% of 11th graders statewide met the CDC physical activity recommendations. Adolescents in the tri-county Portland area were a bit less active, at 55.4% and 45.8%, respectively [24].

The Built Environment and Physical Activity

As the loosely linear dose-response relationship between physical activity and health has become better documented and understood, so has our understanding of the impact that the built environment can have on physical activity levels. Numerous studies have demonstrated that neighborhoods with well-connected street networks and a wide variety of retail opportunities produce high rates of walking for transport [13, 25-29], and that these rates also correlate with obesity levels which can serve as

a rough proxy for other physical activity-related health outcomes [30-37]. A much smaller body of research has also looked at the impact of the built environment on biking for transport, and has demonstrated that the presence of bicycle infrastructure such as bike lanes, bike boulevards, and multi-use paths correlate with increased rates of cycling and, thus, physical activity [38-39]. In addition to impacting opportunities for physical activity via active transportation, research has also demonstrated that proximity to parks and open space is also positively correlated with levels of physical activity because of the active recreational opportunities they provide [34, 40-44].

Taken together, primary built environments features that research most frequently identified as correlating with increased levels of physical activity include:

- A diverse mix of retail opportunities
- Well-connected pedestrian networks
- An attractive, safe, and convenient pedestrian realm
- High levels of transit service, especially high-frequency and multiple route choices
- The presence and type of bicycle infrastructure
- The presence, accessibility and design of parks, recreation facilities, open space

Much of this research also indicates that these and other less-examined variables tend to be synergistic, having a cumulative effect on physical activity levels when multiple features are present in a community. This synergy is important because much of this research also indicates that the changes in behavior resulting from making changes in many of these variables in isolation will likely be relatively modest. In a recent meta-analysis of published empirical studies of the associations of various features of the built environment and walking, for example, Ewing and Cervero found that the relationship between each individual variable and walking rates is inelastic, meaning that a 1% change in the variable produces a less-than-1% change in walking rates. As they point out in their conclusion, however, "the combined effect of several built environment variables on travel could be quite large" (p. 275) [29]. Similarly, regarding bicycling rates, Pucher et al., conclude that "individual interventions can increase bicycling to varying degrees, but the increases are not usually large… Substantial increases in bicycling require an integrated package of many different, complementary interventions, including infrastructure provision and pro-bicycle programs, as well as supportive land use planning and restrictions on car use." [39]

Opportunities for Physical Activity in the SE 122nd Ave Combined Study Area

The conditions of the above-listed features in the SE 122nd Avenue combined study area are displayed in Maps 2-13, and discussed in detail below. Overall, the neighborhood lacks good supports for encouraging and facilitating physical activity, either through active transportation or through the use of parks, recreation facilities, and open space for active recreation. In part as a result of these conditions, residents of the combined study area are more likely to drive more, walk and bike less, and use their parks and recreation facilities less often than most other Portlanders. As Table 3 shows, according to the US Census, combined study area residents are more likely than other Portlanders to own and use cars for their work commutes. Table 4 contains some results of the City of Portland Auditor's Office 2009 annual Resident Survey. Although the results of this survey are only broken down by district—of which there are seven in Portland—and not by neighborhoods, they can be taken as good indicators of behaviors and attitudes in the combined study area since the comments of residents generally corroborate the conditions described in the survey results.

Table 3: Car Ownership Rates and Primary Work Commute Modes, 2009*

	Households without vehicles	Work commute mode			
		Car	Public Transportation	Work at home	Other, including walking & biking
Combined study area Block Groups**	8.1%	86.1%	7.7%	3.9%	2.3%
Portland	11.4%	78.4%	10.3%	5.2%	6.1%

*Census-based projections from SimplyMap

**Multnomah County Block Groups 82023, 84001, 84002,85001, 89012, 90001, 90002, 90003, 92013

Table 4: Selected 2009 Resident Survey Results, Bicycle and Pedestrian Issues*

	East Portland (inc. combined study area)	Rest of Portland
Primary or secondary work commute mode: walk	4%	11%
Primary or secondary work commute mode: bike	8%	19%
Primary or secondary work commute mode: drive alone	87%	72%
Pedestrian safety: good or very good	43%	56%
Bicycle safety: good or very good	41%	49%
Did not visit a city park near your home in the past year	26%	10%
Physical condition of housing is good or very good	52%	70%
Walking distance to transit stops is good or very good	81%	87%
Access to shopping and services is good or very good	68%	77%

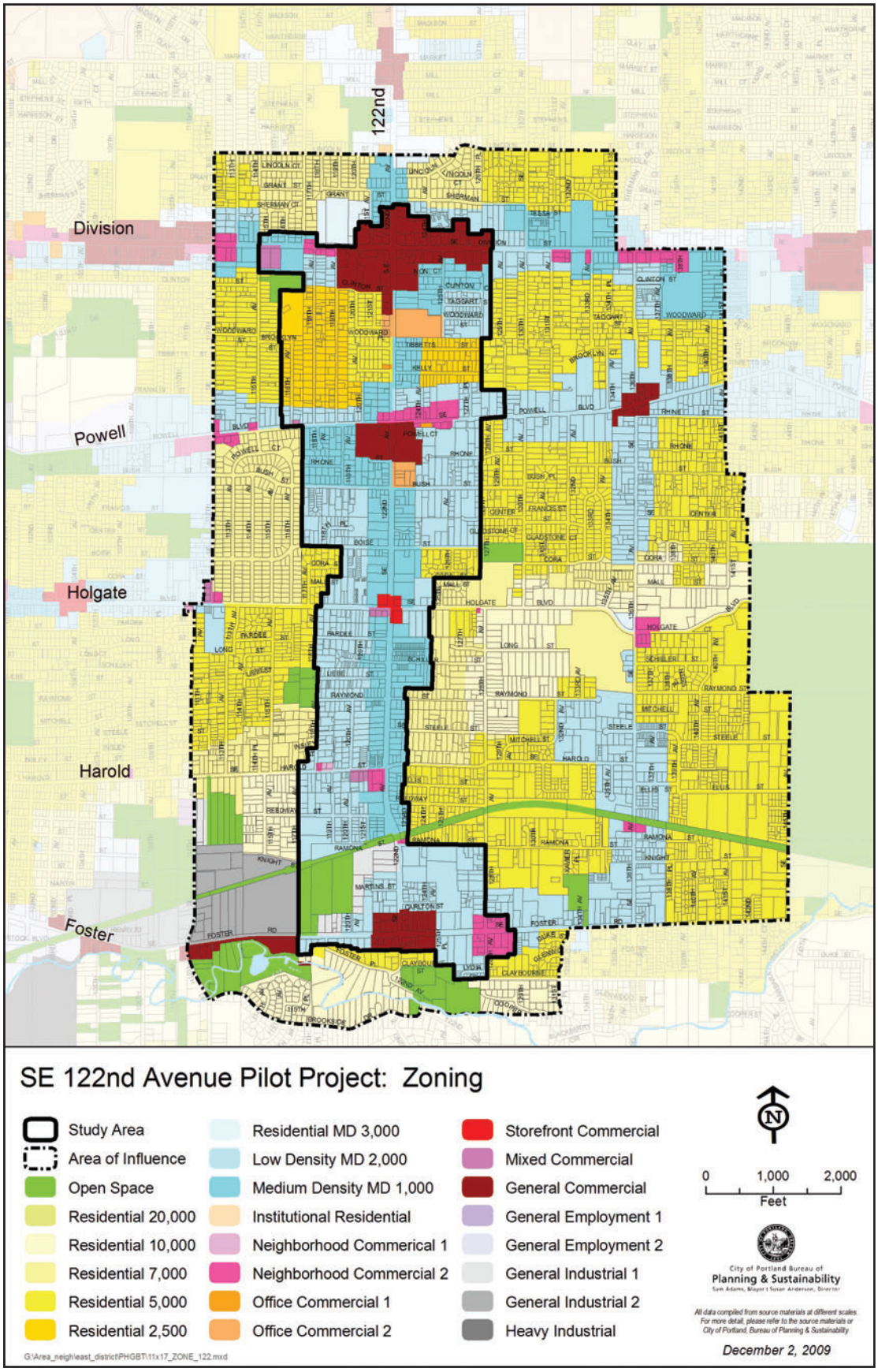
*City of Portland Auditor's Office

Retail Mix

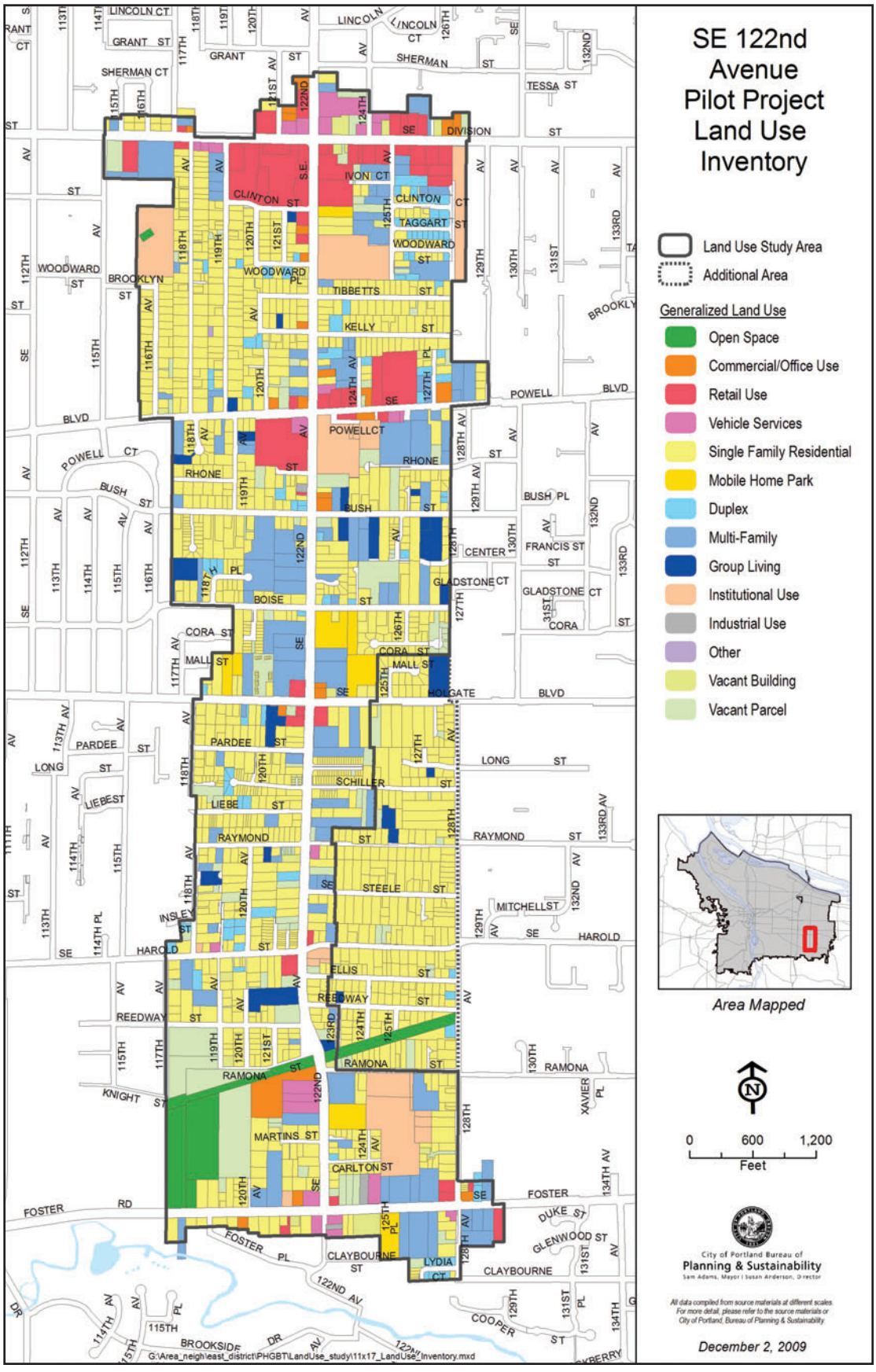
Map 5 displays the combined study area's current zoning designations and Map 6 shows the area's current actual land uses. As these maps demonstrate, commercial activity in the area is primarily located at the intersections of SE 122nd Avenue at Division Street and Powell Boulevard in the northern portion of the combined study area. There are full service grocery stores at each of these intersections, along with a few restaurants, small-scale retail trade, and a smattering of finance, health care, automotive, beauty, and professional services.

To get a sense of whether the combined study area's businesses are sufficient to meet the needs of the area's residents, BPS performed a retail gap analysis, a technique for quantifying the extent to which the corridor is capturing the spending potential of households residing of the corridor's trade area. This study found that, with the exception of the grocery stores, the area is significantly underserved, indicating that many people have to leave the area to meet their needs. In addition, despite the fact that the grocery stores have the capacity to meet the needs of the area residents, many people who participated in the planning process indicated that the grocery stores are expensive relative to other options farther away, are inconvenient to access from the southern portion of the combined study area and don't offer goods that meet all of their preferences. As a result of the retail conditions in the combined study area, many people are unable to walk or bike to meet many of their daily needs and are forced to drive out of the area to shop.

