Plan East Tennessee | Health Impact Assessment

A Regional Partnership of East Tennessee Communities

Health Impact Assessment

2013

A project of the Metropolitan Planning Commission
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HIA PROJECT TEAM

Jayme French, MPH
Albert Iannacone, MS
Kathy Brown, PhD
Stephanie Welch, MPH
The Knox County Health Department
Knoxville-Knox County Metropolitan Planning Commission
Knoxville Regional Transportation Planning Organization

CONTACT

For more information regarding this health impact assessment, please contact Albert Iannacone, Environmental Epidemiologist, Knox County Health Department.

FURTHER INFORMATION

Related documents for the PlanET project can be found at http://www.planeasttn.org.

Information regarding health impact assessment process and methods can be found at Health Impact Project, http://www.healthimpactproject.org.
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EXECUTIVE SUMMARY

Plan East Tennessee (PlanET) provides an opportunity to collaboratively improve livability for our five-county region. The PlanET project focuses on a series of interconnected trends and issues, and how these will affect the community we will live in for coming decades. As a PlanET partner, the Knox County Health Department conducted a Health Impact Assessment (HIA) to assist the project, to describe baseline conditions and projected positive and negative health impacts of the region’s current and alternative growth trends. Factors such as employment and education, transportation patterns and public transit, safe, affordable housing and development planning, access to care and essential resources and the environment all contribute to – or hinder – the creation of conditions that foster the health and well-being of residents across their lives.

Providing a range of affordable housing in closer proximity to jobs, improving transportation options, and increasing opportunities for people to earn higher wages through a better educated community are all ways to reduce cost-burdened household conditions, where the necessary expenses of daily life are a burden to the point that they are contributing to poor health outcomes in our communities:

- Public health implications of economic trends are well-established; achieving well-being and maintaining good health is hindered through unemployment or fluctuations in employment security. Education and opportunities to access training result in higher wages and improved employment security; these are associated with reduced chronic stress, better access to essential resources and ultimately in improved health outcomes and well-being. By reducing the portion of income devoted to health care, additional income is freed for growth in other areas of the economy.

- Our transportation system impacts health through the levels of vehicle emissions and their impacts on respiratory illnesses, but also through whether it promotes or hinders the ability to engage in active transportation – walking, biking, use of public transportation – activities which are associated with lower rates of obesity, and thus decreased levels of cardiovascular disease and diabetes.

- Opportunities for healthy, active living are also affected by the built environment of our communities. While historical development patterns explain much of our region’s weaknesses in this regard, much can be done to improve the health impacts of our built environment within the constraints of the infrastructure we have inherited. Better connectivity from our homes to the necessary aspects of daily living such as work, school or...
shopping would promote active transportation.

Eighty percent of households in our region struggle to carry the combined costs of transportation and housing; the burden for such households can be reduced through improved proximity of homes to jobs, better street connectivity with access to public transit, and localized services in town centers. An emphasis on affordable mixed-use planning can provide opportunities to purchase or rent homes closer to jobs and services. With improved affordability of housing and transportation, they will have more opportunity to access resources leading to positive health outcomes and well-being, including healthier food, opportunities to exercise, chances for continuing education to improve job prospects to support their families, and engaging in community activities with neighbors that foster the strong social fabric upon which our living in society depends.

The Surgeon General underscores the importance of a focus on the determinants of health for a successful solution to these interconnected problems. The 2012 National Prevention Council Action Plan makes several recommendations relevant to PlanET for reducing disease prevalence, including improving agricultural policies and practices to reflect nutritional goals, increasing healthy food availability in underserved communities ("food deserts"), promoting alternative transportation options to encourage active transportation, and supporting mixed use and compact development to promote active lifestyles.

**The federal Department of Health and Human Services defines physical determinants, or structural influences to health, as including:**

- Natural environment, such as green or open space
- Built environment, such as sidewalks, roads or buildings
- Worksites, schools and recreational settings (also referred to as “place”)
- Housing and community design
- Exposure to environmental toxins and physical hazards
- Physical barriers, especially for people with disabilities
- Aesthetic elements, such as trees and benches

These factors and others are explored in more detail in the HIA, and the report closes with an exploration of their interplay with potential styles of growth for our communities in coming decades, factors which will determine the manner in which we choose to grow our communities.
Plan East Tennessee (PlanET) provides an opportunity to collaboratively improve livability for our five-county region in the coming decades. The PlanET project focuses on interconnected trends and issues related to economy, transportation, housing, health, and environment. This report aims to provide an understanding of how one focus issue of the project – health – is potentially affected by growth trends in our region, and how this in turn affects multiple other PlanET areas of focus. The information in this report is intended to serve as one of many relevant sources of information considered when selecting the preferred regional growth concept for the region.

As a PlanET partner, the Knox County Health Department conducted a Health Impact Assessment (HIA) to assist the project. HIA is a method of analysis designed to reveal and explain both adverse and beneficial health consequences of a given plan or action. The analysis includes detailed review of existing evidence and input from stakeholders, including the community, health officials, planners and policy makers. This report documents the results of the HIA.

The HIA process generally defines health broadly as a “state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.”

Through this broad perspective, the HIA seeks to describe baseline and projected positive and negative health impacts of the region’s current and alternative growth trends related to: employment and education; transportation patterns and public transit; safe, affordable housing and development planning; access to care and essential resources; and the environment.
Methods used to conduct this HIA included: use of quantitative data as well as qualitative, narrative explanation; analysis of scholarly review; disease prevalence estimates; incorporation of environmental measures; and GIS for mapping relevant data.

A core concern of the PlanET process is to seek options that provide equitable opportunities for all to access good health and quality of life. **Therefore, this HIA includes an exploration of “root causes” or determinants of positive or negative health outcomes, as described by the U.S. Department of Health and Human Services (HHS):**

- Access to and quality of educational, economic, and job opportunities
- Access to mass media and emerging technologies (e.g., cell phones, Internet)
- Transportation options
- Availability of resources for daily needs (e.g., housing, food markets, public safety)
- Socioeconomic conditions (e.g., concentrated poverty and accompanying stress)
- Residential segregation
- Exposure to crime, violence and social disorder
- Access to health care services
- Availability of community-based resources and opportunities for recreational and leisure-time activities
- Social support
- Social norms and attitudes (e.g., discrimination, racism or trust of government)
- Culture, language and literacy.⁵

Ultimately, through examining the baseline and alternative regional growth trends, potential health outcomes are projected and analyzed for likelihood, severity, magnitude and distribution among the residents of our region. With a complete picture of the variables associated with health, community members and community leaders can make informed decisions to minimize negative health impacts and improve the overall health and quality of life for all in our region.

As a consideration in the PlanET process, this health impact assessment should provide an additional dimension to the determination of paths leading to equitable and sustainable growth for the region.
An important determinant of health outcomes is access to economic and job opportunities.\textsuperscript{5} Stable employment in a robust economy provides the opportunity to obtain the essential resources needed for health and well-being. Likewise, prevention of illness and a sense of well-being among employees are necessary to develop a productive work force.

Costs of poor health are not only measured in dollars devoted to treating the condition. To accurately quantify the cost of poor health, costs from loss of quality of life, lost productivity, lost earnings, reduced social cohesion, or poor access to services or opportunity must be considered as well.

Businesses require the dependability of a healthy, focused workforce to keep costs low and productivity high. Companies may choose to locate to our area when they realize that...
opportunities for improved quality of life and overall well-being exist here. Overall, our goal to promote successful, sustainable growth must provide a productive workforce with possibilities to access and maintain good health.

The Milken Institute (a nonprofit, nonpartisan organization promoting use of capital markets to solve social and economic challenges) provides an index of chronic diseases and their associated costs to productivity and the economy. On a national level, the index estimates that more than one-third of the U.S. population has at least one of seven major diseases, with a projected increase of 42 percent by 2023. Currently, the combined impact of these diseases to the national economy is more than $1.3 trillion annually. Significantly, only a small portion of that cost is for treatment, while more than $1 trillion is the result of lost productivity.

Adding up these effects, the economic impact of poor health could be reduced by up to 27 percent with a focus on health prevention and promotion. For Tennessee, it is estimated lost productivity costs due to chronic disease are more than $24 billion. Drawing upon multiple data sources, the effects of chronic disease on lost quality of life and lost productivity are shown to be increasing. However, a strategy to reverse the trend and to improve well-being is available.

With modest investments in prevention and early intervention, along with reduction of environmental risk, chronic disease incidence could be reduced by as much as 40 million cases by 2023. This focused strategy for intervention would realize a $218 billion per year reduction in health care treatment costs, and an increase of $905 billion in labor supply and efficiency gain for the nation as a whole. A concerted effort to reduce chronic diseases such as heart disease, obesity and cancer would significantly improve well-being and productivity in our region. The Milken Institute concludes that “good health is an investment in economic growth.”

Similarly, the American College of Occupational and Environmental Medicine (ACOEM) has recommended an emphasis on strategies to promote health in order to “protect the employability of the working-age population to maximize workforce participation and productivity.” Their advocacy strongly supports illness prevention and urges employers to

**Figure 2.** Lost productivity in the U.S. by chronic disease, in billions of dollars. *The Milken Institute, 2008.*

<table>
<thead>
<tr>
<th>Disease</th>
<th>Cost (Billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>$280</td>
</tr>
<tr>
<td>Cancers</td>
<td>$271</td>
</tr>
<tr>
<td>Mental disorders</td>
<td>$171</td>
</tr>
<tr>
<td>Diabetes</td>
<td>$105</td>
</tr>
<tr>
<td>Heart disease</td>
<td>$105</td>
</tr>
<tr>
<td>Pulmonary conditions</td>
<td>$94</td>
</tr>
<tr>
<td>Stroke</td>
<td>$22</td>
</tr>
</tbody>
</table>
incentivize health among their employees, insisting that employers and benefit plans should not create or sustain obstacles for employees to choose healthy behaviors. In this way, employees can remain focused and working at their maximum potential for productivity. 7,8

Studies consistently indicate a healthy workforce is essential to achieving a vibrant economy in our region, and vice versa. However, as the PlanET State of the Region Report describes, unemployment and the cycle of poverty are real obstacles in our region. The majority of households have annual incomes below $50,000. Incomes are not growing to match rising costs, resulting in an increasing number of families in poverty.9

The greatest gains in employment opportunities for our region are in low-paying, low-skilled jobs and that trend is projected to continue. Training options are limited in these low-wage jobs, limiting the opportunity to move to a higher-skilled, higher-paying job and to an improved future. Middle-skilled and high-skilled jobs receive lower wages in our area as compared to other metropolitan areas.10 Unchecked, such factors threaten to create a negative and self-reinforcing cycle of declining health and economic stagnation in our region.

