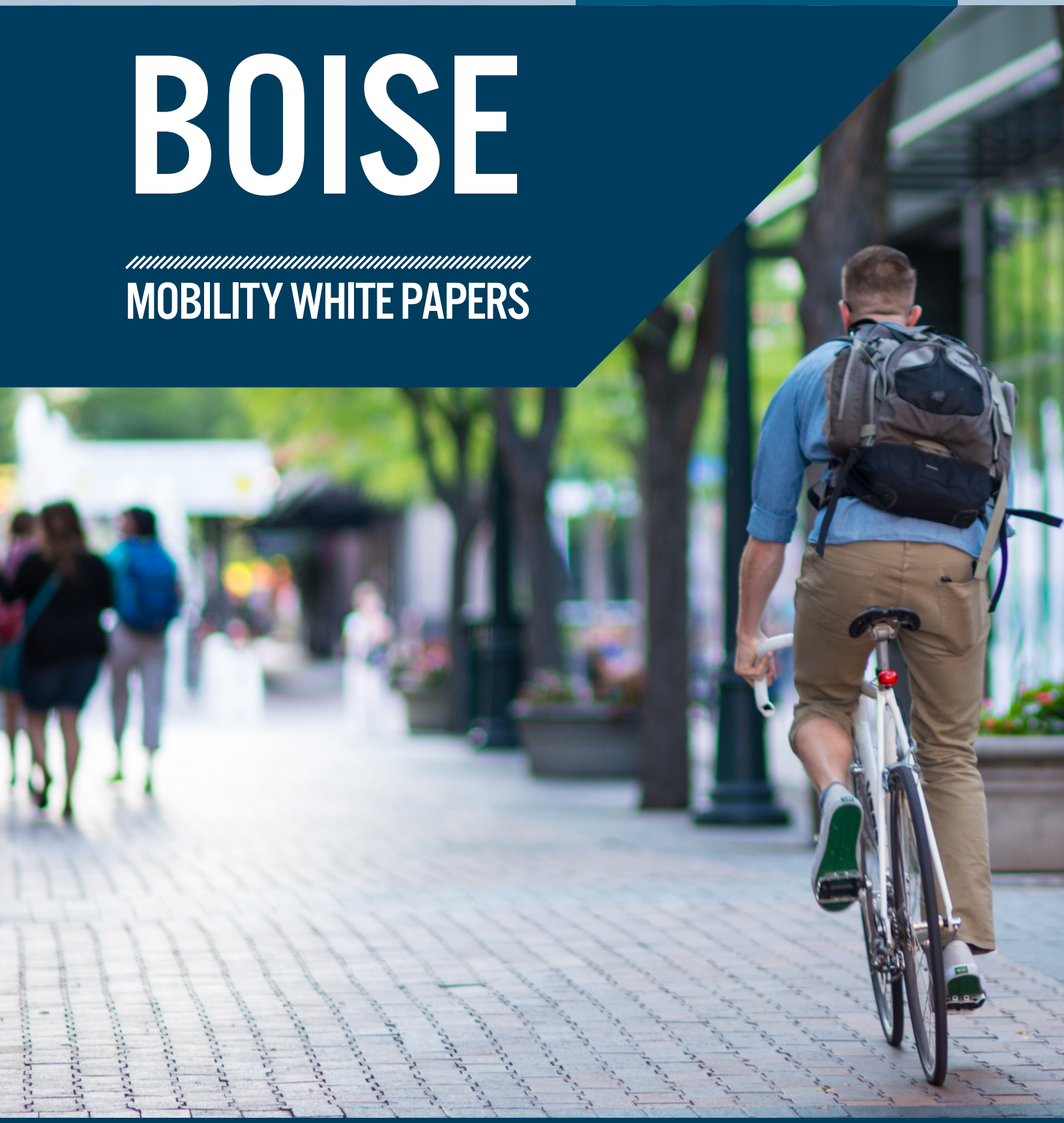
APRIL 2016

BOISE

MOBILITY WHITE PAPERS



TRANSPORTATION ACTION PLAN

BOISE TRANSPORTATION/ACTION PLAN

White paper series

1

THE DEMOGRAPHIC SHIFT

BOISE
CITY OF TREES

1

The Demographic Shift

Across the country more people are expressing a preference for a 'car optional' lifestyle. In order to attract the best talent and investment, cities of all sizes must provide a built environment and a transportation system that supports a range of alternatives to car travel.