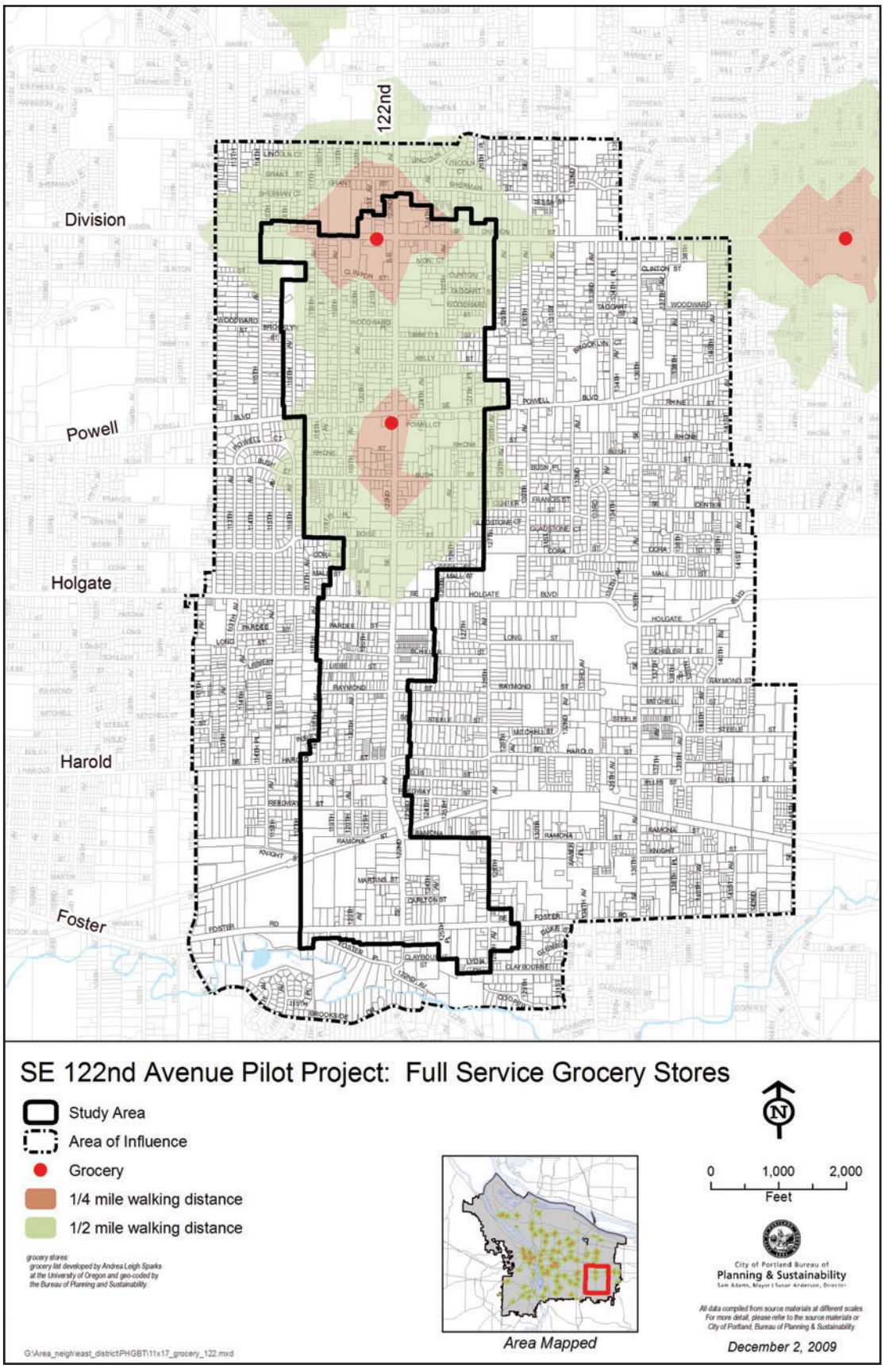
Map 5. Combined Study Area Zoning



Map 6. Combined Study Area Existing Land Uses



Map 7: Combined Study Area Full Service Grocery Stores



Pedestrian Network Connectivity

The combined study area's street network is displayed in Map 8 and is characterized by a few large arterials and collector streets interspersed with an inconsistent, incomplete, and often disconnected set of local streets, many of which are partially or completely unimproved (See Map 9). As a result, there are relatively few direct routes available for people wishing to walk to other parts of their neighborhood, and many of the routes that do exist lack sidewalks or even a paved street surface. While the lack of paved surfaces may not pose a barrier for more able-bodied residents, it is an issue for mobility-restricted people. In addition, this lack of a porous local street grid forces more automobile traffic onto the arterial and collector streets. This increases congestion and discourages walking and biking on these streets.

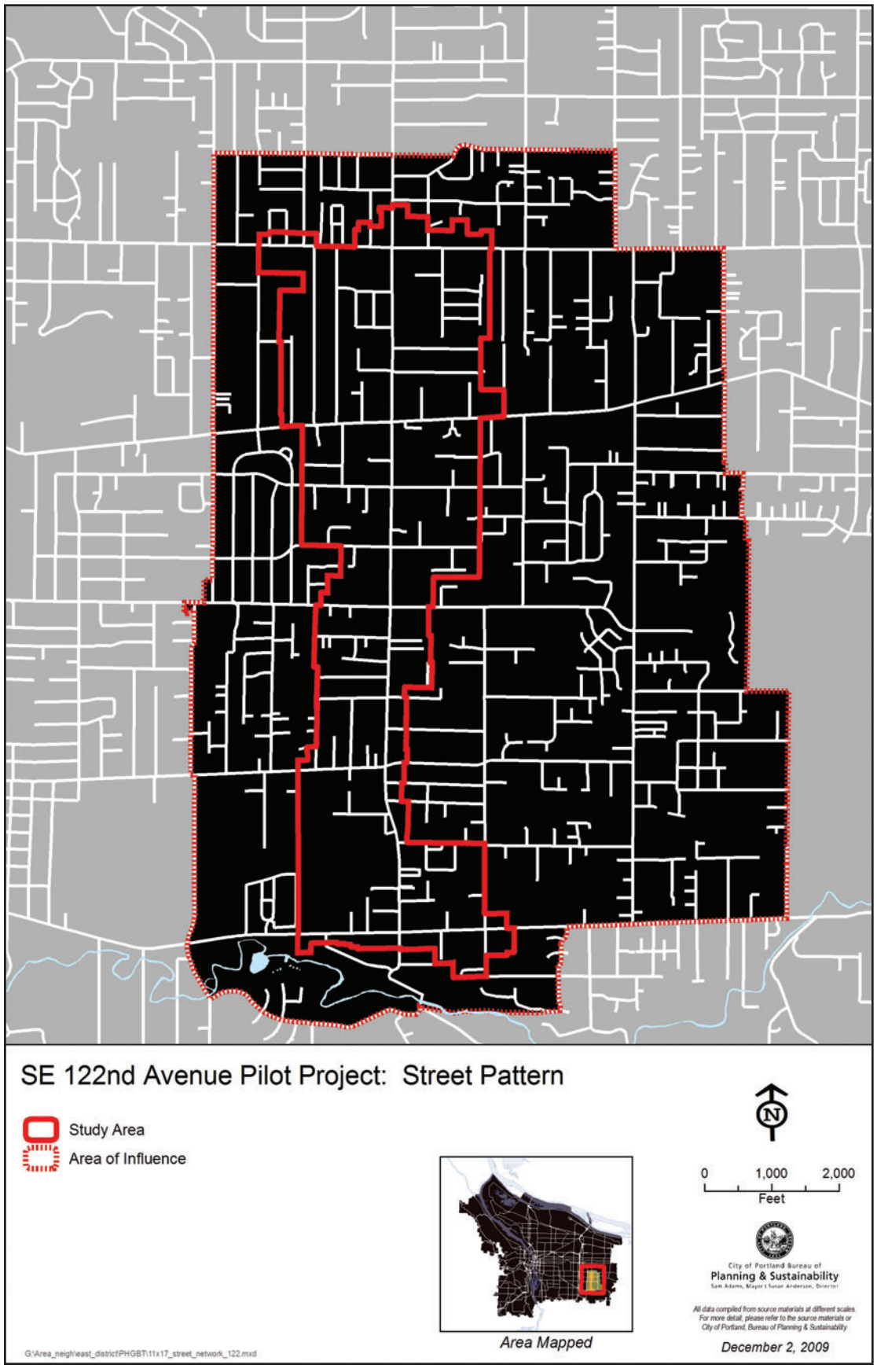
Pedestrian Realm

Many features of the combined study area's pedestrian realm were identified by CWG members, residents, and area users as posing barriers or disincentives to walking in the area, ranging from basic infrastructure issues to safety concerns and aesthetic issues.

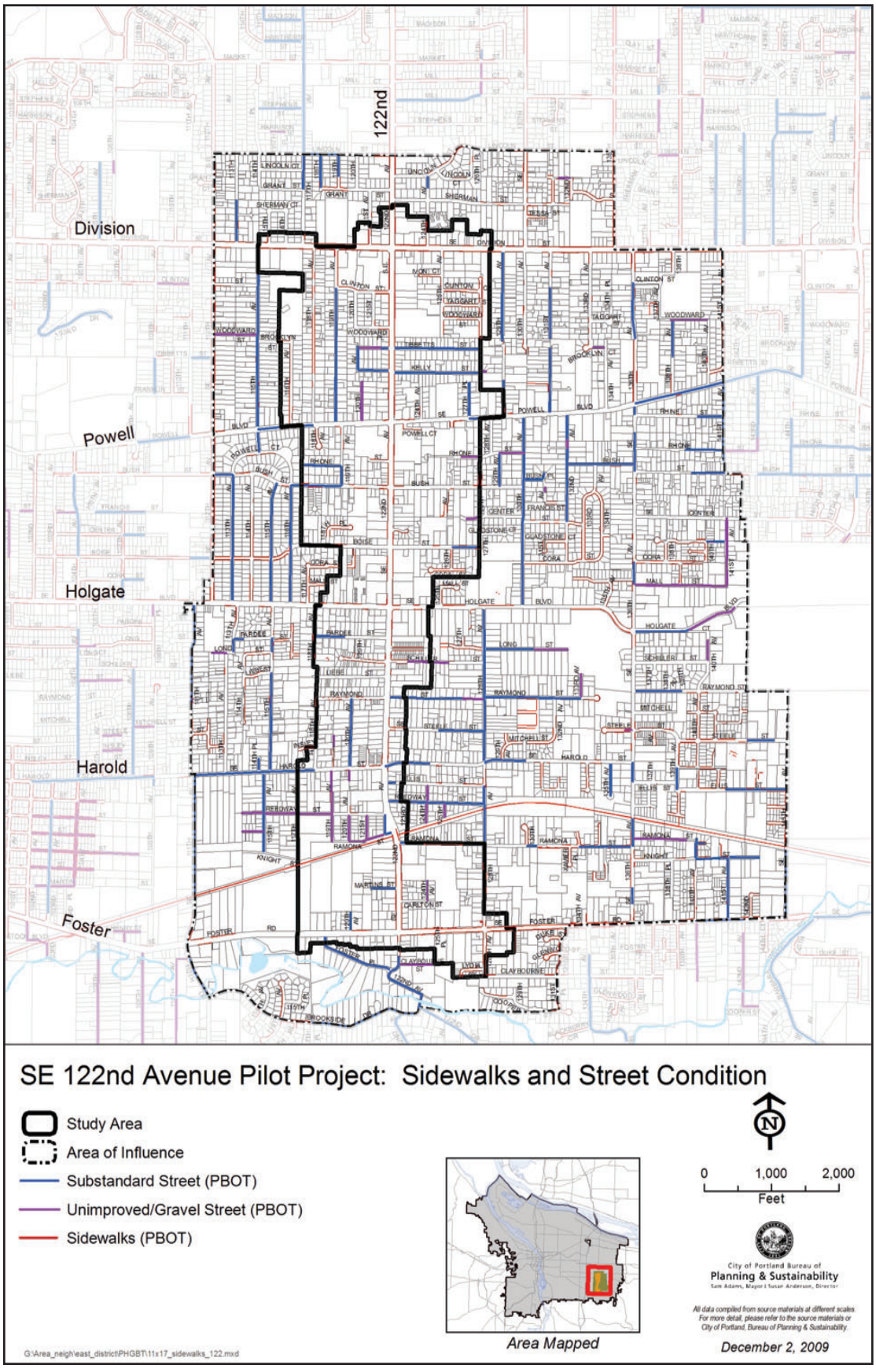
As Maps 10 and 11 demonstrate, the combined study area has a high proportion of both substandard and unimproved/gravel streets, and very few sidewalks. Most of those sidewalks that do exist are isolated and discontinuous, particularly in the residential areas off of the main arterials. As a result, people often have to walk in the street to get where they want to go. While some residents noted that there are some streets with very low traffic flow that does not hinder walking in the streets, they also noted that many streets, particularly near the main arterials where shops and transit are located, are unsafe to walk in. This is particularly an issue for individuals with mobility issues who cannot use the un-maintained areas next to the roads for getting around.

The combined study area's arterials also have significant gaps in their sidewalks. These arterials—Division, Powell, Foster, Holgate, and 122nd—handle high volumes of traffic and walking in them to get around sidewalk gaps is not an option.