Risk of death increases by 63 percent for the unemployed.
One of the determinants of health is access to and quality of economic and job opportunities. The opportunity to achieve well-being through economic and occupational prospects is a vital factor affecting health—physical well-being and employment security are interconnected.

According to the U.S. Department of Labor, December 2012 unemployment in the PlanET region was 7.6 percent, with individual counties in the PlanET region ranging from 5.7 percent (Knox) to 8.2 percent unemployment (Union). Other measures by the Department of Labor, which more fully capture those who have given up looking for work or who have accepted part-time or downgraded positions, place the employment picture in even more stark terms. Future growth of our region should aim to maintain a low unemployment rate, since from a health perspective, opportunity to achieve well-being is hindered through unemployment or fluctuations in employment security. The unemployed have an increased risk for chronic disease and even for premature death.

In fact, a 2011 review of multiple studies demonstrates that the risk for death among the unemployed increases by 63 percent.

Increased health risk through unemployment or employment instability is due in part to chronic stress conditions associated with lower wages, lack of opportunity for promotion or control in one’s job, low socioeconomic status, or low education. These situations result in lack of access to some of the essential resources required for well-being for the individual or the family. As many studies show, chronic stress can be measured as allostatic load, or “the wear and tear the body experiences” during repeated stressful situations. The “wear and tear on the body” resulting from chronic stress produces increased risk for the following conditions:

- Cardiovascular disease, high cholesterol
- Decreased immunity
- Increased risk for diabetes
- Reduced cognitive ability, memory
- Weaker physical performance, reduced mobility
- Depressive symptoms

Given the alarming increase in the risk of chronic disease associated with lack of employment security, factors which prevent employment security must be identified and addressed to create economic conditions where well-being for the individual and productivity for business are promoted and sustained. One of the key factors toward that goal is the education of our community, a consideration addressed in the following section.

Table 1. PlanET Region median household income, 2006-2010. U.S. Census Bureau, 2010.

<table>
<thead>
<tr>
<th></th>
<th>Median household income, 2010</th>
<th>Persons living below poverty level, 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loudon</td>
<td>$49,343</td>
<td>13.8%</td>
</tr>
<tr>
<td>Blount</td>
<td>$47,322</td>
<td>11.7%</td>
</tr>
<tr>
<td>Knox</td>
<td>$46,459</td>
<td>13.7%</td>
</tr>
<tr>
<td>PlanET Region</td>
<td>$46,218</td>
<td>13.9%</td>
</tr>
<tr>
<td>Anderson</td>
<td>$44,650</td>
<td>16.5%</td>
</tr>
<tr>
<td>Tennessee</td>
<td>$43,314</td>
<td>17.2%</td>
</tr>
<tr>
<td>Union</td>
<td>$30,143</td>
<td>21.9%</td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau, American Community Survey Five-Year Estimates, 2006-2010
Access to education has a profound effect on health.

Low educational attainment is directly related to low wages and lack of career advancement, which in turn contributes to chronic stress and poor health outcomes. PlanET has identified that a large portion of our regional workforce has no secondary education, while access to educational opportunities is one of the resources identified by HHS as essential to well-being.

A University of Tennessee survey conducted in 2011 found that 68 percent of those surveyed in our region would rate close proximity to high-quality schools as a top priority for their ideal living arrangement. Higher educational attainment is of value for well-being since college graduates not only earn two times more over a lifetime, but potentially live an estimated five years longer than those without degrees. In contrast, unemployment is higher among those who do not graduate from or have only a high school education. Further, children in low-income families have an increased risk of dropping out of school, perpetuating the cycle of limited opportunity for employment security and improved health outcomes.

In a study associating higher educational attainment and improved health outcomes, Harvard and Princeton researchers found that regardless of demographics or labor market factors, people with higher education have lower rates of acute and chronic disease. People of greater educational levels are less
likely to smoke, to drink heavily, to experience obesity or to use illegal drugs. Workplace productivity is affected as those with less education report an average of nearly three more sick days per year. This association between more education and improved health has grown stronger over time. The data indicate health behaviors or family background alone cannot account exclusively for these results, but rather that there is a range of mechanisms which contribute to the explanation. Health outcomes are dramatically affected by the amount of education that members of our region are able to access.

Studies of health behaviors alone do not provide a complete explanation for health outcomes. Higher educational attainment must be viewed within the context of other social determinants of health. As a model to understand the root causes of health outcomes, the determinants reveal how education creates pathways to access essential resources such as economic opportunity, transportation and basic needs, community-based resources, open spaces and recreational activities, access to health care, and to safe environments.

As such, economic planning in our region must include strategies to promote equitable access to educational opportunities. Education and opportunities to access training result in higher wages and improved employment security which correspond with reduced chronic stress, access to essential resources and ultimately, for the improved health outcomes and well-being our region needs to succeed.
A transportation system that provides affordable access to work, school, shopping, medical care, recreation, houses of worship and any of the myriad of other destinations in our daily lives is essential for positive health outcomes. However, due to historical development patterns, transportation options in our region are limited by increased distance between homes, jobs, services and activities. Often transportation costs are prohibitive, due to fuel and maintenance costs or to the stress of time spent waiting in traffic.

According to statistics from the U.S. Census for 2009, residents of the PlanET Region drove an average of more than 34 miles per day with an average one-way commute time of 24 minutes. Time spent in traffic congestion in the urbanized areas averaged 21 hours per year per person. In total for 2010, the time spent in vehicles due to traffic congestion cost the members of the region approximately 7.5 million hours in lost productivity and $151 million.

Increased driving times and distances can translate into increased risk for accidents. Tennessee has a slightly higher average fatality rate than the nation as a whole. In 2011, there were 32,367 (10 per 100,000) traffic-related fatalities in the U.S., while Tennessee reported 946 (14 per 100,000). In that same year in Tennessee, there were 80
(8 percent) pedestrian fatalities. Key causes of pedestrian death include lack of infrastructure, such as safe sidewalks and crosswalks, for pedestrian traffic. Where an individual lacks adequate transportation and safe walkways for accessing essential resources such as employment, food or medical care, increased risk of pedestrian injury is a likely consequence.

Another effect of traffic density and congestion is air pollution. Emissions from traffic have the potential to increase risk for serious health consequences for our communities as more vehicles spend more time on the road. Nearly 338 million tons of freight moves through our region. Only 25 percent of this freight is meant for the region, while the other 75 percent passes through. Contributing to emissions as well, our current population of nearly 700,000 in the metropolitan statistical area drives an average of more than 35 miles per day.

In part because of our increased traffic emissions, from 2004 to 2010, the U.S. Environmental Protection Agency (EPA) categorized our region as failing to attain goals for eight-hour ozone and particulate matter concentrations in the air. Although improvement was seen for eight-hour ozone in 2011, we slipped back into non-attainment status for both eight-hour ozone and particulate matter in 2012. Nationally, transportation and fuel production related emissions can be linked to more than $55 billion in damages to health and lost productivity. A detailed discussion of the health consequences of increased emissions follows in the Environment and Healthy Communities sections of this assessment.

Figure 5. Hidden health costs of transportation. APHA, 2010.
Options to reduce negative health effects include reduction of emissions (by changing vehicles or their fuel); reduced traffic density and congestion; and/or fewer average daily miles driven per person. The latter two options can be addressed by better connectivity between our homes and the necessary aspects of daily living such as work, school or shopping.

Historical development patterns explain much of our region’s lack of connectivity. Zoning may prohibit placement of essential resources such as shopping or medical care near residential areas. Availability of safe, accessible sidewalks for the region as a whole is low. Increasingly, as a result of these factors, residents often must drive great distances to work as employment opportunities may be located far from home or in one of the other counties of our region. Increased travel expenses caused by distance between home and employment or other services may cause some families to delay or to refuse other essential resources such as healthy food or medical care.\textsuperscript{10, 13}

Transportation deficiencies block access to employment, education, or services which prevent some members of our community from achieving goals.\textsuperscript{22} Additionally, many families who do have access to a vehicle live in cost-burdened situations in which transportation costs overwhelm their household budget.\textsuperscript{10} The inability to afford basic needs for the individual or the family has been related to increased risk for chronic stress, a condition associated with many chronic diseases.\textsuperscript{13, 22} Better connectivity from our homes to the places we “are born, live, learn, work, play, worship, and age” should improve access to essential resources and reduce risk of chronic stress and disease.\textsuperscript{5}
**PUBLIC TRANSIT**

Connectivity may be improved by use of public transit. Multiple studies show that with increased connectivity and improvements such as better sidewalks and access to public transit, there is a reduction in vehicle miles traveled. However, with an average residential density of 1.4 units per acre, the PlanET Region lacks the necessary population density to support development of wide-scale public transit, limiting services for most of the five-county region. As the region develops, mixed-use planning to increase the number of dwelling units to the required 6-8 units per acre is necessary to reduce our auto dependency. Mixed-use planning allows zoning of dwelling units in close proximity to employment or essential services such as markets or physician offices. Increased utilization of public transit is more likely when connectivity is improved.

**Use of public transit has positive health benefits including:**

- Increased physical activity to reach transit access point
- Reduced risk for injury
- Improved air quality due to reduced emissions and traffic congestion (See illustration at right.)
- Reduced chronic stress due to fewer miles driven or due to improved access to essential services
- Improved access to one’s community and to social interaction.\(^{19, 24, 25}\)

A growth strategy that improves availability and access to public transportation in our region will also help ensure improved health outcomes in the region.
ACTIVE TRANSPORTATION

There are additional transportation options that offer even greater health benefits. Active transportation refers more broadly to the use of walking, bicycling and public transit to commute or run errands. These modes of travel result in physical exercise, which has been strongly linked to prevention of obesity, diabetes and coronary heart disease. People who walk and bicycle for transportation weigh less than those who rely exclusively on driving, and they have a lower risk of cardiovascular disease. In the U.S., the CDC has found that states where a higher percentage of people commute by bike or on foot have lower rates of obesity than states with low rates of active commuting. Tennessee is among the states with the highest rates of obesity, diabetes, and cardiovascular disease, and the high rates of physical inactivity are partly responsible. Increasing people’s ability to walk or bicycle, as an alternative to driving, would have an enormous impact on improving the health of our citizens.