Map 8. Combined Pilot Study Area Street Network



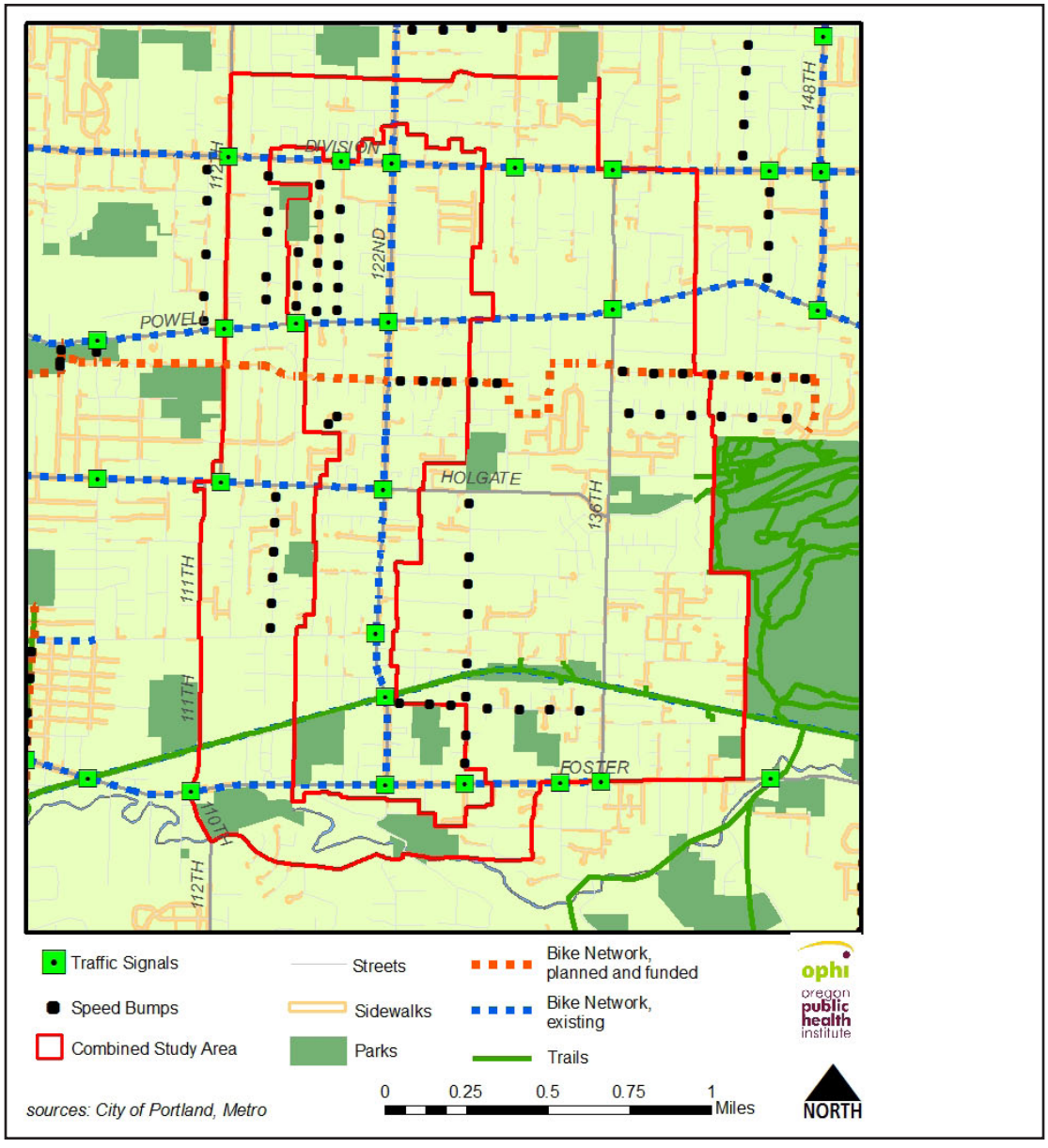
Map 9. Combined Study Area Sidewalk and Street Conditions



In addition, as Map 12 indicates, signalized crossings along SE 122nd Avenue and the other arterials are about ½ mile apart. As a result, they often act as a barrier rather than a connector for people needing to cross them, and pose a safety concern for those people who do cross them.

The feeling of vulnerability that this lack of sidewalks and signalized crossing creates is exacerbated by the presence of numerous curb-cuts and access points serving the area's primarily auto-oriented commercial sites. In addition, residents noted that drivers often greatly exceed posted speed limits, particularly on SE 122nd Avenue, where the posted speed is 35mph.

Map 10: Combined Study Area Bicycle and Pedestrian Infrastructure



Map 11. Combined Study Area Pedestrian and Bike Safety Conditions

Source: City of Portland Bureau of Transportation

As Map 11 indicates, there were three pedestrian and one bicyclist fatalities in the combined study area between 1999 and 2009, in addition to numerous injuries over the same period, particularly in the area's northern section where traffic volumes are high and the arterials' sparse signalized crosswalks tempt people to jaywalk.

In addition to the generally poor and unsafe quality of the combined study area's pedestrian infrastructure, the site and building design of the area's residential and commercial structures, particularly many of the newer multi-dwelling developments, is generally considered to be unattractive, further discouraging pedestrian activity. Market demand, irregular lot sizes, and existing development codes have led to the construction of many two-to-four story units often lacking architectural details, finishes, and quality materials that would otherwise help create an attractive pedestrian realm and sense of community pride. The massing and orientation of the newer construction creates a stark and often unappealing contrast between new construction and existing housing stock. Newer construction has also led to the removal of numerous mature fir trees, which many residents consider to be one of the neighborhood's most prized and distinctive assets. These aesthetic issues, and

the increasing vehemence with which the community has voiced their concern over them, were among the primary motivators for initially undertaking this study.

Neighborhood residents also cited fear of crime as another deterrent to walking and biking about their neighborhood, a condition that has been noted by residents for a number of years. In a 2006 survey, 83% of Powellhurst-Gilbert respondents agreed that crime was a problem in their neighborhood, and only 42% of respondents stated that they would feel safe while walking around in the evening. In the survey's comparison neighborhood, Centennial (East Portland), 68% of respondents thought crime was a problem and 63% felt safe in the evenings [45]. Similarly, in a 2004 neighborhood study focusing on the SE 122nd Avenue area in Powellhurst-Gilbert, survey respondents most often noted crimes and drugs as their biggest concerns about the neighborhood [46]. According to the 2009 City Auditor's annual Efforts and Accomplishments survey, East Portlanders felt less safe than residents in other parts of the city. Only 33% of East Portland respondents said that they felt very safe in their neighborhood compared to 58% for the city as a whole, and 8% of East Portlanders felt unsafe or very unsafe, compared with 3% for the entire city [47].

Bicycle Infrastructure

The combined study area contains a moderate amount of bicycle infrastructure with painted bike lanes on the main arterials (SE 122nd, Division, Powell, Holgate, and Foster), and an off-street multi-use path, the Johnson Creek Springwater Corridor Trail, running through the southern section of the area. However, according to resident input at community meetings and workshops, the high traffic volumes on these streets and lack of physical separation between the bike and auto lanes discourages many would-be riders from using these facilities. Parents, in particular, noted that they would be unwilling to let their children use these bike lanes. Some residents also noted that movement by bike through the neighborhood on non-arterial streets is hindered by the same connectivity and road conditions that discourage movement by foot. As a result, people wanting to bike on the Springwater Trail often end up driving to trail access points with their bikes in their cars. Residents' perceptions of the area's bicycling environment have been corroborated by a recent study conducted by the City of Portland Bureau of Transportation which rated the area's bike infrastructure as poor compared to the much of the city [45].

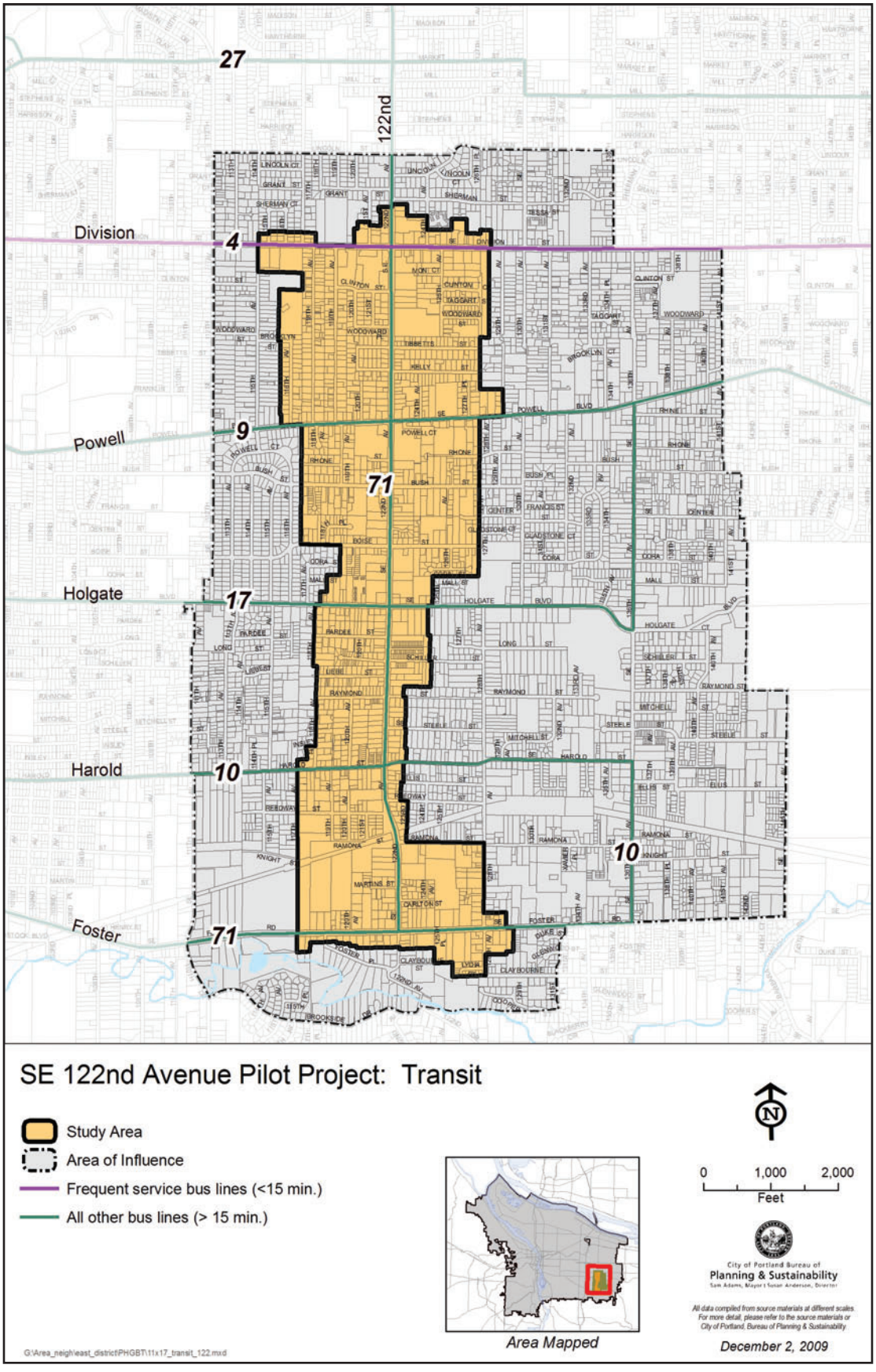
Transit Service

Transit service in the area consists of six bus lines operated by Tri-Met. Of the six routes (see Map 12), only Line 4 provides frequent (less than 15 minutes between buses) service at most times, although all of the east-west lines provide good, frequent access to the area during peak weekday service hours, and serve as conduits to the regional light rail system whose north-south Green Line is about 1.5 miles to the west of SE 122nd Avenue. The condition of the bus stops in the combined study area for all of the lines is generally quite poor. Many stops lack paved waiting areas, shelters, benches, adequate lighting, and route/schedule information. Access to the stops is also hindered by the lack of sidewalks and poor street connectivity noted above.

To find out more about barriers to transit use among the area's low-income residents and communities of color, OPHI partnered with a local organization, OPAL Environmental Justice Oregon, to conduct outreach activities at two area income-restricted multi-family developments with large immigrant and minority populations. Through meetings and interviews, residents identified a number of concerns that discouraged them from using transit, including:

- The high and rising cost of fares;
- Bus drivers frequently failing to stop at transit stops to pick up passengers;
- Racial discrimination and animosity by driver;
- Lack of schedule and route information;
- Transfer problems;
- Late and infrequent buses;
- Harassment/racial profiling by transit police; and
- Inadequate capacity for wheelchair and scooter users.

Map 12. Combined Study Area Transit Routes

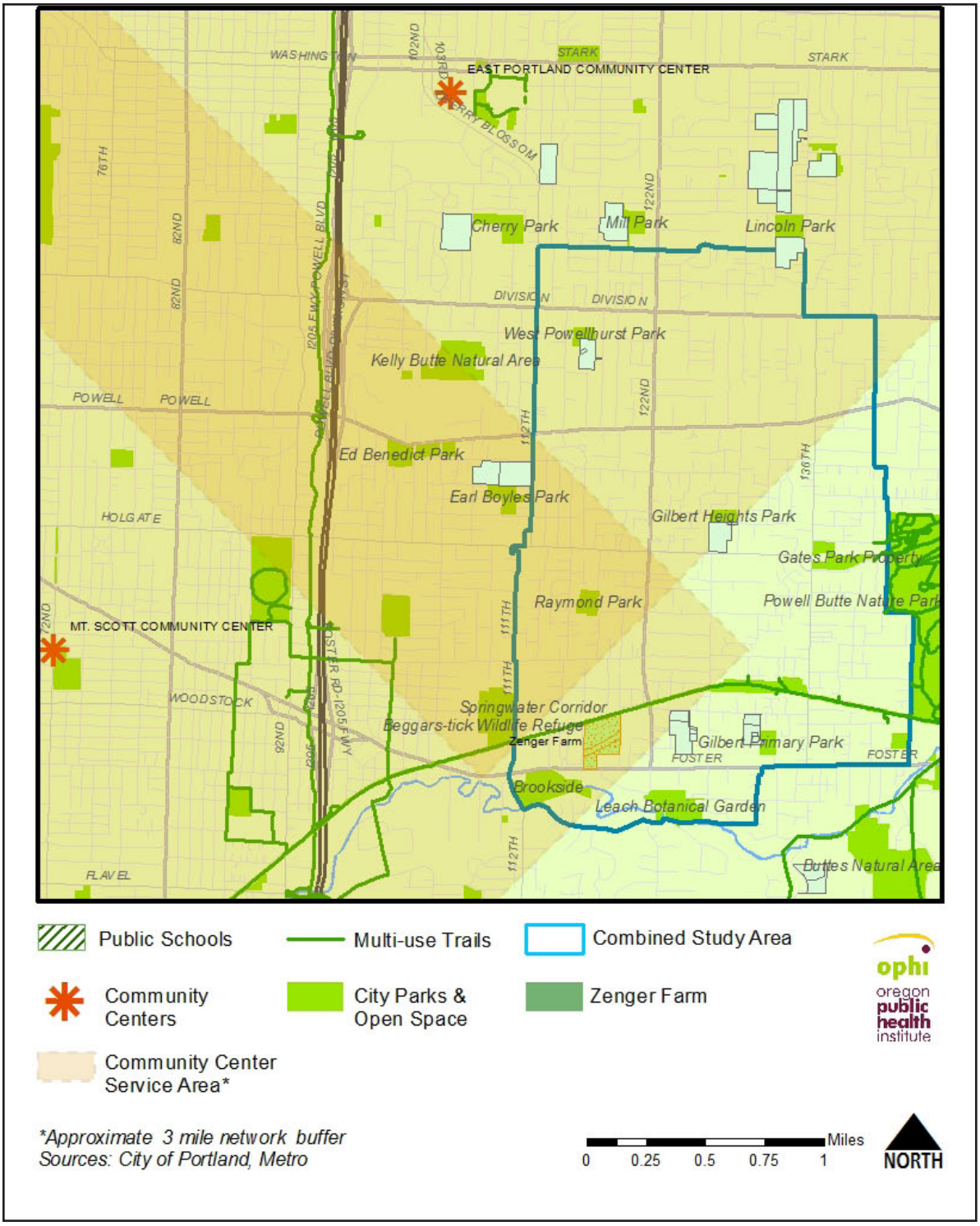


Parks and Open Space

The combined study area's parks and open spaces are displayed in Map 13. There are four improved parks within the area, and five additional improved parks within ¼ mile of the study area. In addition, the Springwater Trail Corridor runs through the southern section of the combined study area and connects to a variety of other nearby recreational areas and trails, including Beggars Tick Wildlife Refuge on the western boundary of the combined study area, and Powell Butte Nature Park to the east. The area's public schools also offer additional play space for neighborhood residents. While many of these places offer a variety of outdoor amenities including playgrounds, picnic tables, sports fields, basketball courts, and trails, they lack indoor facilities such as community centers, reservable party/gathering rooms, and indoor or outdoor swimming pools. The two regional community centers that offer these facilities are about 1.5-3.5 miles away, depending on where in the combined study area one lives. The City's service goal is to place such community centers within 3 miles of all residents, so the southeast portion of the combined study area is underserved in this respect.

According to residents, the problem with the parks and open space in the combined study area is not its quantity, but its quality and, more importantly, its accessibility. All of the parks were inherited from the Multnomah County park system upon annexation in the mid-1990s and have yet to all be improved to Portland Parks and Recreation standards. Even when a park is improved such as Raymond Park, its use is greatly hindered by the area's large, irregular lot configurations and lack of local streets. These conditions limit the parks' street frontage, visibility, and possible access points. Many parks have edges that butt up against the backyard fences of residential developments, making access difficult even for nearby residents. Such configurations also limit visibility for many park areas thus creating safety and security issues which many residents noted discourages use of these places.

Map 13. Combined Study Area Parks and Open Space



Combined Influences on Physical Activity

As noted above, current research indicates that when multiple physical activity-supportive features of the built environment are present in a given area, higher rates of physical activity and lower levels of obesity result. While no single study focuses on the combination of all of the six variables being assessed here, there are some published studies that can provide an indication of the amount of increased physical activity and decreased obesity that might result from the implementation of the study's recommendations:

- Sallis, et al., found that residents in high-walkability neighborhoods (as measured by a composite score based on residential density, land use mix, street connectivity, and commercial building setbacks) walked an average of 34-47 minutes per week (depending on income) more than residents of low-walkability neighborhoods, and met the CDC's recommended 30 minutes per day physical activity guideline at least one more day per week. These differences in physical activity levels due to different walking rates translated into a 35% higher chance of not being over-weight or obese for residents of high-walkability neighborhoods [9].
- Dill and Carr found that each additional mile of bikeway per square mile was associated with an additional 1% bicycle mode share [49]. Completion of the City of Portland's 2030 Bike Master Plan would add 7.3 miles of bikeways to the combined study area which, at 3.46 square miles, would triple the area's current regular bike commuter rate from 1.0% to 3.1%. Dill also found that 60% of regular utilitarian (non-recreational) cyclists met or exceeded the CDC's recommended 150 minutes of moderate-to-vigorous physical activity per week. However, since many bikeways in the 2030 plan include bike boulevards which have proven to be more effective than the bike lanes examined in Dill and Carr's study, it is likely that the actual increase in bike commuters would be much greater, especially if the impacts of programs such as PBOT's Smart Trips, Safe Routes to School, and other encouragement programs are taken into account. Neighborhoods in the NE and SE parts of the city that have received more investment in encouragement and infrastructure over the past decade and have a more established bike culture have posted bike commuter rates of 8-14% [50] and it is reasonable to expect that the SE 122nd Avenue combined study area could reach similar levels.
- Giles-Corti, et al., found that residents with good access to high quality public open space were 50% more likely to record high levels of walking, and that residents with poor access were 68% more likely to be obese [51-52].
- Taken together, these studies indicate that improving the SE 122nd Avenue

combined study area's walking, biking, and recreational supports, as the study's recommendations intend to do, would likely yield lower rates of overweight and obesity in the combined study area.

However, while it is important to note that the biggest increases in physical activity come with improvements on multiple fronts, it should also be noted that Tables 2A-D suggests that direct improvements in network connectivity and the pedestrian realm have larger impacts relative to the other variables because of the indirect impacts that they often confer on the other four variables; when pedestrian network connectivity and the pedestrian realm are directly and positively impacted, all the other health determinants are also positively impacted.

The relative influence of pedestrian network connectivity, in particular, is also indicated by existing research. In Ewing and Cervero's recent meta-analysis of studies of the built environment and walkability, improvements in network connectivity was identified as the strongest single intervention for increasing walking rates.

Exposure to Outdoor Air Pollutants

Summary of Impacts

The Pilot Study recommendations have the potential to alter people's exposure to outdoor air pollutants in positive and negative ways, primarily by changing travel behaviors. On the positive side, it is likely that the Pilot Study recommendations will help produce a reduction in the per capita emissions of these pollutants being generated by residents in the combined study area. As discussed in greater detail in the physical activity section, the Pilot Study recommendations would likely increase walking, biking, and transit mode shares, and thus lead to a reduction in car use by area residents. However, increased commercial and residential development along SE 122nd Ave could also attract more cars to the combined study area, adding to pollutant concentration levels. In addition, it is also possible that the recommendations could increase residents' exposure to outdoor air pollutants as a result of spending more time walking, biking, and exercising outdoors, particularly when these activities occur on or near the combined study area's main arterials where much of the area's outdoor air pollutants are concentrated. Given the contradictory nature of the Pilot Study recommendations' impacts on exposure to outdoor air quality, is difficult to say whether the Study's recommendations would result in an overall increase or decrease in exposure to outdoor air toxics.

Current research indicates that vulnerable groups would feel the same set of the recommendations' positive and negative impacts, but would feel them more acutely than the rest of the population. Groups who are most likely to be adversely impacted by exposure to outdoor air toxics include youth, seniors, and people with pre-existing conditions. Since low-income or minority individuals are more likely to contract cardiac and respiratory illnesses than the rest of the population, they would also likely have heightened sensitivity to changes in outdoor air quality. However, since it is not clear whether the combined effect of the Pilot Study's recommendations on exposure to air toxics is positive, negative, or neutral, it is likewise difficult to say whether the Study's recommendations would result in adverse effects on vulnerable populations.

Summary of Plan Impacts and Additional Recommendations

Potential Positive Impacts:

- If implemented, many of the Pilot Study's recommendations from all four topic areas would likely cumulatively lead to lower per capita vehicle-miles-traveled (VMT) and related per capita pollutant emissions from automobiles as a result of increased walking and biking rates in the area.
- If lower per capita VMT results in improved outdoor air quality, all neighborhood residents, particularly vulnerable populations, would likely experience decreased exposure to outdoor air toxics, and a decreased likelihood of suffering from multiple cardio- respiratory illnesses, including asthma and heart disease.

Potential Negative Impacts:

- Increased commercial activity in the combined study area might increase the number of people accessing the area by car and produce higher overall VMT in the area.
- Increased walking, biking, and outdoor recreation rates would likely increase people's exposure to outdoor air pollutants, particularly when these activities take place on or near the area's main arterials.
- If increased commercial activity and outdoor physical activity results in higher total VMT in the area and thus increased exposure to outdoor air pollutants, the health of all neighborhood residents, particularly vulnerable populations, might be adversely impacted.

Additional Recommendations:

- Prioritize those Pilot Study recommendations that would lead to improvements in bicycle and pedestrian infrastructure and bicycle and pedestrian network connectivity. Such improvements would facilitate movement through the neighborhood while also minimizing exposure to air toxics by reducing the need to walk and bike along main arterials which generate localized air pollution and safety issues. The Pilot Study recommendations that would best accomplish this include recommendations 1A-1M which address improved bicycle and pedestrian infrastructure and connectivity; 1L-1N which address improved street conditions; and 1P which addresses improvements in pedestrian infrastructure around transit stops.
- Work with DEQ to develop a monitoring program to assess changes in levels of exposure to outdoor air toxics as the neighborhood develops in order to determine the overall positive or negative impacts of the recommendations on exposure to outdoor air quality.

Outdoor Air Pollutants and Health

There are three main variables that help determine the impact of air pollutants on health: the type(s) of pollutant present in the air, the concentration levels of the particular pollutants, and the amount of time people are exposed to particular pollutants. Accordingly, research on air pollutants and health has focused on developing health-based benchmark concentration levels for known hazardous air pollutants based the particular health outcomes of exposure to specific toxics, and on how long people need to be exposed to differing concentrations of particular toxics in order for different adverse health effects to appear. As a result, one pollutant can have numerous concentration benchmarks, depending on how long people are exposed to it.

In addition, since the type and concentration of different pollutants can vary greatly according to different settings, they are monitored and regulated by different public agencies in different ways, and often using different sets of benchmarks. The US Occupational Safety and Health Administration (OSHA) is responsible for monitoring and regulating short and long term air quality in occupational settings, and the US Environmental Protection Agency (EPA) and state departments of environmental quality are responsible for short and long term outdoor air quality. Residential indoor air quality has no single regulatory or monitoring agency and generally lacks the types of specific guidelines and regulations that have been developed for outdoor and occupational air quality. Since the changes in air quality and exposure to air pollutants that will result from the changes proposed by the Pilot Project are primarily related to long-term exposure to outdoor air pollutants, this overview of air pollution and health and the subsequent sections focusing on the relationships between the built environment and air pollution and on the impacts of the Pilot Project recommendations will focus on long-term exposure to outdoor air pollutants and health, and how exposure to outdoor air pollutants is impacted by the built environment.

There are many different types of outdoor air pollutants that are either known or strongly suspected to negatively impact human health. The US Environmental Protection Agency (EPA) currently regulates six "criteria" outdoor air pollutants by requiring cities or regions to keep emissions of these pollutants below certain health-based benchmark levels. The criteria pollutants include ozone, particulate matter, carbon monoxide, sulfur dioxide, nitrogen oxides, and lead. In addition to the EPAs regulated criteria pollutants, the Oregon Department of Environmental Quality (DEQ) also monitors 19 other outdoor air toxics with known or suspected negative health outcomes, and has established health-based benchmarks for each pollutant.

Table A.1 in Appendix A lists the six criteria pollutants monitored by EPA and the 19 additional air toxics monitored and modeled by DEQ, along with the known health outcomes resulting from long-term exposure.

In general, the adverse health effects of long-term exposure can include:

- Accelerated aging of the lungs and loss of lung capacity;
- Decreased lung function;
- Development of diseases such as asthma, bronchitis, emphysema, and possibly cancer; and
- Shortened life span.

People most susceptible to severe health problems from air pollution are:

- Individuals with pre-existing cardiac or respiratory problems such as heart disease, asthma, or emphysema;
- Pregnant women;
- Outdoor workers;
- Children under age 14 (their lungs are still developing);
- Older adults; and
- Athletes who exercise vigorously.

The Built Environment and Exposure to Outdoor Air Pollutants

Changes in land use and transportation systems can impact exposure to outdoor air pollutants in two related ways. First, development and growth can produce changes in pollution types and concentration levels resulting from changes in the type, location, and/or intensity of use of sources of pollution such as manufacturing sites, roads, and vehicles. The construction of a new street, for example, would lead to increased automobile use and thus bring more auto-related pollutants to an area [10, 53-54]. Similarly, if people reduce automobile use in favor of walking or biking, concentrations of auto-related pollutants would decrease. Second, development and growth can bring people closer to pre-existing sources of air pollution such as busy roadways by placing residences and destinations close to such pollution sources, and by changing behavior patterns that impact the amount of time people spend outside and the amount of air that they breathe. If people substitute walking and biking for automobile use, then they would be more likely to spend more time outside and take in more outdoor air pollutants [55-59].

Exposure to Outdoor Air Pollution in the Combined Study Area

While there is no existing data regarding the total amount of time people in the combined study area spend outside, information from the City of Portland's annual Resident Survey (Table 5) indicates that residents of the combined study area spend less time engaged in common outdoor activities such as walking, biking, and visiting parks than other Portlanders, and thus spend less time breathing outdoor air than other city residents.