Due to the dispersed land-use patterns in our region, bicycling is actually more feasible as a mode of transportation than walking in many suburban areas, due to the fact that the distances that need to be covered in daily life in such neighborhoods are too great to be readily traversed by walking but can be bicycled easily. Bicycling allows a person to travel four times as
far in the same amount of time, as compared to walking.

Unfortunately, as we saw for pedestrians, the current transportation infrastructure does not support safe bicycling in many areas. KCHD performed an analysis of automobile-pedestrian and automobile-bicycle crashes in Knoxville that occurred between December, 2006, and June, 2011, based on data provided by the Knoxville Regional Transportation Planning Organization. In that time period, there were 494 crashes involving either pedestrians or bicyclists; 348 crashes involved pedestrians, 145 involved cyclists, and 1 crash involved both. Unfortunately, the data did not include details of medical outcomes or fatalities. However, given the relatively small percentage of pedestrians and bicyclists in Knoxville these statistics reinforce the need for appropriate infrastructure so others can share our roads safely with automobiles.

The requirements for these two forms of active transportation are extremely different. Walkers need sidewalks, cross-walks, signals, pedestrian bridges and compact land-use design. Bicyclists need dedicated bike lanes, cycle tracks, sharrows (shared roads with cars where traffic speeds and volumes are low), traffic signals that can be triggered by bicycles, bike racks, and integration with public transit (bike racks on buses, etc.) Compact land use is less critical for bicyclists than for pedestrians. Addressing these needs within the budget constraints of local governments will require creativity and public education by local officials.

**Use of active commuting has positive health benefits including:**

- Increased physical activity
- Reduced risk of obesity, diabetes and coronary heart disease
- Improved air quality due to reduced emissions and traffic congestion
- Reduced chronic stress due to fewer miles driven or due to improved access to essential services
- Improved access to one’s community and to social interaction.19, 24, 25
One challenge identified for our region is low household income, resulting in limited ability to pay for essential resources. A majority of households in the region have incomes below $50,000, with little chance of increase. However, many of these low-income families do not fall below federal income guidelines to qualify for assistance with basic needs. Such members of our region live in a “cost-burdened” status.

While housing is generally affordable in the region overall, low incomes cause employees to drive greater distances to work in order to live in an area they are able to afford. Transportation costs have continually risen over the last decade as distance between low-cost homes and jobs or services increases. Although most of the country spends 15 percent of household income on transportation, the PlanET Region spends an average of 31 percent – more than double the national rate. The report explains that increased transportation costs are due in part to auto dependency/necessity, higher costs of fuel and maintenance and increased miles traveled due to increased distance to destination.

In total, the region’s households are spending an average of 52 percent of income on housing and transportation costs combined. The imbalance of cost to low income means that 80 percent of the region’s neighborhoods are in a cost-burdened
status. Since many households do not have opportunity to increase income, this cycle is self-perpetuating, causing the household financial situation to slowly deteriorate. As costs rise in conjunction with lagging salary increases, the families struggle to pay for basic needs such as groceries, transportation to work or school, and/or medical care. Often this juggling act causes the family to choose foods that may be more affordable, but less healthy. They may also avoid car repairs, or delay preventive or required medical care since these needs are considered to be less important than the most basic needs. Without access to essential resources, adults and children experience chronic stress. The negative health effects of chronic stress have been explained earlier in this assessment. Providing a range of affordable housing outcomes in closer proximity to jobs, improving transportation options, and increasing opportunities for people to earn higher wages are all ways to reduce cost-burdened household conditions, and are necessary to avoid poor health outcomes.
MIXED-USE PLANNING

One solution that has been used in communities to address some of the challenges of cost-burdened living is mixed-use planning. This type of planning places housing in closer proximity with jobs and essential services. Although a large portion of respondents in the PlanET survey stated they would prefer a home closer to work, homeowners in the region must drive long distances to work due to their inability to afford homes closer to jobs or services.10

Smart Growth America is an initiative focused on enabling community members to create or to choose neighborhoods which promote health, affordability and access to jobs and services. The initiative created measures and evaluated our 5-county region based on the following neighborhood features: residential density; neighborhood mix of uses; strength of activity centers and downtowns; and accessibility of the street network.17 The initiative ranked our region as the eighth most-sprawling of 83 metropolitan areas measured.17

According to the index, the term “sprawl” refers to neighborhoods with:

- Less compact housing
- Reduced proximity of homes to jobs
- Poor street connectivity
- Focus away from town centers17

These features are reflected by relatively high transportation costs and increased distance between homes and jobs or services in the area. A strategy to reduce household transportation costs through improved proximity of homes to jobs, better street connectivity with access to public transit, and localized services in town centers may improve affordability. An emphasis on affordable mixed-use planning can provide opportunities to purchase or rent homes closer to jobs and services. With improved affordability of housing and transportation, the 80 percent of households in our region that struggle with costs will have more opportunity to access essential resources, leading to positive health outcomes and well-being.

Figure 6. Conceptual illustration of the positive feedbacks between the built environment and socioeconomic and health outcomes. Artwork provided by CDC.
HEALTHY COMMUNITIES

DISEASE PREVALENCE

Health statistics in the PlanET Region reflect a national decline of health and a reduced sense of well-being.\textsuperscript{1, 10} In 1970, life expectancy was improving while health care spending was only 7 percent of the gross domestic product (GDP).\textsuperscript{1} Today, one of the most prosperous nations in the world, the U.S. ranks only 32nd in life expectancy, yet spends more of its GDP on health care than most every nation.\textsuperscript{27} By 2019, health care spending is projected to be at least 20 percent of the GDP, with a rise in disease prevalence and a decline in life expectancy.\textsuperscript{5}

The figure could be greater as the projection does not take into account the increased costs associated with the epidemics of obesity and diabetes.\textsuperscript{1} These epidemics have the potential to overwhelm the economy. The National Research Council and the CDC report that one-third of adults and nearly one-fifth of children ages 6-19 are obese.\textsuperscript{1, 28} Among children, the obesity rates tripled from 1980 to 2008.\textsuperscript{28} Related to obesity, CDC found that in 2007, 65 percent of high school students did not get the recommended amount of physical activity for their age range.\textsuperscript{29} The National Committee for Quality Assurance reports that if a child is obese between the ages of 10 and 13, risk for obesity during adulthood is 80 percent.\textsuperscript{30}

In 2007, the cost of diabetes treatment alone was $174 billion in the U.S.\textsuperscript{3} By 2050, diabetes prevalence is expected to increase.
from the current 14 percent to 21 percent, and by some estimates, up to 33 percent. Additionally, associated indirect costs (e.g. lost productivity) will accrue for these conditions along with increased prevalence.

Obesity and diabetes prevalence are regional concerns as well. The obesity rate in Tennessee is greater than 30 percent. The CDC have been tracking increases in obesity for our region through their Behavioral Risk Factor Surveillance System. CDC found that from 2004-2010, the percentage of those in the five-county PlanET Region who self-reported obesity increased from 25.5 percent to 30.5 percent.

According to CDC, diseases and health complications associated with obesity are:

- Type 2 diabetes
- Heart disease, high blood pressure, and high cholesterol
- Cancers, such as endometrial, breast and colon
- Liver and gallbladder disease
- Sleep apnea and respiratory problems
- Osteoarthritis
- Reproductive complications
- Mental health conditions

Clearly, diseases attributable to obesity cause negative health effects, extreme cost and reduced productivity. These burdens collectively jeopardize quality of life and strain the economic strength of the region. Diabetes, heart disease and cancer alone have dramatically affected many in our region. However, as studies suggest, by addressing the root causes for the obesity epidemic, we have the opportunity to reduce incidence of multiple diseases.

In 2006, the State of Tennessee released a report on obesity and its associated costs. The report emphasized the importance of the Surgeon General’s remarks from 2001 regarding the determinants of obesity:

“Successful efforts... must focus not only on individual behavioral change, but also on group influences, institutional and community influences, and public policy. Actions to reduce overweight and obesity will fail without this multidimensional approach. Furthermore, actions aimed exclusively at individual

Avoidable Economic Impact (in billions of dollars)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Obesity</th>
<th>Other factors</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancers</td>
<td>$85</td>
<td>$312</td>
<td>$397</td>
</tr>
<tr>
<td>Heart disease</td>
<td>$73</td>
<td>$118</td>
<td>$191</td>
</tr>
<tr>
<td>Hypertension</td>
<td>$100</td>
<td>$87</td>
<td>$187</td>
</tr>
<tr>
<td>Diabetes</td>
<td>$52</td>
<td>$39</td>
<td>$92</td>
</tr>
<tr>
<td>Stroke</td>
<td>$3</td>
<td>$15</td>
<td>$18</td>
</tr>
</tbody>
</table>

Figure 7: Avoidable economic costs attributable to a decline in obesity. The Milken Institute, 2007.
behavioral change, while not considering social, cultural, economic, and environmental influences, are likely to reinforce attitudes of stigmatization against the overweight and obese.”

The Surgeon General’s findings underscore the importance of a focus on the determinants of health for a successful solution. The 2012 National Prevention Council Action Plan, developed by a cross-sector collaboration of federal partners, identifies several recommendations relevant to PlanET for reducing disease prevalence, including improving agricultural policies and practices to reflect nutritional goals, increasing healthy food availability in underserved communities, promoting alternative transportation options to encourage active transportation, and supporting mixed use and compact development to promote active lifestyles.

Asthma is another disease with significant prevalence in our region. In 2006, asthma prevalence in Tennessee was 8.5 percent, while among TennCare enrollees, the rate was 10.6 percent. The Tennessee Department of Health reports that as income and education decrease, asthma prevalence increases. Individuals in Tennessee with incomes less than $15,000 had double the rate of asthma at 16.8 percent compared to those with greater incomes at 7.2 percent. For those with less than a high school education, asthma rates are 14.3 percent compared to those with at least a high school education, who had rates of 7.6 percent.