Table 5: Selected 2009 Resident Survey Results, Commuting and Local Travel*

	East Portland (inc. combined study area)	Rest of Portland
Primary or secondary work commute mode: walk	4%	11%
Primary or secondary work commute mode: bike	8%	19%
Primary or secondary work commute mode: drive alone	87%	72%
Did not visit a city park near your home in the past year	26%	10%

*City of Portland Auditor's Office

Regarding the types and amounts of air pollutants present in the combined study area, the ambient concentrations of different outdoor air pollutants are measured in different ways and at different geographies. For the six federally regulated criteria pollutants, the EPA requires DEQ to conduct continuous monitoring and reporting of 24 hour average citywide ambient concentrations of each pollutant. In Portland, there are 7 monitoring stations whose readings are combined to produce the average citywide concentration levels. The EPA then takes this information and calculates the Air Quality Index (AQI), a composite score ranging from 0 (good) — 300 (bad) which is designed to help Portlanders estimate the impact of air quality on health for any given day of the year (see Table 6). Figure 2 displays the daily AQI scores for Portland for 2009. The inset table in Figure 2 also displays information specific for PM2.5 and ozone concentrations since these two pollutants have been identified as the primary contributors to the city's AQI scores. As this figure indicates, there were 54 days on which the AQI fell in the moderate range, indicating that particularly sensitive individuals with severe cardiac or respiratory problems should remain indoors. In

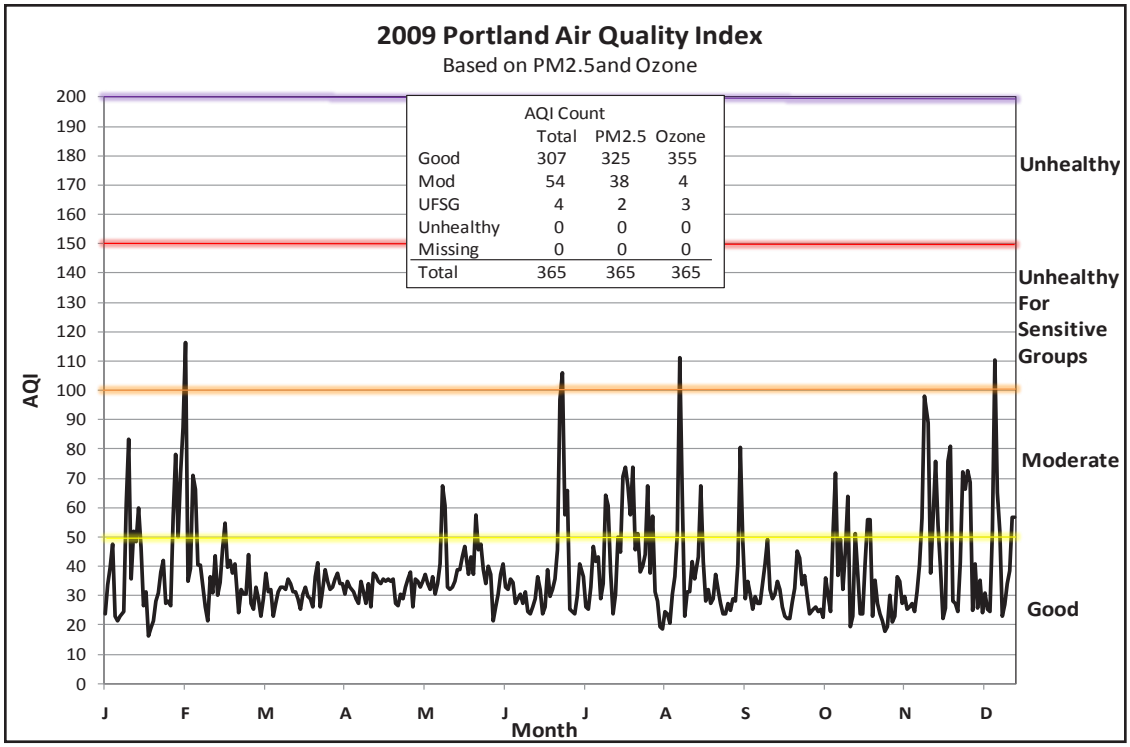
addition, there were four days last year that Portland's air quality was compromised to the point of being unhealthy for vulnerable populations, including young and old people, and anyone with cardiac or respiratory conditions.

Table 6. Air Quality Index Health Category Descriptors.

Air Quality	AQI	Health Advisory
Good	0-50	No health impacts expected.
Moderate	51-100	Unusually sensitive people should consider reducing prolonged or heavy outdoor exertion.
Unhealthy for Sensitive Groups	101-150	People with heart disease, respiratory disease (such as asthma), older adults, and children should reduce prolonged or heavy exertion. Active healthy adults should also limit prolonged outdoor exertion.
Unhealthy	151-200	People with heart disease, respiratory disease (such as asthma), older adults, and children should avoid prolonged or heavy outdoor exertion. Everyone else should reduce prolonged or heavy outdoor exertion.
Very Unhealthy (Alert)	201-300	People with heart disease, respiratory disease (such as asthma), older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.

It is also possible that the combined study area might contain "hot-spots", locations where ambient concentrations might be higher than the city's average levels. Such hot-spots can be created by a variety of activities such as industrial processes, construction, and driving. Based on DEQs modeling of other air toxics (discussed below), the most significant localized pollution sources in the combined study area are the main arterials whose heavy traffic flow produces elevated concentrations of five of the six criteria pollutants (minus lead) on and near these roadways. Two of the area's main arterials, SE Division and SE Powell, have traffic counts of 30,000-39,999 vehicles per day. Three others, SE Holgate, SE Foster, and SE 122nd, have daily counts of 20,000-29,999 vehicles (See Map 11, above).

Figure 2. Daily AQI scores for Portland, 2009



According to a report produced by the San Francisco Department of Public Health, roads with 10,000 vehicles per day produce elevated air pollutant-related health risks for people living within 50 meters of the roadway, and roads with 50,000 vehicles per day produce elevated risks for people living within 100 meters [55]. From this, one would expect that people in the combined study area living or working near these roads would be exposed to pollutant concentration levels that are higher than the citywide averages expressed in EPAs AQI.

DEQ's measurement of the 19 other air toxics is based on a modeling approach which combines information on the type and estimated amounts of pollutants generated by known pollution sources, with a geography and climate-based dispersion model that estimates where these pollutants go after emission. The output of this modeling is estimated annual ambient concentrations of each of the 19 toxics for each census block group in Portland. To help assess the health impacts of these modeled concentrations, DEQ has developed health-based benchmarks to which the modeled concentrations can be compared. The benchmarks are meant to indicate the level at which a lifetime of constant exposure is anticipated to produce elevated health risks. For carcinogens, an elevated health risk is defined as the level at which one additional person per million will likely contract cancer. For non-carcinogens, an elevated health risk is defined as an appreciable risk of deleterious effects during a lifetime for any part of the population, including sensitive groups. It is important to keep in mind,

however, that air epidemiologists have yet to establish clear "no effects" thresholds for any air toxics, and it is possible that some individuals will experience negative health outcomes even at concentrations lower than the established benchmarks.

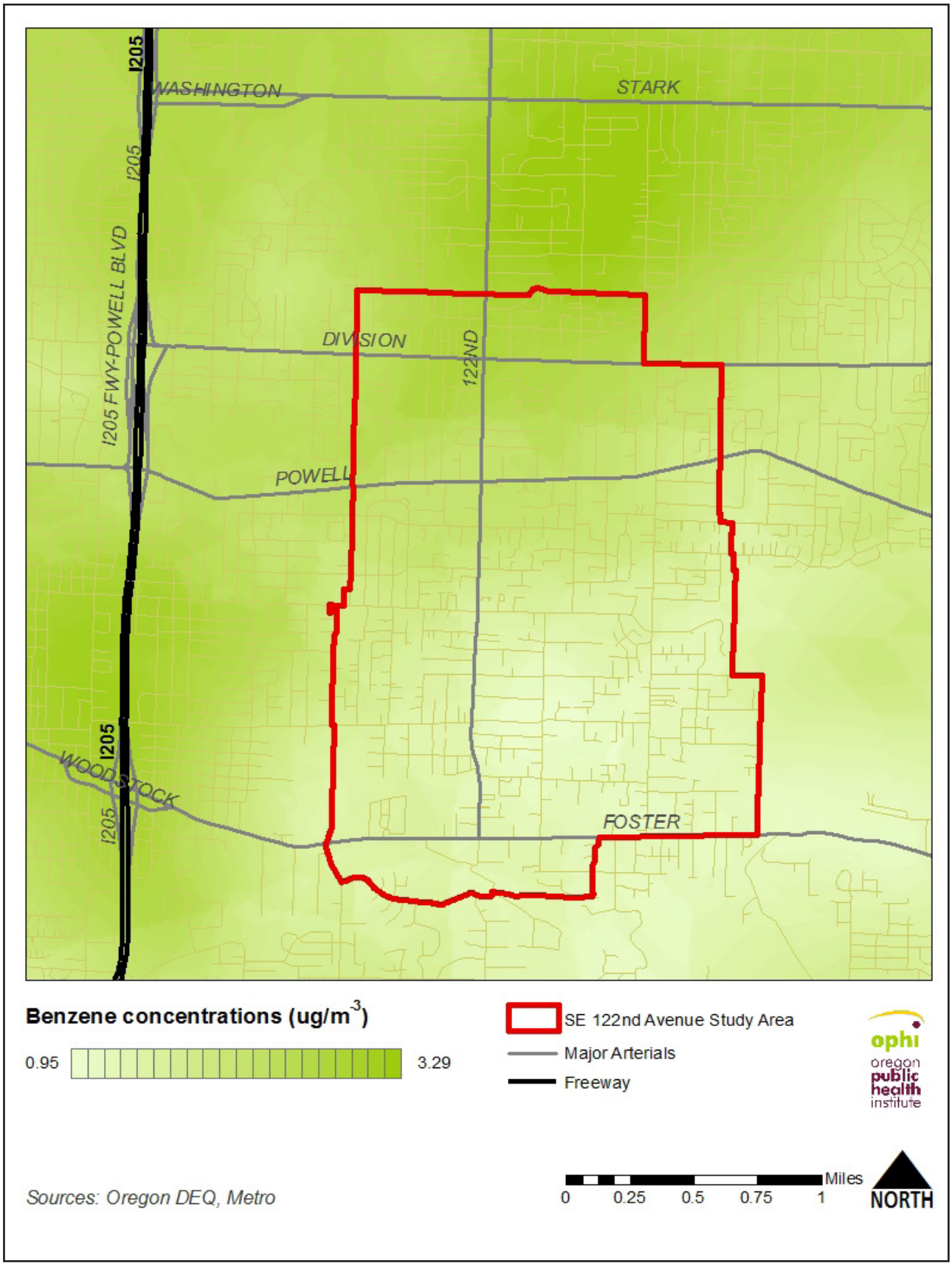
Table 7 displays the average annual ambient benchmark concentrations in the combined study area for those air toxics which exceed the DEQ benchmarks, as well as the extent to which they exceed the benchmarks, and their primary source. The average ambient concentrations are the average of the concentrations modeled for each of the combined study area's block groups, which means that some areas within the combined study area have higher levels of ambient concentrations than those listed here, while some areas have lower levels, depending on the pollutant. As Table 7 indicates, on-road vehicles are one of the primary sources of seven of the nine toxics.

Table 7. Combined Study Area Modeled Average Annual Ambient Concentrations for Toxics Exceeding DEQ Benchmarks, and Percent Attributable to On-Road Sources

	Study Area Modeled Average Ambient Concentrations (µg/m3)*	DEQ Ambient Benchmark	Benchmark Exceedence	Primary Sources
Acetaldehyde	0.48	0.45	6.7%	On-road vehicles
Acrolein	0.17	0.02	730.7%	Residential wood-burning; on-road vehicles
1,3 Butadine	0.15	0.03	396.7%	On-road vehicles
Benzene	1.64	0.13	1,164.7%	On-road vehicles
Diesel Particulate Matter (DPM)	1.55	0.1	1,451.7%	On- and off-road vehicles
Ethylbenzene	0.56	0.4	40.6%	On-road vehicles
Methyl chloride	4.34	2.1	106.9%	Solvent use
Arsenic	0	0.0002	21.9%	On-road vehicles
PAH 15	0.17	0.0009	18,328.4%	Residential wood-burning

* µg/m3= micrograms per cubic meter

Map 14. Modeled Distribution of Benzene Concentrations In and Around The Combined Study Area



Map 14 displays the modeled benzene concentrations in the area and presents a distribution pattern similar to the other toxics whose primary sources include on-road vehicles. Not surprisingly, the levels of these seven pollutants are generally higher where traffic is heaviest: close to I-205, and in the northern portion of the combined study area where SE Powell, SE Division, and SE 122nd and the increased residential and commercial density they serve create more traffic congestion.

Bicycle and Pedestrian Traffic Safety

Summary of Impacts

The Pilot Study's recommendations are likely to improve bicycle and pedestrian safety in both direct and indirect ways. Many of the recommendations, particularly those in the "Accessibility, Connections, Pedestrian Comfort and Safety" section, would directly improve safety by producing or encouraging the design and construction of bike and pedestrian infrastructure improvements on both arterial and local streets. In addition, most of the recommendations would indirectly improve bicycle and pedestrian safety by encouraging more bicycle and pedestrian activity.

Current research indicates that vulnerable groups would similarly benefit from improved bicycle and pedestrian safety. Indeed, to the extent that vulnerable groups, particularly youth, seniors, and people with low-incomes are less likely to own cars and more likely to rely on walking and biking for transportation, they would disproportionately benefit from the changes resulting from the Pilot Study's recommendations.

Summary of Plan Impacts and Additional Recommendations

Potential Positive Impacts:

- The Pilot Study's set of recommendations will likely increase walking, biking, and active recreation levels in the area.
- The Pilot Study's recommendations will likely lead to lower crash rates for both bicyclists and pedestrians.
    - Many of the "Accessibility, Connections, Pedestrian Comfort and Safety" recommendations would directly improve bike and pedestrian safety by providing mode-specific infrastructure designed to minimize the potential for bicyclists and pedestrians to be struck by cars.
    - Many of the recommendations in the plan's other three sections would indirectly improve bike and pedestrian safety by encouraging higher walking and biking rates in the area, which typically lead to lower crash rates for these modes.
- The improvements resulting from recommendations 1A-1Q will likely benefit all neighborhood residents.

Potential Negative Impacts:

None

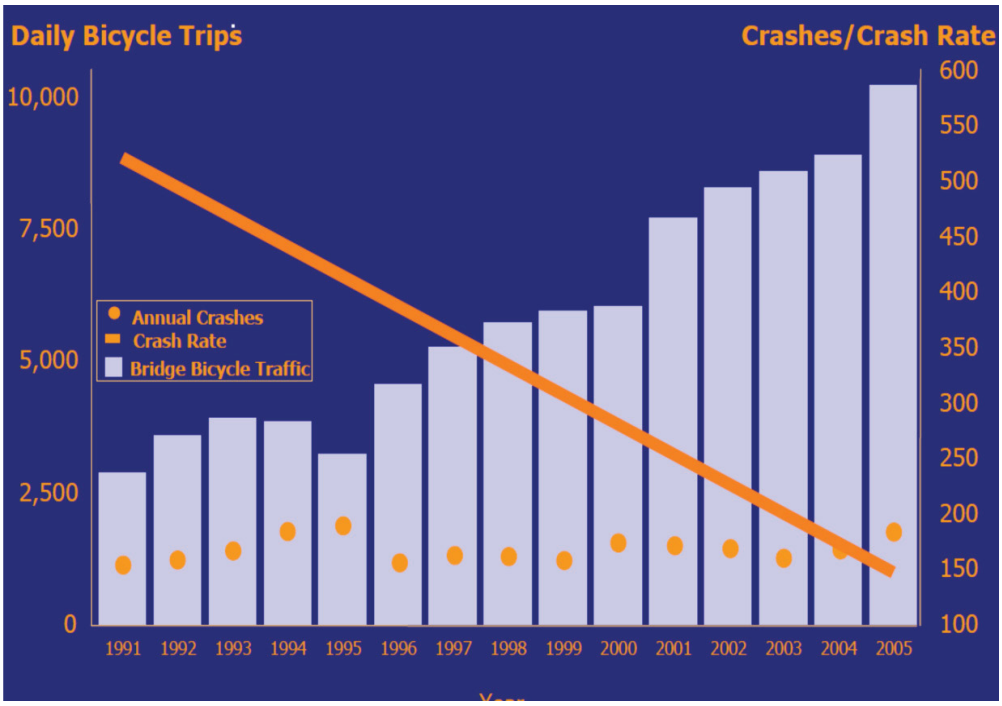
Additional Recommendations:

- Prioritize improvements in bicycle and pedestrian infrastructure and pedestrian network connectivity, particularly near main arterials. Improved bicycle and pedestrian network condition and connectivity near arterials would facilitate movement through the neighborhood and access to retail and commercial services and transit on main arterials while minimizing time spent walking along the main arterials themselves which generally have higher crash bicycle and pedestrian crash rates than local streets. The Pilot Study recommendations that would best accomplish this include recommendations 1A-1F which address improved pedestrian routes; 1G-1H which address improved bicycle infrastructure; 1I-1K which address street connectivity; 1L-1N which address improved street conditions; and 1P which addresses improvements in pedestrian infrastructure around transit stops.
- Continue to support bicycle and pedestrian encouragement and education programs such as PBOT's Safe Routes to School and SmartTrips programs. Such encouragement programs have proven effective in increasing walking and biking rates, and can be tailored and targeted to specific groups.

Bicycle and Pedestrian Traffic Safety and Health

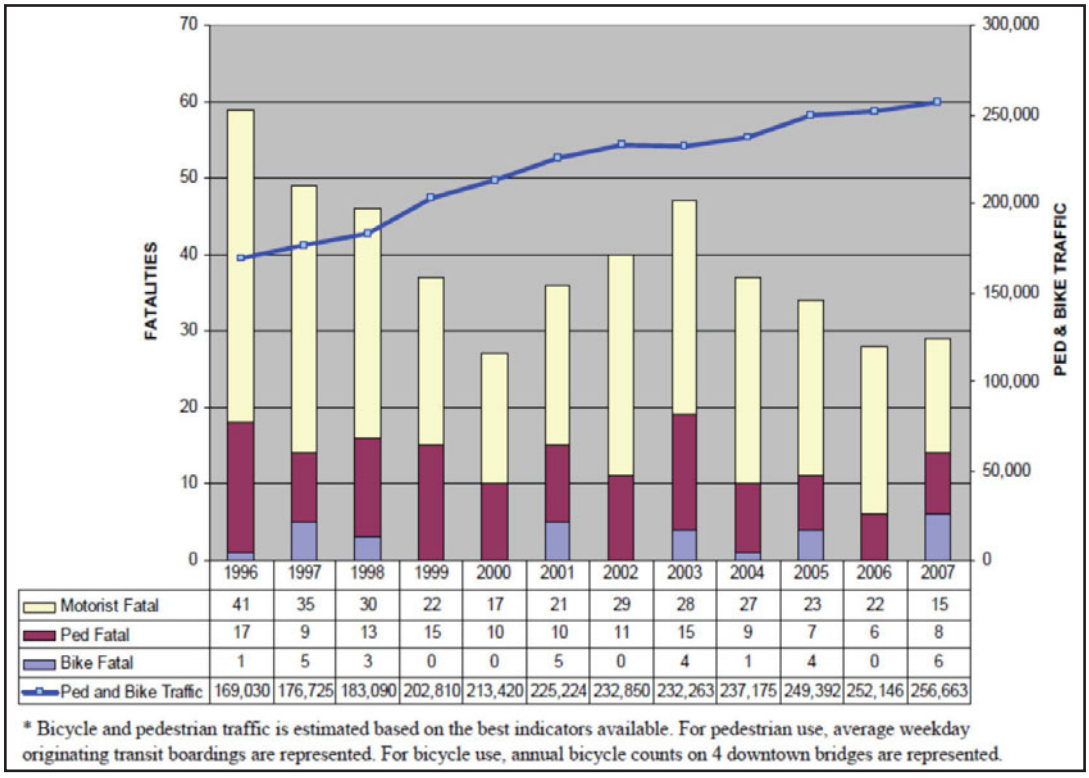
According to the CDC, motor-vehicle-related injuries are the leading cause of death for people ages 1-34, and among the top leading causes of death for every age group. In 2007, there were more than 41,000 people killed in roadways, the vast majority of whom were either in cars or struck by cars. That same year, more than 2.5 million people were injured as a result of a crash involving motor vehicles [60]. Bicycle and pedestrian safety have also been a primary public health issue for many years, and also constitute one of the leading preventable causes of deaths in injuries in the United States, particularly for people under the age of 44. In the United States in 2008, 4,378 pedestrians died as a result of being struck by a vehicle, and there were 69,000 reported pedestrian injuries that year. Also in 2008, 630 bicyclists were killed in traffic accidents, and another 51,000 were injured [61].

Figure 3. Changes in Portland's Bicycle Usage and Crash Rates, 1991-2005



Source: City of Portland Bureau of Transportation

Figure 4: Portland Traffic Fatalities Compared to Estimated Growth in Bicycle and Pedestrian Travel (1996-2007)



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Motorist Fatal	41	35	30	22	17	21	29	28	27	23	22	15
Ped Fatal	17	9	13	15	10	10	11	15	9	7	6	8
Bike Fatal	1	5	3	0	0	5	0	4	1	4	0	6
Ped and Bike Traffic	169,030	176,725	183,090	202,810	213,420	225,224	232,850	232,263	237,175	249,392	252,146	256,663

* Bicycle and pedestrian traffic is estimated based on the best indicators available. For pedestrian use, average weekday originating transit boardings are represented. For bicycle use, annual bicycle counts on 4 downtown bridges are represented.

Source: City of Portland Bureau of Transportation

Bicycle and Pedestrian Traffic Safety and the Built Environment

The primary way in which the built environment impacts bicycle and pedestrian safety from traffic crashes is through right-of-way design and construction. Right-of-way refers to land designated for public travel, and can be designed and constructed to serve particular modes and provide different levels of safety for different users. Most existing rights-of-way were designed primarily for vehicular traffic, and as a result, have proven unsafe for people traveling by other modes, including bicyclists and pedestrians. Infrastructure's impacts on bicycle and pedestrian safety become apparent when more auto-oriented settings are compared to places where rights-of-way have been designed with bicyclists and pedestrians in mind. According to an analysis of 2000 crash data from Germany, the Netherlands, and the United States, American pedestrians are three and six times more likely to die, respectively, than German and Dutch pedestrians. American cyclists are twice and three times to die, respectively, than German and Dutch cyclists. Regarding injuries as a result of being struck by a vehicle, Americans are twice and four times as likely to get injured as German and Dutch pedestrians, while American cyclists are eight and 30 times more likely to get injured as German and Dutch cyclists [62]. This study also highlights the fact that the pedestrian and bicyclist injury and death rates in Germany and the Netherlands are drastically lower than they were 25 years prior, and reflect a concerted effort to address these problems in large part through re-designing their rights-of-way to better accommodate these modes.

There are two main ways in which infrastructure intentionally designed for bicyclists and pedestrians can contribute to lower traffic crash and injury rates for bicyclists and pedestrians. First, it can reduce opportunities for collisions, either through the provision of separate facilities for different modes, or through improved coordination of shared spaces such as crosswalks. Second, it can encourage higher rates of walking and biking which have been correlated with lower crash rates for both modes. Although increased bicycle and pedestrian activity would increase people's exposure to motor vehicle accidents, numerous studies have shown that increased numbers of cyclists and pedestrians actually produce lower rates of accidents with motor vehicles as cyclists, pedestrians, and drivers grow more accustomed to regularly interacting with each other in public rights-of-way [38-39, 49, 62]. In addition, infrastructure designed to slow vehicular traffic can reduce the severity of pedestrian injuries resulting from crashes [63].

Bicycle and Pedestrian Traffic Safety in the Combined Study Area

In Portland, improving bicycle and pedestrian safety have been priorities for PBOT for many years, and crash rates for both modes have steadily been declining as a result of various engineering, education, encouragement, and enforcement efforts by the city and partner organizations. As Figures 3 and 4 indicate, the absolute numbers of cyclists and pedestrians being injured or killed by motor vehicles have remained within the same range for the past decade, while bicycle and pedestrian activity has steadily increased.

As noted in the previous physical activity section, there were three pedestrian and one bicycle deaths and numerous accidents in the combined study area between 1999 and 2008 (see Map 8). Without good data on the absolute numbers of bike and pedestrian trips being taken in the area, it is difficult to say how the combined study area's bike and pedestrian injury and death rates compare to the rest of Portland. Regardless of the actual rates, however, both the city and the residents consider the numbers higher than they should be, and recognize that many of these accidents are due in part to the relatively poor condition of the area's pedestrian and bicycle infrastructure, a recognition which is reflected in a number of the Pilot Study's recommendations.

Opportunities for Social Cohesion

Summary of Impacts

The Pilot Study's recommendations would both directly and indirectly impact opportunities for social cohesion in a positive manner, directly as a result of the creation of additional public and retail spaces that could facilitate increased contact and interaction between neighborhood residents, and indirectly as a result of improved access to these spaces. The primary public spaces created by the recommendations would be sidewalks and other pedestrian infrastructure that would not only provide people with space to interact, but would also improve access to other public and private gathering spaces such as parks and neighborhood oriented retail operations. Since the recommendations are also meant to expand neighborhood retail opportunities, they would also help create private spaces such as shops and restaurants where neighbors could come into contact with each other and interact.

It is likely that vulnerable groups would similarly benefit from increased opportunities for social cohesion. To the extent that vulnerable groups, particularly youth, seniors, and people with low-incomes are less likely to own cars and more likely to rely on walking and biking for transportation, they would disproportionately benefit from public places that improve the area's pedestrian infrastructure. However, their ability to take advantage of opportunities for social cohesion provided by new neighborhood retail operations would depend on the character of these operations and extent to which they would appeal to the area's immigrant, minority, youth, elderly, low-income, and disabled populations.

Summary of Plan Impacts and Additional Recommendations

Potential Positive Impacts:

- The Pilot Study's recommendations would improve opportunities for social cohesion in the combined study area.
- Many of the "Accessibility, Connections, Pedestrian Comfort and Safety" recommendations would create more sidewalks where people could interact, and would encourage more people to use these spaces.
- Many of the "Convenience and Availability of Services" recommendations would encourage the creation of neighborhood retail operations which could serve as gathering places.

- Most of the "Residential Infill Development and Design" recommendations would improve the pedestrian realm and thus encourage people to walk about their neighborhoods and frequent local businesses.
- Many of the "Community Amenities and Livability" recommendations would result in improvements to parks, schools, community gardens, and open spaces where people could gather, and would encourage use of these sites by improving their access and safety.
- The opportunities for social cohesion created by the Pilot Study's recommendations would be available to all area residents.

Potential Negative Impacts:

None.

Additional Recommendations:

- Support community development efforts such as the EPAP civic engagement committee that are actively working to develop a more engaged and empowered citizenry in East Portland.
- Involve the area's immigrant groups and communities of color in designing and improving public spaces such as parks and community gardens to ensure that these spaces meet their needs and preferences, as well as those of other area residents.
- Continue to support programming such as Portland Parks and Recreation programs, Sunday Parkways, and the East Portland Expo, that are intended to activate public and private gathering spaces.
- Work with BPS and the Portland Development Commission to identify and recruit retail businesses that will provide gathering spaces for neighborhood residents.