From 2001 to 2009 more than 4 million additional people were diagnosed with asthma, an increase from 1 in 14 in 2001, to 1 in 12 in 2009. The condition was linked to approximately nine deaths per day in 2007. Among black children, asthma prevalence has increased by almost 50 percent from 2001-2009. In fact, 1 in 6 non-Hispanic black children experienced the effects of asthma in 2009.

Identification of the determinants of this condition will reduce prevalence, thereby decreasing suffering, lost productivity and treatment costs. Particularly in children, chronic stress along with a sudden negative event increases the risk of an asthma attack. Recent research suggests that among children with asthma, “interventions to reduce real-life stress may protect against the relatively greater increases in airway inflammation.” Therefore, access to essential resources such as employment security, reduction of costs for basic needs, or access to a safe environment is a determinant of health. The role of environmental factors in asthma incidence and its reduction will be explored in a following section of this report.
Access to care

Another essential resource for positive health outcomes is access to care. The Institute of Medicine defines access to health care as “the timely use of personal health services to achieve the best health outcomes.” The HHS Agency for Healthcare Research and Quality (AHRQ) explains that improved health outcomes can be achieved by following these vital steps:

- Gain entry into the health care system
- Obtain access to sites of care where patients can receive needed services
- Find providers who meet the needs of individual patients and with whom patients can develop a relationship based on mutual communication and trust.

The AHRQ National Healthcare Disparities Report cautions that these vital steps are compromised when “racial and ethnic minorities and people of low socioeconomic status (SES) are disproportionately represented among those with access problems.” For some of the members of our region, access to care is limited by cost-burdened situations, lack of availability/affordability, or inequality or trust.

Reasons for limited access vary from inability to pay, lack of providers or services in an area, or a feeling of distrust or misunderstanding due to cultural or background differences. A major obstacle for our region is the proliferation of low and middle-income households that do not have access to health care benefits. This group, known as the “working poor”, does not qualify for TennCare, but cannot afford to pay for preventive or essential health care. The balancing act of cost-burdened living often necessitates delay or refusal of preventive or essential health care.

Further, access to health care is reduced in the region within areas categorized as “medically underserved.” HHS defines these areas by their shortage of health care providers or facilities, increased population aged 65 or over, percentage of population with incomes below the poverty level, and increased infant mortality. From the Livability Report Card, we know that the baby boomer generation has increased dramatically in our region, causing increased demand for providers and health care services. Although providers and services may be available within the neighborhood, inability to pay or a feeling of distrust may prevent access. For maximum success as a region, we must choose a plan which will reduce these medically underserved areas and improve access to health care for all, and consequently opportunity for optimal health.
HEALTHY FOOD

Some of the health conditions with the most negative, costly effects are diabetes, heart disease and cancer. These diseases can be linked to obesity, which is on the rise.28 Indeed, many public health and government agency plans are directly targeting obesity reduction as a method to reduce disease prevalence. For the PlanET Region, designing a strategy to reduce obesity is a key element to reduce disease, improve well-being and plan for sustainability.

A diet of safe, healthy foods is associated with lower risk for obesity and improvements in overall health.39 However, several factors may hinder availability or choice of healthy foods. The U.S. Department of Agriculture (USDA) identifies factors which prevent healthy food choice as:

- Store proximity, lack of transportation to a store
- Food prices, inability to pay for healthy foods
- Food and nutrition assistance programs
- Community characteristics, lack of stores with healthy food options.40

The 2008 Farm Bill defined a “food desert” as an area in the U.S. with limited access to affordable and nutritious food, particularly an area composed of predominantly lower income neighborhoods and communities. While there are many ways to define a food desert, a working group of members from the departments of Treasury, HHS and USDA, who are partnering to expand availability of nutritious food, have more specifically defined a food desert as a low income census tract where either a substantial number or percentage of residents have low access to a supermarket or large grocery store.

A food desert meets both of the following criteria for being low income and having low access to foods:

- The neighborhood qualifies as a “low-income community” if poverty levels are 20 percent or greater or a median income at or below 80 percent of the median family income is demonstrated.41
- There is low-access to healthy food if at least 33 percent of the people within the census tract live more than one mile away from a supermarket or large grocery store (41).
A neighborhood is categorized as a food desert if both low-income and low-access factors are identified. Interventions to mediate food desert situations are given priority funding by the USDA, the Treasury and HHS.41

Lack of healthy food or resources to pay may result in choosing unhealthy food or as the only option available. These choices have the potential to lead to obesity which creates pathways to diseases such as heart disease, diabetes, or even certain cancers.28 According to the USDA’s Economic Research Service, an estimated 23.5 million people live in food deserts and more than 50 percent of those people are considered low-income.40 For 10 percent of those in rural areas, access to healthy food options can be more than 10 miles away, especially significant for those with limited or expensive transportation.40

A report describing the lack of access to healthy food has been funded by the Department of the Treasury. The report determined that, from a review of multiple studies, supermarkets can be important points of access to healthy foods.39, 42 For 2011, the project provided a map of areas in our five-county region which have limited access to supermarkets. Areas in Union and Loudon Counties and in central Knox County have been identified as areas where the ability to travel to or the distance to a supermarket is greater than average distances traveled by residents in the region who have above moderate incomes.42

Figure 10. Food desert locations in the five-county PlanET region. The Reinvestment Fund, 2012.

Food Desert:
Limited access to healthy foods due to availability or affordability

<table>
<thead>
<tr>
<th>County</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Union</td>
<td>0.05%</td>
</tr>
<tr>
<td>Anderson</td>
<td>4.86%</td>
</tr>
<tr>
<td>Blount</td>
<td>9.53%</td>
</tr>
<tr>
<td>Knox</td>
<td>11.26%</td>
</tr>
</tbody>
</table>

Table 2. Percentage of households in the PlanET Region with both low income and low access to stores, 2010. USDA Economic Research Service, 2012

To improve access to essential resources in our area, planning must include reduction of food deserts through improved affordability and availability of healthy foods. Denying some members of the region the ability to choose safe, healthy foods due to cost, transportation difficulties, or variety of market options can only hinder the region’s goal of sustainability and well-being.
PHYSICAL ACTIVITY

The CDC estimates that more than $75 million in health care costs can be linked to lack of physical activity.29 The agency found that in 2007, less than 50 percent of adults in the country reported enough physical activity to gain health benefits and as reported earlier, 65 percent of high school aged children did not receive enough physical activity for health benefit.29 In numerous studies over the last decade, physical activity has been shown to reduce risk for obesity.29, 39, 43

Currently, with the region’s development patterns of less compact housing, limited street connectivity and a focus away from town centers, residents of our region may be challenged to engage in more physical activity. For our five-county region, data show that only slightly more than 50 percent of households are located within one mile of a public park. As well, 36 percent of those aged 65 or older reported having a disability in 2010, and 12 percent of those reported incomes below the poverty level, further reducing opportunity to access open spaces or recreational activities. To complicate the issue, reduced physical activity is on the rise among all of our population over age 65.30 By age 75, one-third of men and one-half of women will typically engage in no physical activity.30 From a cost standpoint alone, health care costs are estimated to reduce by $5,300 per year if older adults increase their physical activity to at least 90 minutes per week.30

To improve opportunities for physical activity, and thus reduce the burden of chronic disease in our region, future development should: support improved transportation options, including public transportation, walking and bicycle infrastructure; reduce the distance and improve connectivity between homes, jobs and essential services to allow walking or biking as a transportation option; and provide open space and parks so that members of our communities will have the option to be physically active.
ACCESS TO ACTIVE TRANSPORTATION INFRASTRUCTURE

WALKABILITY

When planners speak of “walkability,” they are referring to “the extent to which the built environment facilitates or hinders walking for purposes of daily living.” A wealth of recent studies has focused on identification of the variables which may affect walkability or predict the choice to walk to destinations including the demographics and design features of an area.

The effort to define walkability requires cooperation by many disciplines to produce measures related to the design of an area. Some of these measures include availability of healthy food options, green space and park availability, transit options or sidewalk design, or land use and zoning factors. Social factors are analyzed including socioeconomic status, rates of crime, social cohesion or engagement, group interaction or relative age and health status of the population.

To further explain walkability, psychosocial factors are tested. For example, researchers seek to understand perceptions of safety or route choices. Walkability can be perceived by the individual as a “feeling of physical and psychological well-being” which can be linked to perception of a “sense of place” and “identity within ones surroundings.”

Predicting factors which explain choice to walk will benefit planners as they determine the design strategy which will represent simultaneously the most effective use of resources and health promotion.

In 2004, the Georgia Institute of Technology released results of a seven-year study, Strategies for Metropolitan Atlanta’s Regional Transportation and Air Quality. A cross-sectional survey of more than 10,000 people over two years was conducted using measures of street connectivity, residential density and land-use mix within a one kilometer (0.62 miles) distance of residence. After adjusting for socio-demographic factors, it was discovered that for every hour spent in a car per day, likelihood of obesity increases by 6 percent.
Researchers also found that as land-use mix diversifies, with a mix of business and residence for ease of walking and connectivity, likelihood of obesity decreases by 7 percent. Each additional kilometer (0.62 miles) per day of walking reduces the risk of obesity by 4.8 percent, a distance frequently covered by those walking to and from mass transit stops on one or both ends of a trip. As “land-use mix, residential density, employer density and street connectivity” increase, residents experience “fewer vehicle miles traveled; reduced emissions; greater use of public transit; and increased physical activity.” In summary, these researchers substantiated the idea that walkability improvements and auto dependency reduction “can be as effective as health interventions” in combating obesity.45

Cost savings is another benefit of walkability. The average two-car household in a “highly walkable neighborhood” was found to use 25 percent less gasoline than a household of similar size in one of Atlanta’s least walkable neighborhoods. Even greater savings could be realized if a family could reduce car ownership due to a more walkable neighborhood. Monetary gains are not the only benefit of reduced car ownership.
BIKEABILITY

The health benefits discussed in the previous section for improving walkability in our communities are applicable to bikeability as well. Since bicycling allows a four-times greater distance to be covered in a given amount of time, improving bikeability in less densely developed areas is a complementary strategy to improving walkability in more densely developed areas, to bring the health benefits of active transportation to the greatest number of residents possible. Since more than 90 percent of the roads in our region do not have sidewalks, in many areas bicycling will be the manner in which active transportation comes to a neighborhood, in order to spread the limited capital available for infrastructure improvements to positively impact the widest number of people possible.