Social Cohesion and Health

Social cohesion, or social capital, refers to the degree to which people know, trust, and interact with other members of their community, and the degree to which people Social Cohesion and Health

Social cohesion, or social capital, refers to the degree to which people know, trust, and interact with other members of their community, and the degree to which people are involved in organizing or influencing their community [22]. High levels of social cohesion can contribute to positive health outcomes by enabling the dissemination of health-related information such as medical care options, establishing and maintaining social norms and practices associated with healthful behaviors, and by discouraging unhealthful behaviors such as smoking and drug use [64-66]. In addition, higher levels of social cohesion have been correlated with increased rates of physical activity, including walking and biking among both children and adults [19-20, 64, 67].

The Built Environment and Opportunities for Social Cohesion

While there are numerous variables that can influence social cohesion in a particular area, one of the necessary precursors is physical space for people to be able to come into contact with each other. Research has shown that spaces accessible by the general public such as schools, parks, community centers, and libraries can serve this function, as well as sidewalks and trails [19-22, 67-69]. Retail operations such as coffee shops, public houses, and farmers' markets can also provide such possibilities, offering the chance for people intentionally or unintentionally come face to face and interact with each other [27, 70-71]. As the amount and accessibility of such spaces improves, so do the opportunities for enhancing social cohesion.

Opportunities for Social Cohesion in the Combined Study Area

The primary public spaces that the combined study area possesses are its parks and schools (reference maps). The schools, in particular, have come to act as de facto community centers, offering space for community events, including many of the workshops and community meetings held in support of the Pilot Study. However, this use is restricted by the fees that the district charges for the use of their facilities. The area's parks are also used by some groups, although this use is hindered by the street condition and connectivity issues noted in the Physical Activity section of this report. In general, the area's retail operations are auto-oriented and designed to attract customers from a much wider area than the

surrounding neighborhood, and don't serve as community gathering places. Only one restaurant was identified by residents as serving such a function. While the area's parks and schools do serve to bring some people together, residents noted that improved and additional public and retail spaces would enhance the area's potential to develop a higher degree of social cohesion between groups.

In part as a result of the neighborhood's lack of accessible public spaces, the numerous sub-groups within the area that are somewhat cohesive appear to have little interaction with each other, in part because of cultural and linguistic differences, but also because there are limited spaces and opportunities for people from different groups to engage each other. As noted earlier in this report, the relatively large number of affordable housing units (both market-based and subsidized) and particular mix of social service agencies such as the Immigrant and Refugee Community Organization (IRCO), ROSE Community Development Corporation, and Human Solutions has made this area attractive to recent immigrants, and is reflected in the facts that 23.7% of the students in the school district are English language learners, and 67 different languages are represented in the student population. While the supply and affordability of housing units has allowed families and cultural groups to stay together (28% of newer infill occupants listed proximity to family/friends as a reason for moving to the neighborhood in the 2004 Liv-In study), it has also made for a fluid population in which many residents only stay in the area for a short while. Moreover, there appears to be very little interaction between this newer, more diverse population that tends to live in the area's newer multi-dwelling developments, and the long-time homeowners who have traditionally been more active in community organizations such as the neighborhood associations. As study participants pointed out, at least some of this lack of interaction is likely due in part to the area's lack of public spaces that could facilitate interaction, or at least the development of a sense of familiarity.

Food Access

Summary of Recommendations

The Pilot Study's recommendations have the potential to impact food access by both improving the availability and variety of food sources in the combined study area, and by improving bicycle, pedestrian, and transit access to existing and future healthy food resources. Three of the recommendations explicitly seek to expand the availability of healthy foods by attracting a grocery store to the southern portion of the combined study area, by attracting small-scale and/or culturally appropriate healthy food retailers to the area to serve its' diverse population, and by encouraging expanded small scale urban agriculture opportunities. Other recommendations in the "Convenience and Availability of Services" section would also potentially support an increase in healthy food retail by expanding available commercial areas, and by offering economic development tools for supporting and encouraging new businesses, including food retail. Finally, recommendations in the "Community Amenities and Livability" section would also expand food production opportunities by increasing community gardening opportunities.

However, some of the "Convenience and Availability of Services" recommendations, particularly 2A-F that are designed to create more retail opportunities in general, could possibly create more opportunities for unhealthy food retail establishments such as convenience stores and fast food restaurants, potentially near schools, parks, and other public places.

It is likely that vulnerable groups would similarly benefit from the recommendations. To the extent that vulnerable groups, particularly youth, seniors, and people with low-incomes are less likely to own cars and more likely to rely on walking and biking for transportation, these groups would disproportionately benefit from improved bike, pedestrian, and transit access to healthy food retail. However, their ability to take advantage of new food offerings being provided by new neighborhood retail operations would depend on the character of these operations and extent to which their offerings would appeal to the area's cultural and price preferences.

Summary of Plan Impacts and Additional Recommendations

Potential Positive Impacts:

- The Pilot Study's recommendations would increase food retail and community gardening opportunities and improve accessibility to these resources.
    - Many of the "Accessibility, Connections, Pedestrian Comfort and Safety" recommendations would support improved food access by making it easier for people to walk, bike, and take transit to existing and future food retail sites.
    - Many of the "Convenience and Availability of Services" recommendations would encourage the creation of neighborhood retail operations which could include new food retail sites.
    - Most of the "Residential Infill Development and Design" recommendations would improve the pedestrian realm and thus encourage people to walk about their neighborhoods and frequent local businesses.
    - Some of the "Community Amenities and Livability" recommendations would result in improvements to community gardens where people could grow their own produce.
- The benefits of improved food access created by the Pilot Study's recommendations would accrue to all residents, particularly if new food retail catered to the area's ethnically diverse population.

Potential Negative Impacts:

- If implemented, the Pilot Study's recommendations, particularly the "Convenience and Availability of Services" recommendations 2A-F that are designed to create more retail opportunities in general, could possibly create more opportunities for unhealthy food retail establishments such as convenience stores and fast food restaurants, potentially near schools, parks, and other public places.

Additional Recommendations:

- Conduct a Community Food Assessment to determine how to best improve the availability and affordability of healthy foods that match community preferences.
- Work with PDC to identify and recruit neighborhood-scale healthy food retail businesses to the area that would likely be supported by the community.
- When re-zoning areas for commercial uses, develop and apply a "healthy food zone" ordinance that would prevent unhealthy food retail activity from being established near parks, schools, and other public places.

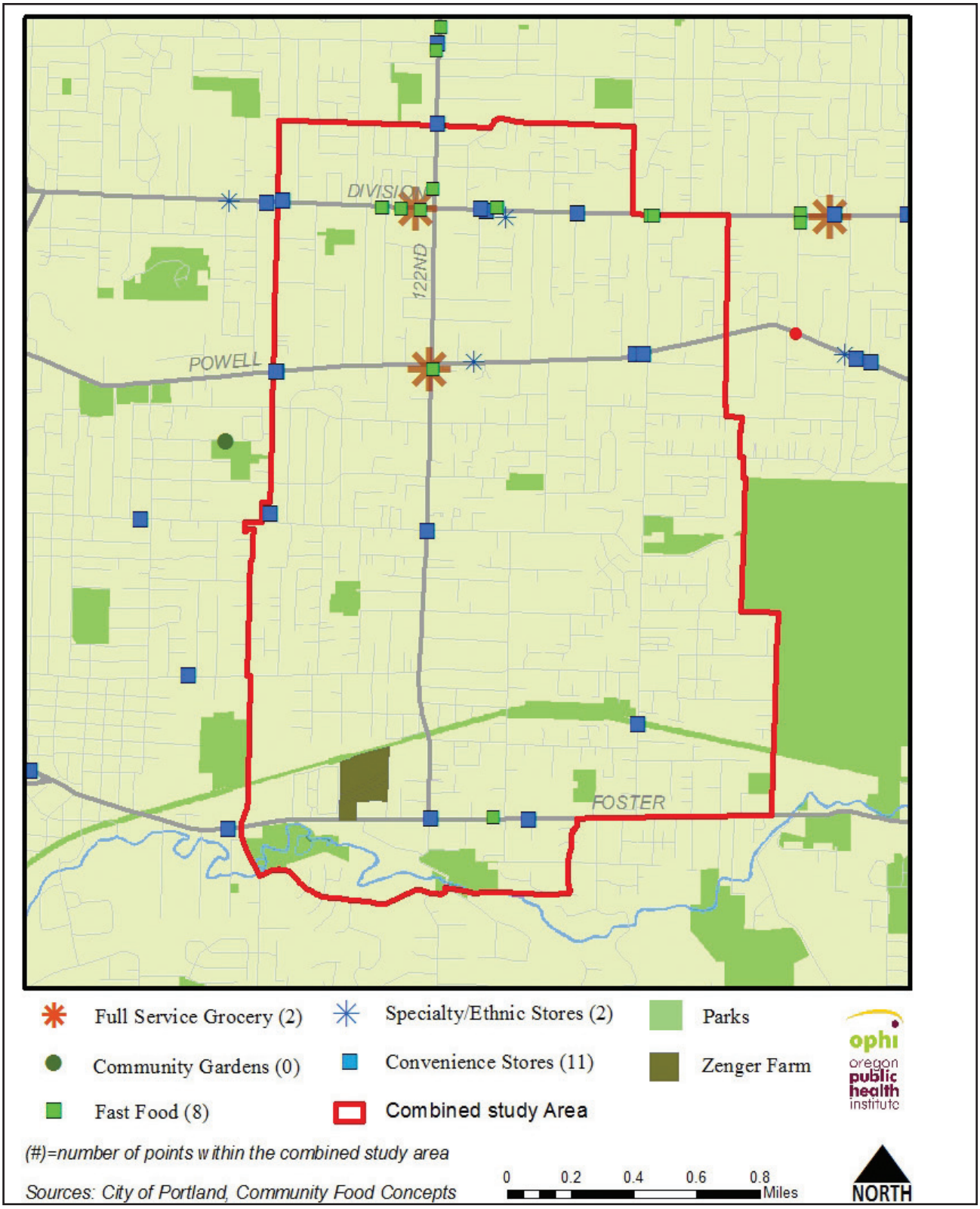
- Develop and disseminate an inventory of available land and commercial space that would be suitable for new food retail and urban agriculture opportunities in order to help potential users better identify existing opportunities.

Food Access and Health

According to the US Centers for Disease Control and Prevention (CDC), a diet high in fruits, vegetables, and other healthy foods can reduce the risk for many leading causes of disease and death. Specific diseases and conditions linked to poor diet include cardiovascular disease, hypertension, dyslipidemia, type 2 diabetes, overweight and obesity, osteoporosis, constipation, diverticular disease, iron deficiency anemia, oral disease, malnutrition, and some cancers [72]. Recent research has demonstrated that people who have convenient access to healthy foods, particularly fruits and vegetables, tend to consume more produce and have lower rates of obesity, type 2 diabetes, and other nutrition related health problems [73-77]. While much of this research has been based on assessing the consumption habits and health of people relative to their geographic proximity to full-service grocery stores, it has also highlighted other issues influencing food access, including the affordability and appropriateness of available food [68-73]. In addition, researchers and nutrition and public health advocates have also emphasized the potential for other food sources such as farmers' markets, healthy corner stores, and community gardens to play a role in improving the accessibility of healthy foods, particularly fruits and vegetables [83-85].

However, research has also found that people's willingness to purchase and consume accessible healthy food can also be influenced by the relative accessibility of unhealthy food retail outlets, as well as the relative availability of unhealthy food within a particular retail outlet. Researchers have found that individuals in communities with high ratios of unhealthy to healthy choices—a calculation referred to as a Retail Food Environment Index (RFEI)—were more likely to suffer from poor nutrition-related health outcomes including obesity and type-II diabetes. The RFEI is calculated by dividing the number of fast food and convenience stores in a particular area by the number of full-service grocery stores, produce markets, and farmers' markets in the area. According to this research, communities with an RFEI greater than 5 are more likely than others to have increased rates of nutrition-related health problems [86-88]. Related research also indicates that restricting access to unhealthy foods is more important for community health than increasing access to healthy foods [83, 89-92].

Map 15. Food Access Points in the Combined Study Area



The Built Environment and Food Access

The built environment can influence food access not only by helping determine one's spatial proximity to food sources, but also through the provision of the transportation options and infrastructure necessary for people to get to and from food sources. Spatial proximity can be impacted by a variety of factors including zoning codes, existing development and uses, and community and economic development policies and practices. Zoning codes can potentially limit or encourage specific allowable uses, as has been demonstrated by a number of jurisdictions that have recently sought to increase the availability of healthy foods and/or decrease the availability of unhealthy foods [93-94], and by the development of model zoning codes designed to increase the proportions of healthy food in particular communities.*

Existing development and uses, including the presence of competing businesses, can influence the availability of appropriate retail/open space, as well as the economic viability of a particular enterprise in a particular location. Full-service grocery stores, for example, have certain lot size, building size, and parking space requirements. If current vacant retail spaces or buildable lands in a particular area can't provide or accommodate these features, then the area would not be able to attract a full service grocery store [95]. Specialty grocers also have specific space requirements, and also tend to do well when they are near other specialty grocers offering complementary goods. If there is not sufficient retail space to allow specialty stores to cluster, then it is difficult for single retailers to succeed.

Community and economic development policies and programs have traditionally been used to attract particular businesses to specific locations, and to encourage particular types of business practices. Numerous jurisdictions have begun developing policies and programs designed specifically for improving healthy food access in developing communities, the most notable of which is Pennsylvania's Fresh Food Financing Initiative, a publicly and privately funded program designed to attract full service grocery stores to underserved areas.

Transportation options and infrastructure can influence food access by helping determine whether and how people can access food sources, as well as influence the types of businesses that get established and succeed. A lack of pedestrian or transit infrastructure, for example, would limit accessibility for people who lack access to a car. Similarly, stores located in auto-oriented commercial developments such as strip malls would also limit access by bicyclists and pedestrians.