The Alliance for Biking and Walking, an advocacy group promoting active transportation, has evaluated data for miles of bike lanes and shared use paths for the 50 largest cities in the United States. Where bike lanes are expanding (not only large cities such as New York, but smaller cities including Portland, Ore., and Boulder, Colo.) bicycling numbers are rising rapidly. In our region, the Knoxville Regional Transportation Planning Organization (TPO) has developed a bicycle program and released a Regional Bicycle Plan in 2009, which includes a number of performance measures and goals. The plan reported (based on information from the U.S. Census and the CDC’s Behavioral Risk Factor Surveillance System) that nationally, about 0.4 percent of workers commute by bicycle. In Knoxville, approximately 0.25 percent of workers commute by bicycle and in Knox County that number drops to 0.12 percent. Surrounding counties have similar, or lower, percentages to Knox County. However, counts of bicyclists conducted locally twice a year show that bicycling is on the rise. Bicycle counts conducted at locations since 2005 were up an average of 87.5 percent by 2009; counts at locations conducted since 2007 were up an average of 41.5 percent.

While concern about potential costs of adding bicycle infrastructure is appropriate, it must be kept in mind that bicycle-friendly communities can benefit through economic development in addition to the cost savings from reduced health expenditures. As noted in the Regional Bicycle Plan, local counties “...have significant potential for bicycle tourism because of the proximity to the Smoky Mountains. Bicycle tourism includes lodging, restaurants and bicycle rentals that cater to the bicycle tourist. Bicycle tourism can have tremendous economic impacts. In Maine, a study by Wilbur Smith Associates estimated that bicycle tourism generates $61.3 million a year in economic activity. The study also reports that 1,200 full-time jobs are attributable to bicycle tourism, totaling $17.9 million in wages (average salary of $14,900).”
Benefits of increased physical activity, improved social cohesion and community building, and reduced pollution to the environment are additional advantages of walkability which eventually improve the health of the population.

HHS, in their Healthy People 2020 initiative, identifies one of the project’s primary goals as “creation of social and physical environments that promote good health.” HHS defines physical determinants, or structural influences to health, as:

- Natural environment, such as green or open space
- Built environment, such as sidewalks, roads or buildings
- Worksites, schools and recreational settings (also referred to as “place”)
- Housing and community design
- Exposure to environmental toxins and physical hazards
- Physical barriers, especially for people with disabilities
- Aesthetic elements, such as trees and benches

As part of our effort to promote successful, sustainable development as well as health and well-being, planning for physical environments which promote health is an integral component of the process. Clearly, PlanET is an opportunity to offer the residents of our region the opportunity to access and choose options demonstrated to benefit their health.
### PERFORMANCE MEASURES FOR 2009 BICYCLE PLAN

<table>
<thead>
<tr>
<th>Performance measure</th>
<th>2009 baseline</th>
<th>2010</th>
<th>2011</th>
<th>Target</th>
<th>Frequency of data collection</th>
<th>Responsibility of data collection</th>
<th>Status notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of bicyclists observed at count locations in TPO area</td>
<td>See bike/pedestrian counts chart</td>
<td>See counts</td>
<td>See counts</td>
<td>Double the average 2007 - 2011; Triple by 2015</td>
<td>Twice a year</td>
<td>TPO, member agencies; UT</td>
<td>Meeting goal at many count locations</td>
</tr>
<tr>
<td>Number of bicycle racks installed through the TPO grant program</td>
<td>411 as of July 2009</td>
<td>440</td>
<td>460</td>
<td>525 by 2011</td>
<td>Quarterly</td>
<td>TPO</td>
<td>Needs work, but reached 502 in January 2012</td>
</tr>
<tr>
<td>Number of local engineers attending training on bicycle issues</td>
<td>48 in 2007</td>
<td>40 - 50 at TDOT’s in 2010; 3 - 5 at our webinars</td>
<td>3 - 5 at TPO-hosted webinars</td>
<td>Average of five at each training opportunity</td>
<td>Annually</td>
<td>TPO and member agencies</td>
<td>On track</td>
</tr>
<tr>
<td>Number of page views on Bicycle Program website*</td>
<td>2,300/month</td>
<td>2,250/month</td>
<td>2,500/month</td>
<td>2,000 by 2011; Double by 2015</td>
<td>Monthly (report annually)</td>
<td>TPO</td>
<td>Exceeded 2011 goal; Switched to Google Analytics in July 2011, resulting in lower but more accurate counts</td>
</tr>
<tr>
<td>Number of fans on Facebook</td>
<td>67 fans as of July 2009</td>
<td>363</td>
<td>651</td>
<td>Double by 2011; Triple by 2015</td>
<td>Annually</td>
<td>TPO</td>
<td>Has exceeded 2015 goal</td>
</tr>
<tr>
<td>Number of people on TPO Bicycle Program email list</td>
<td>1,500</td>
<td>1,679</td>
<td>2,105</td>
<td>2,000 by 2011</td>
<td>Annually</td>
<td>TPO</td>
<td>Exceeded 2011 goal</td>
</tr>
<tr>
<td>Number of Smart Trips participants logging bicycle commutes</td>
<td>165 for May - June 2009</td>
<td>159 for May - June 2010</td>
<td>232 for May - August 2011</td>
<td>250 by 2011; Double by 2015</td>
<td>Quarterly</td>
<td>TPO</td>
<td>Need to work hard to meet 2015 goal</td>
</tr>
<tr>
<td>Number of attendees at Bike to Work Day event</td>
<td>50 (it was rainy)</td>
<td>40</td>
<td>67</td>
<td>Double by 2011; Triple by 2015</td>
<td>Annually</td>
<td>TPO</td>
<td>Need to work hard to meet 2015 goal</td>
</tr>
<tr>
<td>Number of bicyclists in Neighborhood Bike Ride and Tour de Lights</td>
<td>About 350</td>
<td>450 for TDL in 2009</td>
<td>425 for 2010 TDL and 2011 NBR</td>
<td>500 by 2011; 800 by 2015</td>
<td>Annually</td>
<td>TPO</td>
<td>Need to work hard to get back to 2010 level, but TDL is very weather dependent</td>
</tr>
<tr>
<td>Percentage or arterial and major/urban collector roads with bike lanes or shoulders</td>
<td>16.5</td>
<td>16.7</td>
<td>20 by 2015; 30 by 2020</td>
<td>Every two years</td>
<td>TPO and member agencies</td>
<td>2015 target may need to be revised. Difficult to change percentage on such a regional scale</td>
<td></td>
</tr>
<tr>
<td>Number of miles of signed, official bike routes</td>
<td>0</td>
<td>0</td>
<td>20 by 2011; 35 by 2015</td>
<td>Every two years</td>
<td>TPO/member agencies</td>
<td>Project to sign three routes stalled</td>
<td></td>
</tr>
<tr>
<td>Number of miles of linear greenways</td>
<td>75 (See note)</td>
<td>87.4</td>
<td>85 by 2011; 95 by 2015</td>
<td>Every two years</td>
<td>TPO/member agencies</td>
<td>Met 2011 target</td>
<td></td>
</tr>
<tr>
<td>Number of bike shops</td>
<td>15</td>
<td>16</td>
<td>Maintain</td>
<td>Every two years</td>
<td>TPO</td>
<td>Two opened in Blount, but one closed</td>
<td></td>
</tr>
<tr>
<td>Number of bike clubs</td>
<td>7</td>
<td>7</td>
<td>Maintain</td>
<td>Every two years</td>
<td>TPO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of bicycles parked at racks</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>Volunteers</td>
<td>Methodology not yet set up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of rides offered by local shops and clubs</td>
<td></td>
<td></td>
<td></td>
<td>Annually, starting 2010</td>
<td>Volunteers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Page views from April, May, November and December averaged

**Note:** Breakdown of linear greenway miles, 2009: 30 in Knoxville; 7 in Farragut; 7.5 in Knox County; 13 in Alcoa and Maryville; 5.7 in Townsend; 0.8 in Lenoir City; 2.25 in Sevierville; 2 in Pigeon Forge; 7 in Oak Ridge.

2011 additions: 3.15 in Knoxville; 7 in Farragut; 2 in Alcoa (including bike/pedestrian bridge over major road).

**Figure 12:** Performance measures in the Knoxville Regional Bicycle Plan and attainment progress.
Bike to Work Day is an annual event sponsored by the TPO’s Knoxville Regional Bicycle Program.
Our region boasts a wealth of natural resources that benefit our well-being and our economy. Beautiful lakes and rivers, abundant open spaces, agricultural land and the natural diversity of the area support conditions which promote health. Unfortunately, some of those conditions are threatened by pollutants and patterns of development:

- Air quality has been rated as poor in the region due to failure to meet EPA air pollutant criteria for eight-hour ozone and particulate matter.\(^{21}\)
- The Tennessee Department of Environment and Conservation (TDEC) reports that a portion of the area’s waterways and water bodies do not support all designated uses because of several types of pollution, thereby categorizing them as impaired.\(^{48}\)
- Patterns of land use which reduce connectivity, walkability or access to open spaces may cause a reduction in physical activity and increase conditions which promote chronic stress, chronic disease, and reduced life expectancy.\(^{13, 22, 44, 49-51}\)

**AIR QUALITY**

The EPA completed a Health Assessment Document for Diesel Engine Exhaust in 2002. This report revealed that particles from diesel engine exhaust are “highly respirable and able to reach the deep lung” because of their small size.\(^{52}\) The report substantiated the findings that some of the organic compounds within the particles or in gases were “individually known to have mutagenic”[causing birth defects] and
Although dilution and dispersion occurs, the compounds in the emissions can be present in the atmosphere for periods of hours to days allowing dispersal over a wide swath of the region.

The young are at a special risk from many forms of pollution. A 2005 review determined that exposure to environmental pollution while in utero has the potential to affect health negatively. In children, potential causes for increased risk of poor health due to environmental pollution is related to the ongoing development of metabolic systems, immature immunity and defense, the ongoing development of detoxification systems and a higher rate of outdoor activity.

Expectant mothers exposed to high levels of carbon monoxide and air particulates had babies at increased risk for preterm delivery or low birth weight, increased risk of infant mortality in infants aged 1-3 months, increased mortality risk due to respiratory illness for infants up to age 12 months, and an increased risk of Sudden Infant Death Syndrome. After adjustment for other variables, the relative risk of respiratory death and for Sudden Infant Death Syndrome

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**Figure 13. The effects of air pollution for children. UCLA Institute of the Environment and Sustainability, 2008.** (http://www.environment.ucla.edu/reportcard/article.asp?parentid=1700)
in normal birth-weight infants increased dramatically with exposure to particulate matter.\textsuperscript{53} Exposure during development and in childhood also increases risk of disease later in life through damage to the lungs, resulting in a lifelong susceptibility to respiratory infection and reduced lung capacity, and an increased risk of asthma.\textsuperscript{53} Multiple studies have found that when asthmatic children live within 500-1,000 feet of high traffic areas, where carbon monoxide levels emitted from vehicles are elevated, they experienced more frequent emergency room visits or hospitalization compared to those living in low traffic areas.\textsuperscript{53}

The consensus of numerous studies is that poor health outcomes are associated with air pollution exposure, often from areas of high traffic density. While individuals experience lower or higher exposures to vehicle exhaust dependent upon their circumstances, EPA advises that “a cancer hazard for diesel exhaust at environmental levels of exposure” exists, as well as a risk for non-cancerous effects (such as promotion of respiratory and cardiovascular illness) particularly affecting subgroups such as “infants/children, the elderly, or individuals with preexisting health conditions.”\textsuperscript{52}

Negative health effects on children living near highways included a higher prevalence of asthma and allergy symptoms reported, and concentrations of pollutants were found to be higher inside local schools.\textsuperscript{20} Health impacts were stronger on children living within 300 meters of a road.\textsuperscript{20} Concentrations of air pollutants in and outside schools near highways are significantly associated with distance, traffic density and composition, and time spent downwind.\textsuperscript{54} As truck traffic increased, concentrations of soot and particulate matter significantly increased, while levels of these particles diminished in both outdoor and indoor air with increased distance from the highway.\textsuperscript{54}

Residents of our region consistently express concern regarding poor air quality and its potential health impact. Finding ways to address these issues as part of a strategy for healthy and sustainable economic growth in our region over coming decades is essential to maintain the quality of life that current residents find precious and which is a major selling point attracting newcomers to our area. Fortunately, several of the growth strategies already discussed as promoting healthier living in other ways have the added benefit of reducing vehicle traffic and thus cutting one of the major sources of air pollution. While some changes to reduce air pollution will require actions at the federal level to address the two largest contributors to regional air quality problems - vehicle and power plant emissions - there are other, more localized and common-sense actions that can be taken to reduce exposures and resulting health effects. These include siting schools, athletic facilities or care facilities for the elderly away from highways, and developing policies for school drop-off and pick-up that reduce exposures to fumes from idling vehicles. Tools such as zoning policies could be used to reduce environmental exposures to promote health in our communities.
WATER QUALITY

Water is abundant in the PlanET region, however many waterways and water bodies have been designated as impaired by TDEC. Pollutants affecting local waterways include sediment/silt, pathogens and nutrients. These pollutants are the result of agricultural operations, modification to the waterway, discharge from municipal processes, and construction. For the entire state in 2012, TDEC estimated that 42 percent of the streams assessed do not fully support their designated uses due to pollutant load.

In the more developed parts of our region, a significant source of pollution to our water resources is construction and runoff from storm water drains. These drains collect water runoff from yards, parking lots or businesses. Known as impervious surfaces, collection points such as parking lots gather pollutants during rain storms, depositing them into nearby waterways. Developed land with impervious surfaces increases risk that pollutants will enter the waterway through storm water drains. Downstream, the impacts include increased costs for drinking water treatment, loss of recreational opportunities where waterways are not safe for fishing or swimming, and environmental degradation. In less developed areas, waterways may be degraded because of soil erosion or agricultural runoff of pesticides, herbicides, and/or fecal bacteria contamination. Riparian (streamside) buffer zones can help prevent such contamination of waterways.
Degraded water quality can become a health concern in several ways:

- Drinking water treatment facilities may not remove all contamination from a polluted waterway, causing a waterborne disease outbreak. Even when operating properly, the treatment process itself can also result in creation of trihalomethanes (compounds such as chloroform) that pose a low-level risk of cancer, especially when the water supply is muddy or contaminated with organic matter and chemicals.

- Direct contact with contaminated water (typically posted as “no swimming” area) can result in increased cases of gastrointestinal illness, skin rashes, and potentially parasitic infections.

- Eating fish from contaminated water bodies (typically posed as “no fishing” area) can result in ingestion of excessive amounts of the contamination found in the waterway. Locally, for example, PCBs (polychlorinated biphenyls, formerly used in transformers) and mercury are contaminants of concern in local river sediments.

- There is an economic impact when “no swimming” and “no fishing” areas are posted, from loss of tourist dollars to decreased attendance at riverfront events and venues, as well as lost sales in the recreational boating industry and businesses supporting such activities. And as noted in an earlier section, economic damages translate into health impacts over the community as a whole.

As with clean air, preservation of clean water has direct and indirect benefits to the community as a whole which are only incompletely captured by standard economic analyses. As a result, the direct costs to a developer or industry for taking actions to preserve the resource are readily measured, while the avoided costs of illness or degraded quality of life are not. Tools such as environmental and health impact statements can help document these considerations as part of decision-making for specific projects. While much of the enforcement of the Clean Water Act happens at a state or federal level, local actions to protect waterways are possible, such as requiring preservation of riparian lands, development that avoids impervious surfaces and preservation of wetlands. Because much of our region is built on karst (“spongy” bedrock that acts as a ready route for groundwater – and well water – contamination), policies that avoid inappropriate development of such areas are a wise precaution to protect the water supply of current and future generations.
**LAND USES**

**FARMLAND AND OPEN SPACE**

Preservation of farmland is an important focus for our community as identified by participants in the PlanET public forums. Not only do local farms provide needed healthy foods, they are an important aspect of our heritage and the region’s natural beauty. Although some agricultural processes may add to the pollutant load in our waterways if managed injudiciously, the overall health benefit obtained through farmland preservation is significant. Lightly developed rural areas – both farmland and lands preserved as “open space” for future generations to use or enjoy in their natural state – offer valuable “ecosystem services” in terms of air and water purification, pollination of crops, and control of crop pests and mosquitoes by birds and bats that benefit all residents of our area, and beyond. Adopting a more dense model for future growth of the community will preserve our remaining rural areas for local farmers while encouraging healthier, more walkable or bikeable communities in our urban areas. Policies promoting markets for products of local farms can simultaneously address issues like food deserts (discussed previously) and promote ongoing stewardship of our rural areas for future generations.

**Table 3. Percent of developed land cover in the PlanET region. USDA CropSpace GIS analysis.**

**Developed land cover type**
- **Developed Open Space**: Impervious surfaces are 20% or less of total cover.
- **Developed Low Intensity**: Impervious surfaces are 20% - 49% of total land cover.
- **Developed Medium Intensity**: Impervious surfaces are 50% - 79% of total land cover.
- **Developed High Intensity**: Impervious surfaces are 80% or more of total land cover.
**Brownfields**

Brownfields are defined as a vacant property with the “presence or potential presence of a hazardous substance, pollutant, or contaminant,” usually because of a particular business located on the property perhaps many years earlier. When left abandoned they are a potential source of pollution in our communities, most commonly in urban areas, but potentially even in rural areas (such as farm chemical suppliers or former mines and tailings) as well as a loss of valuable real estate from potential use. Threats to environmental health may exist from biological, physical or chemical contaminants on these properties, which range from leaking underground storage tanks (such as at a former gas station) that might contaminate residential well water, through “normal” levels of contamination at a business (what EPA refers to as RCRA corrective action sites) to major environmental and health threats that become “Superfund” sites. These contaminants may run off into storm water drains, into the groundwater, or by migration; individuals (such as exploring children) venturing onto such sites may also be directly exposed to chemical contamination.

Remediation and reuse of these areas provides economic benefits, as typically well-located parcels are returned to productive use in the community and potential health threats are ameliorated. “Recycling” of brownfields supports the preservation of farmland discussed above, by providing “infill” properties for development instead of converting open space or farmland for other uses. While there may be cleanup costs compared to developing a remote “greenfield” site, the cost to provide utilities (partially borne by the community) are less, and the health and economic benefits of more compact development which accrue to the community as a whole often justify use of zoning or tax tools to facilitate such redevelopment.
Determinants of Health
Health Outcomes and Equity

While most of the factors affecting health considered so far in this report are physical impacts on individuals, there are also a range of social realities – the way we choose to live together in society – that impact health as well. These factors are referred to as “social determinants of health.” The idea of social determinants of health has been characterized as “a concept designed to highlight the impact of living and working conditions, and patterns of social and economic relationships, on the health of individuals and groups.”56 A 2008 report explains that the social determinants of health impact individuals through the “immediate and structural conditions in which people are born, grow, live, work, and age.”16 In its Healthy People 2020 goals, HSS defines the social determinants of health to include “environments in which people are born, live, learn, work, play, worship, and age that affect a wide range of health, functioning, and quality-of-life outcomes and risks.”5 These environments include “school, church, workplace and neighborhood,” which are characterized collectively as “place.”

Social customs, public policy and economic structures are among the ways through which the social determinants of health impact the well-being of individuals.16 Factors such as “income, education, occupation, gender, race/ethnicity and others” serve to define how these effects occur.16 Unfortunately, health inequity can be a negative outcome of these effects. Distribution of the resources necessary for a healthy life are often unevenly distributed among the population.5, 16
An Executive Order in 1994 directed the federal government to address issues affecting equity and health, and calls for each federal agency to “make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities.”

HHS explains that health equity “requires valuing everyone equally with focused and ongoing societal efforts to address avoidable inequalities, historical and contemporary injustices, and the elimination of health and healthcare disparities.”