**For model code examples, see Public Health Law & Policy's "Healthy Planning" web-site: http://www.phlpnet.org/healthy-planning/products/healthy-planning-policies*

Food Access in the Combined Study Area

Healthy food sources include two full-service groceries in the northern portion of the area (Map 15), as well as a meat market on SE Powell Boulevard. The nearest community garden is in Earl Boyles Park, just outside of the combined study area, although community gardens are planned for property next to Zenger Farm in the southern part of the combined study area, and on a lot on SE 136th Avenue in the eastern part of the study area that is currently owned by the City of Portland Water Bureau. The nearest farmer's market is the Lents International Farmers Market, which is between roughly 2-3 miles away from most of the combined study area.

However, as Map 15 also indicates, there are also eight fast food restaurants and eleven convenience stores in the combined study area, giving the combined study area a RFEI of 9.5, which is much higher than the threshold for indicating the likelihood of increased rates of nutrition-related health problems for the study area population. In addition, recent market basket surveys and community input indicate that the two grocery stores in the combined study area are more expensive than other more distant options, and several residents indicated that they travel longer distances to access discount grocery stores.

At many points in the project's outreach process, residents indicated that they were aware of this imbalance in food choices and its implications, and identified the need for increased food retail options, particularly in the southern portion of the combined study area, to improve community health. They also voiced support for more community gardening space, particularly for residents of multi-dwelling developments which typically lack gardening space. Residents also pointed out that the zoning along SE 122nd Avenue (see Map 7), which provides small amounts of commercial land only at major intersections, makes it difficult for small businesses such as specialty and ethnic grocery stores to find suitable locations. And while there are some vacant retail spaces in current developments, they are primarily in auto-oriented developments and are not suitable for neighborhood-oriented businesses.

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Appendix A

Table A.1: Health Effects of Vehicle-related Air Pollutants and Toxics*

Pollutant	Health Effects
Criteria Pollutants:	
Ozone (O3)	Short term exposure can lead to irritation of the nose, throat, and lungs, and can cause increased airway resistance and decreased efficiency of the respiratory system. For individuals involved in strenuous physical activity and for people with pre-existing respiratory disease, ozone can cause sore throats, chest pains, coughing, and headaches. Long term exposure effects include significant breathing problems, such as loss of lung capacity and increased severity of both childhood and adult asthma.
Carbon Monoxide (CO)	High concentrations of CO strongly impair the functions of oxygen-dependent tissues, including brain, heart, and muscle. Prolonged exposure to low levels of CO aggravates existing conditions in people with heart disease or circulatory disorders. There is a correlation between CO exposure and increased hospitalization and death among such patients. Even in otherwise healthy adults, carbon monoxide has been linked to increased heart disease, decreased athletic performance, and diminished mental capacity. Carbon monoxide also affects newborn and unborn children. High CO levels have been associated with low birth weights and increased infant mortality.
Particulate Matter (PM2.5 & PM10)	Relationships have been shown between exposure to high concentrations of particulate matter and increased hospital admissions for respiratory infections, heart disease, bronchitis, asthma, emphysema, and similar diseases. In addition, there may be several potential carcinogens present on particulate matter.
Nitrogen Dioxide (NO2)	Nitrogen dioxide is a lung irritant and may be related to chronic pulmonary fibrosis. It is also important in the photochemical reactions leading to the formation of ozone.

Table A.1: Health Effects of Vehicle-related Air Pollutants and Toxics* (cont'd)

Sulfur Dioxide (SO2)	Sulfur dioxide is a lung and eye irritant. When SO2 is inhaled, it causes bronchial constriction which results in breathing difficulty and increased pulse and respiratory rate. People with respiratory diseases like asthma, bronchitis, or emphysema are particularly susceptible to the effects of SO2. Chronic exposure to SO2 can lead to coughing, shortness of breath, fatigue, and bronchitis.
Air Toxics:	
Benzene	Long-term inhalation of benzene causes many disorders including anemia, excessive bleeding, damage to the immune system and genetic damage. On the job exposure to benzene has been shown to produce an increased incidence of leukemia. EPA has classified benzene as a known human carcinogen.
1, 3 Butadine	Studies have shown that long-term inhalation of 1,3-butadiene can result in an increased incidence of cardiovascular diseases, including rheumatic and atherosclerotic heart diseases (hardening of the arteries) and can cause blood disorders. EPA has classified 1,3-butadiene as a probable human carcinogen.
Diesel Particulate Matter (DPM)	The health impacts of diesel particulate matter include premature death, lung cancer, decreased lung function in children, and chronic bronchitis.
Formaldehyde	Chronic exposure to inhaled formaldehyde is associated with respiratory symptoms and eye, nose, and throat irritation. Increased incidences of menstrual disorders and pregnancy problems have been observed in women workers using urea-formaldehyde resins. Studies of workers have shown significant associations between exposure to formaldehyde and increased incidence of lung and nasal cancer. EPA considers formaldehyde to be a probable human carcinogen.
Polycyclic Aromatic Hydrocarbons (PAH)	Information about short and long-term human health impacts is limited. Long-term exposure to one form of PAH, benzo(a)pyrene, has resulted in dermatitis, eye irritation, and reduced fertility. EPA has classified most PAH compounds as probable human carcinogens.

Table A.1: Health Effects of Vehicle-related Air Pollutants and Toxics* (cont'd)

Acetaldehyde	Health effects from breathing small amounts of acetaldehyde over long periods are uncertain. EPA has classified acetaldehyde as a probable human carcinogen.
Arsenic	Breathing inorganic arsenic increases the risk of lung cancer. EPA has classified inorganic arsenic as a known human carcinogen.
Chromium and its compounds	Chromium occurs in several forms, one of which is chromium VI. Long-term inhalation of chromium VI causes respiratory tract damage. Studies suggest that exposure to chromium VI may result in complications during pregnancy and childbirth. Inhalation of chromium VI can also increase the risk of lung cancer. EPA has classified chromium VI as a known human carcinogen. The most common form of chromium, chromium III, is not known to cause cancer and is less toxi
Nickel and its compounds	Respiratory effects, including chronic bronchitis and reduced lung function, have been observed in workers who breathe large amounts of nickel. Nickel may also cause reactions in sensitive skin upon contact. Some people react if they consume nickel in food or water, or react if they breathe it. EPA has classified several forms of nickel as known or probable human carcinogens
Perchloroethylene (a.k.a tetrachloroethene)	Exposure to high levels of perchloroethylene can cause acute human health effects. These effects include central nervous system damage, kidney dysfunction, and severe respiratory irritation. Long term, low level exposures can cause neurological impairment, and severe liver and kidney damage. EPA has classified perchloroethylene as a possible human carcinogen.
Manganese	Chronic (long-term) exposure to high levels of manganese by inhalation in humans may result in central nervous system (CNS) effects. Visual reaction time, hand steadiness, and eye-hand coordination were affected in chronically-exposed workers. A syndrome named manganism may result from chronic exposure to higher levels; manganism is characterized by feelings of weakness and lethargy, tremors, a mask-like face, and psychological disturbances. Respiratory effects have also been noted in workers chronically exposed by inhalation. Impotence and loss of libido have been noted in male workers afflicted with manganism.

Table A.1: Health Effects of Vehicle-related Air Pollutants and Toxics* (cont'd)

Dichlorobenzene	Acute (short-term) exposure to 1,4-dichlorobenzene, via inhalation in humans, results in irritation of the skin, throat, and eyes. Chronic (long-term) 1,4-dichlorobenzene inhalation exposure in humans results in effects on the liver, skin, and central nervous system (CNS). No information is available on the reproductive, developmental, or carcinogenic effects of 1,4-dichlorobenzene in humans. A National Toxicology Program (NTP) study reported that 1,4-dichlorobenzene caused kidney tumors in male rats and liver tumors in both sexes of mice by gavage (experimentally placing the chemical in their stomachs). EPA has classified 1,4-dichlorobenzene as a Group C, possible human carcinogen.
Naphthalene	Acute (short-term) exposure of humans to naphthalene by inhalation, ingestion, and dermal contact is associated with hemolytic anemia, damage to the liver, and neurological damage. Cataracts have also been reported in workers acutely exposed to naphthalene by inhalation and ingestion. Chronic (long-term) exposure of workers and rodents to naphthalene has been reported to cause cataracts and damage to the retina. Hemolytic anemia has been reported in infants born to mothers who "sniffed" and ingested naphthalene (as mothballs) during pregnancy. Available data are inadequate to establish a causal relationship between exposure to naphthalene and cancer in humans. EPA has classified naphthalene as a Group C, possible human carcinogen.
Ethylbenzene	Acute (short-term) exposure to ethylbenzene in humans results in respiratory effects, such as throat irritation and chest constriction, irritation of the eyes, and neurological effects such as dizziness. Chronic (long-term) exposure to ethylbenzene by inhalation in humans has shown conflicting results regarding its effects on the blood. Animal studies have reported effects on the blood, liver, and kidneys from chronic inhalation exposure to ethylbenzene. Limited information is available on the carcinogenic effects of ethylbenzene in humans. In a study by the National Toxicology Program (NTP), exposure to ethylbenzene by inhalation resulted in an increased incidence of kidney and testicular tumors in rats, and lung and liver tumors in mice. EPA has classified ethylbenzene as a Group D, not classifiable as to human carcinogenicity.

Appendix B

All of the information in the following tables comes from the "SE 122nd Avenue Study: A Pilot Project of the Portland Plan, Existing Conditions and Planning Implications Report" produced by the City of Portland Bureau of Planning and Sustainability.

Table B-1. Changes in Numbers of People, Households, and Families, 1990-2014

	1990	Annual Growth 1990-2000	2000	Annual Growth 2000-2009	2009	Annual Growth 2009-2014	2014
Population Study Area	4,180	1.9%	4,966	2.2%	6,037	0.7%	6,461
Combined Area	16,151	2.5%	20,251	1.9%	24,173	0.7%	25,885
Portland	486,600	0.9%	529,121	0.8%	570,845	0.4%	595,484
Households Study Area	1,593	1.3%	1,796	2.2%	2,190	0.7%	2,342
Combined Area	6,075	1.7%	7,095	1.9%	8,420	0.7%	9,000
Portland	206,105	0.9%	223,737	0.9%	243,821	0.5%	254,849
Families Study Area	1,078	1.1%	1,199	2.0%	1,440	0.6%	1,522
Combined Area	4,183	1.7%	4,881	1.7%	5,727	0.6%	6,062
Portland	117,040	0.1%	118,447	0.7%	126,180	0.3%	129,857

Table B-2. Change in Average Household Size, 1990-2014

	1990	2000	2009	2014	Change 1990-2000	Change 2000-2014
Average Household Size Study Area	2.56	2.67	2.68	2.68	4.3%	0.4%
Combined Area	2.59	2.78	2.81	2.82	7.3%	1.4%
Portland	2.30	2.30	2.28	2.28	0.0%	-0.9%

Table B-3. Median Household Income and Income as Percentage of Portland Median, 1990-2014

	1990		2000		2009		2014	
	Med. HH Inc.	% of city	Med. HH Inc.	% of city	Med. HH Inc.	% of city	Med. HH Inc.	% of city
Study Area	$24,613	95.4%	$35,050	87.3%	$49,461	91.4%	$52,751	92.1%
Combined Area	$25,462	98.6%	$36,462	90.8%	$51,378	95%	$51,488	89.9%
Portland	$25,812	100%	$40,150	100%	$54,134	100%	$57,279	100%

Table B-4. Percentages of Households by Income, 2009

	<$15K	$15-$24.9K	$25-$34.9K	$35-$49.9K	$50-$74.9K	$75-$99.9K	$100-$149.9K	$150-$199.9K	$200k+
Study Area	13.2%	9.1%	11.5%	16.8%	24.3%	15.0%	7.3%	1.9%	1.0%
Combined Area	10.6%	9.3%	11.2%	17.3%	23.6%	16.7%	8.1%	2.0%	1.1%
Portland	11.3%	9.2%	9.9%	15.5%	22.3%	15.3%	9.8%	3.5%	3.2%

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Table B-5. Percent Non-White Population, 1990-2014

	1990	2000	2009	2014
Study Area	11.9%	24.2%	30.9%	35.5%
Combined Area	11.9%	25.1%	32.0%	36.6%
Portland	20.7%	28.4%	35.0%	39.2%

Table B-6. Race and Ethnicity, 2009

	White Alone	Black Alone	American Indian Alone	Asian Alone	Pacific Islander Alone	Some Other Race Alone	Two or More Races	Hispanic Origin (Any Race)
StudyArea	76.4%	3.1%	0.9%	8.7%	0.2%	5.2%	5.5%	10.6%
Combined Area	75.7%	3.0%	1.0%	9.4%	0.3%	6.1%	4.5%	11.9%
Portland	74.1%	7.1%	1.0%	8.0%	0.4%	4.9%	4.5%	9.5%

Table B-7. Race and Ethnicity in Study Area Schools 2009

White	Black	Native American	Asian	Pacific Islander	Multi-racial	Unspecified	Hispanic
56.8%	8.6%	3.7%	14.0%	8.9%	6.0%	10.1%	21.3%

Table B-8. Languages Spoken in Area Schools, 2009

School	# of Languages	Top Three First Languages (% of student body)		
Earl Boyles ES	19	English (59.6)	Spanish (21.3)	Vietnamese (6.2)
Gilbert Heights ES	23	English (55.3)	Spanish (13.9)	Russian (10.4)
Gilbert Park ES	23	English (54.2)	Russian (13.3)	Spanish (8.6)
WestPowellhurstES	21	English (46.7)	Spanish (20.6)	Ukrainian (7.7)
Alice Ott MS	27	English (54.3)	Spanish (11.2)	Russian (10.7)
Ron Russell MS	38	English (48.5)	Spanish (20.2)	Russian (6.3)
David Douglas HS	53	English (55.6)	Spanish (13.4)	Russian (7.3)