A health disparity exists when disadvantage is experienced by a particular group. Typically, the disparity is realized as a “a particular type of health difference that is closely linked with social, economic, and/or environmental disadvantage.”

One measure of our success in achieving healthy growth for our community in coming decades will be the degree to which we eliminate health inequity and health disparities in our region. Poverty and low educational attainment create a disparity for risk of chronic disease and reduced life expectancy. Children living in poverty are seven times more likely to have poor or fair health than those whose parents obtained college degrees. Income potential is reduced for these households as well. The median income for male college graduates is more than twice that of high school drop-outs and 60 percent higher than male high school graduates. These circumstances lead to poor health for children in low-income households through limited access to healthy food, safe housing, physical activity/open spaces, and high quality schools. Since children who experience poor or fair health in childhood are likely to continue in poor health into adulthood, the effects - for individuals, families, and the regional economy and society as a whole - continue across generations unless the “cycle of poverty” is broken.

The pattern of poor health outcomes for those of low-income or low educational attainment is reflected in a gradient of socioeconomic conditions. Socioeconomic
status refers to the position of the individual within a societal and economic framework, reflecting not only income, but class status as well. Class status may include influence or control in one’s job or position in a community. People in the middle of the gradient are twice as likely to die before age 65 than those at the top of the gradient. People at the bottom are three times more likely to die prematurely as those at the top. On average, American men with the highest incomes live 8 years longer than men in the lowest income group.

Adults in the low-income group are three times more likely to have at least one chronic disease, further limiting the opportunity for well-being, increasing health care cost (a cost often borne by the wider community) and reducing productivity. However, the chronic stress of limited income – as well as conditions of employment insecurity, polluted neighborhoods, unsafe housing, low quality schools, prejudice or racism are not the only cause of these poor health outcomes. Those with four or more years of education past high school are less likely to smoke and to be overweight, for example. Addressing this interrelated web of causes and effects is a major challenge for public health, and a driving factor in the increasing use of tools like HIA to expand the areas where factors impacting the health of a community are considered.

In the final analysis, the choices we make as our community grows over the next thirty years will determine the health of our community at the end of that time. These include collective decisions of how and to what degree we provide support and opportunities for advancement available to the vulnerable—not only in terms of access to medical care, but factors as seemingly unrelated to health as the quality of schools, the prevalence of sidewalks and street lighting, and access to bus routes. They also include the apparently small choices as individuals of where we live, what we buy (locally-grown produce; locally manufactured products), and how we get around the community, the combined effects of which determine which businesses survive and which fail, and whether the money to fund our efforts is circulating within our community or flowing from it.

*   *   *   *   *

Having identified the conditions which limit the potential for productivity and well-being for members of our community, we now turn to considering our options as we plan for how our community will grow in the coming decades. What follows is a consideration of the growth concepts developed by PlanET through the lens of the factors impacting health, discussed in the preceding sections. Improved employment security and access to educational opportunity, reduced cost-burdened living and chronic stress, improved access to healthy foods and physical activity, reduced exposure to pollutants, and improved neighborhood connectivity are goals we can choose as we consider which model for growth will most likely lead to sustainable, equitable development in the region. The historian and sociologist Lewis Mumford, noted for his studies of cities and urban architecture, famously said “Trend is not destiny.” The path we choose into the future, and the cumulative impact from the choice of each step along the way, will determine the community we will live in when we arrive there.
HEALTH ANALYSIS OF REGIONAL GROWTH CONCEPTS

The PlanET project, with input from residents attending PlanET’s public meetings and from the PlanET Working Groups (composed of professionals and interested citizens from throughout the region), developed a series of regional growth concepts to “illustrate the different ways that our region might accommodate the population and job growth that is expected over the next 30 years.”

The growth concepts serve four purposes:

- To illustrate different ways East Tennessee can implement its regional vision
- To identify needed regional investments, particularly in transportation
- To measure each concept’s effect on priority issues identified by residents
- To serve as the basis for creating a preferred regional growth concept and development of strategies for its implementation (see next section).
Alone, none of the individual regional growth concepts is a likely outcome for how the area might actually grow over the next 30 years. Instead, these concepts aid in understanding how different approaches to growth can affect the East Tennessee community as a whole.

The following tables summarize the potential effects on health that would likely result from development in coming decades along the trajectories described by each of the regional growth concepts. Each concept is evaluated for a range of health-related criteria that were discussed in earlier sections of this document, considering the following factors:

- **Likelihood** – How certain is the outcome in relation to the regional growth concept?
- **Severity** – To what degree will health be affected?
- **Magnitude** – What proportion of the population will be affected?
- **Distribution** – How much will it affect one group over another?

Such evaluations cannot be more than estimates, based on the quantitative limits of the concepts themselves. In some cases the health research literature clearly indicates correlations and trends that allow us to make more confident extrapolations of the potential impacts of a given growth concept. A brief paragraph below each summary table discusses areas where lack of knowledge limits our abilities to make projections, or cases where such projections may be made with more confidence.
“SPREAD OUT” GROWTH CONCEPT MAP

Transportation Enhancements
- Major road improvements
- New/improved roadways
- Limit of local transit service

Distribution of new people and jobs
- People: Some new, More new
- Jobs: Some of new, More than jobs
- Both people and jobs: Some of new, More of both
Table 5. Health Analysis Summary, “Spread Out” Growth Concept.

**Observations:** With a strong preference for developing open space into extensions of our community, this concept has a large potential for environmental impacts to health. Large travel distances between home, work, and other activities will increase traffic volume, time spent in traffic, and vehicle emissions. Large investments in infrastructure like water/sewer lines and new schools will be needed relative to other options. These costs may hamper ability to invest in other areas, including maintenance of existing infrastructure, resulting in a “hollowing out” of the core of existing cities. Rural areas are likely to lose farmland as family farms are sold to developers, but they may gain access to jobs and healthcare as development moves outward. The decline of central city areas will increase the likelihood of urban food deserts while remote rural areas may find greater access to newly-built shopping. Walkability and mass transit access will be problematic, as the low-density pattern of development will make infrastructure from sidewalks to bus routes prohibitively expensive, adding to the necessity of driving and resulting cost burdens and stress on those of lower SES. With economic opportunities concentrated at the edges, urban schools will likely suffer neglect and decline, continuing cycles of poverty. Unfortunately, this growth concept reflects current “business as usual” in our region.
“GROW CORRIDORS” GROWTH CONCEPT MAP

Transportation Enhancements
- Major road improvements
- New/improved roadways
- Limit of local transit service
- Park and Ride service
- Park and Ride stations

Distribution of new people and jobs
- People
  - Some new
  - More new
- Jobs
  - Some
  - More
- Both people and jobs
  - Some new
  - More jobs
  - More people
  - More of both

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HEALTH ANALYSIS SUMMARY OF “GROW CORRIDORS” GROWTH CONCEPT

<table>
<thead>
<tr>
<th>Priority area</th>
<th>Probable impact</th>
<th>Likelihood of impact</th>
<th>Likely severity of impact</th>
<th>Expected magnitude of health impact</th>
<th>Likely distribution of impact across specific groups</th>
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<tr>
<td>Employment security</td>
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<td>Moderate-large</td>
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<td>Moderate-high</td>
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<tr>
<td>Public transit use</td>
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<td>Likely</td>
<td>High</td>
<td>Substantial</td>
<td>Unequal</td>
</tr>
<tr>
<td>Cost-burdened living</td>
<td>Increase</td>
<td>Likely</td>
<td>High</td>
<td>Substantial</td>
<td>Unequal</td>
</tr>
<tr>
<td>Mixed-use planning</td>
<td>Some decrease</td>
<td>Likely</td>
<td>High</td>
<td>Substantial</td>
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<tr>
<td>Disease prevalence</td>
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<td>Varies by area</td>
<td>Substantial</td>
<td>Unequal</td>
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<td>Access to care</td>
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<td>Varies by area</td>
<td>Substantial</td>
<td>Unequal</td>
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<td>Access to healthy food</td>
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<td>Moderate</td>
<td>Varies by area</td>
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<td>Air quality</td>
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<td>Substantial</td>
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<td>Water quality</td>
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<td>Moderate</td>
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<td>Redeveloped acres</td>
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<td>Likely</td>
<td>High</td>
<td>Moderate</td>
<td>Unequal</td>
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</tbody>
</table>

Table 6. Health Analysis Summary, “Grow Corridors” Growth Concept.

Observations: Like the “spread out” growth concept, “grow corridors” develops open space, but with a focus on growth along highways. This concept also has a large potential for environmental impacts to health. While travel distances and vehicle miles travelled between home, work, and other activities may not be as great as for “spread out,” the concentration of development along highways increases opportunity for exposure to vehicle emissions. Large investments in infrastructure are likely for this concept, but not as great as “spread out”. The “hollowing out” of urban cores remains a problem. Rural areas may not lose as much farmland to developers, but rural access to jobs and healthcare may not increase unless one lives near a highway. As a result, there may be both urban and rural regions of food deserts or low access to medical care. If development density along the highways is sufficient, mass transit access may be possible, but this model is unlikely to increase walkability or access to parks for exercise. Economic growth and opportunities are again concentrated at the edges, so urban areas will again likely suffer neglect, continuing cycles of poverty.
“GROW CITIES & TOWNS” GROWTH CONCEPT MAP

Transportation Enhancements
- Major road improvements
- New/improved roadways
- Limit of local transit service
- High-frequency local transit
- Regional express bus
- Express bus (low frequency)

Transit access
- Station
- Stop
- Park and ride

Distribution of new people and jobs
- People
  - Some new
  - More new
- Jobs
  - Some new
  - More than jobs

Both people and jobs
- Some of new
- More people than jobs
- More of both
### Health Analysis Summary of “Grow Cities & Towns” Growth Concept

<table>
<thead>
<tr>
<th>Priority area</th>
<th>Probable impact</th>
<th>Likelihood of impact</th>
<th>Likely severity of impact</th>
<th>Expected magnitude of health impact</th>
<th>Likely distribution of impact across specific groups</th>
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<td>Cost-burdened living</td>
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<td>High</td>
<td>Substantial</td>
<td>Equitable</td>
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<tr>
<td>Mixed-use planning</td>
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<td>High</td>
<td>Substantial</td>
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<td>Access to care</td>
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<tr>
<td>Access to healthy food</td>
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<td>Equitable</td>
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<td>Access to open space/recreation</td>
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<td>Moderate</td>
<td>Equitable</td>
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</tbody>
</table>

Table 7. Health Analysis Summary, “Grow Cities & Towns” Growth Concept.

**Observations:** This concept reduces travel distances between home, work, and other activities, as well as traffic volume, time spent in traffic, and vehicle emissions; health benefits should result. Investments in infrastructure should be less, although these savings will be partially cancelled by cleanup costs of brownfields. The resulting re-use of prime real estate, however, will avoid the “hollowing out” of the core of existing cities; cities will be fashionable places to spend time and money, offering locally-based economic opportunities. While family farms will be preserved, attention will be needed to developing farm-to-market programs so rural lifestyles will be sustainable. Such efforts will ideally keep money circulating in the region and promoting jobs, while avoiding or addressing food deserts. Alternative transportation modes will be seen as desirable, as they offer ways to avoid the traffic problems that might otherwise occur with high-density development. With economic opportunities accessible by people from all levels of society, pride in the uniqueness of the community is fostered, encouraging efforts to further redevelop, improve opportunities, and end cycles of poverty. Improved health across the community should result, though avoiding pockets of poverty will still require attention.
“GROW NEW CENTERS” GROWTH CONCEPT MAP

Distribution of new people and jobs

- People
  - Some new
  - More new

- Jobs
  - Some new than jobs
  - More jobs than people

Both people and jobs

- Some of new than jobs
  - More people than jobs
  - More of both

Transportation Enhancements

- Major road improvements
- New/improved roadways
- Limit of local transit service
- High-frequency local transit
- Regional express bus
- Express bus (low frequency)

Transit access

- Station
- Stop
- Park and ride

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### Health Analysis Summary of “Grow New Centers” Growth Concept

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<tr>
<th>Priority area</th>
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<th>Likelihood of impact</th>
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<td>Varies by area</td>
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<td>Vehicle miles traveled</td>
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<td>Public transit use</td>
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<td>Cost-burdened living</td>
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<td>Substantial</td>
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<tr>
<td>Mixed-use planning</td>
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<td>Disease prevalence</td>
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<tr>
<td>Access to care</td>
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<td>Access to healthy food</td>
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<td>Access to open space/recreation</td>
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<td>Redeveloped acres</td>
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</table>

**Table 8. Health Analysis Summary, “Grow New Centers” Growth Concept.**

**Observations:** This concept represents a balance between urban and suburban growth. While travel distances, traffic volume, time spent in traffic, and emissions may not be reduced as much as in “grow cities and towns,” a goal of providing multiple transportation options should be possible with judicious development away from the urban cores. Infrastructure savings will not be as great, but implementing pricing for new infrastructure that reflects fully-loaded development costs can keep sprawl from becoming excessive and help maintain an economic basis for brownfield redevelopment and urban growth/renewal. Rural areas will likely be similar to today, so efforts to connect rural producers to urban consumers will again be a wise investment. With economic growth less concentrated in urban areas than the previous concept, addressing social determinants of health in these communities will require more conscious effort, but potential benefits to rural communities in terms of access to jobs, supermarkets, and medical facilities may be greater. This balanced growth may seem a straightforward process to achieve, but tweaking growth policies and ensuring that development costs reflect their true cost in all aspects will involve a lively and ongoing exchange between competing interests.
CONCLUSIONS

This HIA is but one piece of the PlanET process to collaboratively explore the options we choose to determine the kind of community we will live in in future decades. It has addressed a number of interconnected topics and how these affect the community we live in. Having considered the potential positive and negative health impacts of the region’s current and alternative growth trends, recommendations – based on the health literature and on the broad experience of what has been found to work in other communities regarding these issues – are possible. While an HIA is not commonly performed at this broad of a scale, the same principles apply as in performing an HIA for siting a school or considering the ramifications of a zoning ordinance – through the evidence-based review of the implications of a proposed project or policy, identification of the factors affecting public health which might result can be presented publicly to inform decision-making. In that spirit, the following observations are offered:

• Considering the public health implications of economic trends, future growth of our region should aim to maintain a low unemployment rate, since opportunity to achieve well-being and maintain good health is hindered through unemployment or fluctuations in employment security. Economic planning in our region must include strategies to promote equitable access to educational opportunities.

• Education and opportunities to access training result in higher wages and improved employment security which are associated with reduced chronic stress, better access to essential resources and ultimately in improved health outcomes and well-being for area residents. By reducing the portion of income devoted to illness, additional income is freed for growth in other areas of the economy including education, potentially creating a self-reinforcing virtuous cycle.

• Our transportation system offers a number of opportunities to have a positive impact on public health in coming years, by reducing the negative health effects of emissions (through changing vehicles or their fuel); reduced traffic density and congestion; and/or fewer average daily miles driven per person. The latter two options can be addressed by better connectivity between our homes and the necessary aspects of daily living such as work, school or shopping.

• With an average residential density of 1.4 units per acre, the PlanET Region currently lacks the necessary population density to support development of wide-scale public transit, limiting services for most of the five-county region. As the region develops and population increases, however, we have the opportunity through practices such as mixed-use planning to increase the number of dwellings to the 6-8 units per acre that is typically necessary to support a robust public transit system, reduce our auto dependency, and contribute to improved health outcomes in the region.

• Providing a range of affordable housing outcomes in closer proximity to jobs, improving transportation options, and increasing opportunities for people to earn higher wages are all ways to reduce cost-burdened household conditions, and are necessary to avoid poor health outcomes.
The relatively high transportation costs and increased distance between homes and jobs or services in the area can be addressed by a strategy to reduce household transportation costs through improved proximity of homes to jobs, better street connectivity with access to public transit, and localized services in town centers. An emphasis on affordable mixed-use planning can provide opportunities to purchase or rent homes closer to jobs and services. With improved affordability of housing and transportation, the 80 percent of households in our region that struggle with costs will have more opportunity to access essential resources, leading to positive health outcomes and well-being.

- Consistent with recommendations of both the federal government and private foundations, improving agricultural policies and practices can improve public health on the local to regional level by incorporating nutritional goals, increasing healthy food availability in schools, underserved communities, and across the region. Efforts to promote local food production and consumption have a range of benefits such as increasing job security and incomes in our rural areas, increasing a sense of regional identity and cohesion through locally-produced food products, and buffering the local economy from the vagaries of potentially changing food prices due to political instability, disasters, or energy price shocks that could affect transportation costs or availability. Farmers markets and community gardens offer additional tools to decrease “food deserts,” increase a sense of community spirit, and make healthy, affordable food available to all members of the community.

- To improve opportunities for physical activity, and thus reduce the burden of chronic disease in our region, future development should support improved transportation options, including public transportation, walking and bicycle infrastructure; reduce the distance and improve connectivity between homes, jobs and essential services to allow walking or biking as a transportation option; and provide open space and parks so that members of our communities will have the option to be physically active. From a cost standpoint alone, health care costs are estimated to be reduced by $5,300 per year if older adults increase their physical activity to at least 90 minutes per week, and even greater lifetime savings are anticipated for younger people if they avoid obesity and the constellation of illnesses associated with it.

- While some changes to reduce air pollution will require actions at the federal level to address the two largest contributors to regional air quality problems – vehicle and power plant emissions – there are other, more localized and common-sense actions that can be taken to reduce exposures and resulting health effects. These include siting schools, athletic facilities or care facilities for the elderly a set distance away from highways, and developing policies for school drop-off and pick-up that reduce exposures to fumes from idling vehicles. Tools such as zoning policies could be used to reduce environmental exposures to promote health in our communities.

- Lightly developed rural areas – both farmland and lands preserved as “open space” for future generations to use or enjoy in their natural state – offer valuable “ecosystem
services” in terms of air and water purification, pollination of crops, and control of crop pests and mosquitoes by birds and bats that benefit all residents of our area, and beyond. Adopting a more dense model for future growth of the community will preserve our remaining rural areas for local farmers while encouraging healthier, more walkable or bikeable communities in our urban areas, further reinforcing efforts to promote local agriculture and active transportation. In less developed areas, waterways may be degraded because of soil erosion or agricultural runoff of pesticides, herbicides and/or fecal bacteria contamination. Establishing standards of practice for protecting riparian (streamside) buffer zones can help prevent such contamination of waterways.

- Remediation and reuse of brownfields in urban areas provides economic benefits, as typically well-located parcels are returned to productive use in the community and potential health threats are ameliorated. “Recycling” of brownfields supports the preservation of farmland discussed above, by providing “infill” properties for development instead of converting open space or farmland for other uses. While there may be cleanup costs compared to developing a remote “greenfield” site, the cost to provide utilities (partially borne by the community) are less, and the health and economic benefits of more compact development which accrue to the community as a whole often justify use of zoning or tax tools to facilitate such redevelopment.

The careful reader will have noticed that the recommendations above are mutually reinforcing in their promotion of growth of our communities in ways that foster health by providing opportunities for healthy lifestyle choices. Policies that promote increased urban density, for example, decrease air pollution, increase the amount of incidental exercise a person experiences as a part of their typical day, keep more rural land available as farmland or for preservation in a natural state, increase the economic incentives to redevelop brownfields, and decrease the average cost for connecting a residence or business to utilities – freeing that money for productive use elsewhere in the economy. Encouragement of local food production and marketing promotes social cohesion between rural and urban areas, addresses food access in underserved parts of the community, creates new products and employment opportunities in rural areas, and can protect open space and environmental resources for future generations. And widespread availability of quality education and addressing social disparities has throughout history been associated with a healthy, free and prosperous society. These are not new or original ideas with the authors. These are strategies that promote healthy living, economic growth and social cohesion in regions where they have been implemented. They are data-driven, hard-headed best practices that can be implemented in our region as well to achieve a robust future for our communities.

Concerns are sometimes expressed in fields such as public health and urban planning about the potential for “mindless growth” or “blind progress” as if these were forces of nature like the weather. They are not. The factors which determine the manner in which our communities grow or decline, prosper or fail, suffer illness or thrive are ultimately the choices we make and the values we hold dear as we make the large or small changes that make up our individual and collective lives. They will not be any more blind or mindless than we choose to allow them to be.
APPENDIX

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