Across age groups, there is unmet demand for mixed-use urban, suburban, and small-town neighborhoods.

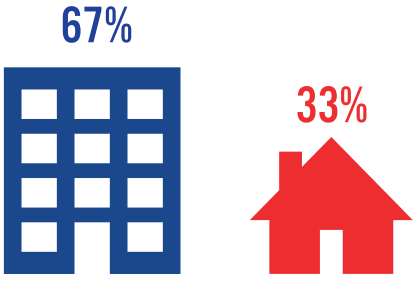
More people—especially young Millennials and Baby Boomers—are expressing a preference for a 'car optional' lifestyle. Neighborhood preferences are changing towards higher density housing options and shorter distances between home, work, and play. New lifestyle choices impact transportation decisions. **Americans are increasingly adopting modes such as walking, bicycling or using transit instead of solely relying on single occupancy vehicles.** Cities must provide a built environment and a transportation system that supports these demographic realities across age groups. To remain competitive, transportation in Boise needs to address the aspirations of millenials and the access needs of aging baby boomers.

Neighborhood Preferences are Changing

More and more Americans are moving to cities, urban areas, or mixed-use suburban 'downtowns' and fewer are choosing a lifestyle in exclusively residential areas. The Millennial generation in particular has shown a preference for denser settlement patterns in cities with easier access to jobs and neighborhood services.

Research shows that many Americans would prefer to live in a different type of neighborhood than they do now. Suburban, residential neighborhoods are the most common type of neighborhood that respondents live in currently, but mixed-use suburban neighborhoods (with a mix of housing, shops, and businesses) are the most desired. In fact, there is unmet demand for mixed-use urban, suburban, and small-town neighborhoods across all age groups. In short, while not all Americans want to move into inner cities, there is widespread demand for walkable cities, suburbs, and towns with more variety of residential and retail.

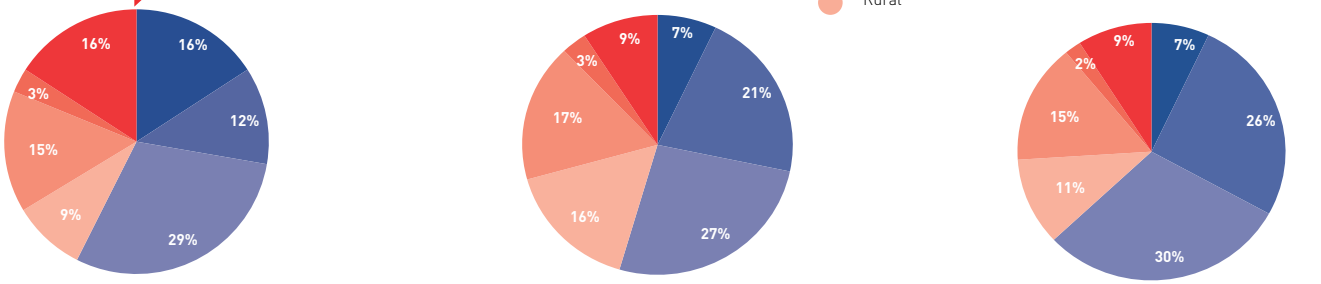
Mixed-use urban centers and villages are growing faster than other neighborhood types.



2010 Seattle Population Increase

Source: Seattle Department of Planning and Development Decennial Census, 2000 and 2010

A majority of people across age groups prefer mixed-use neighborhoods

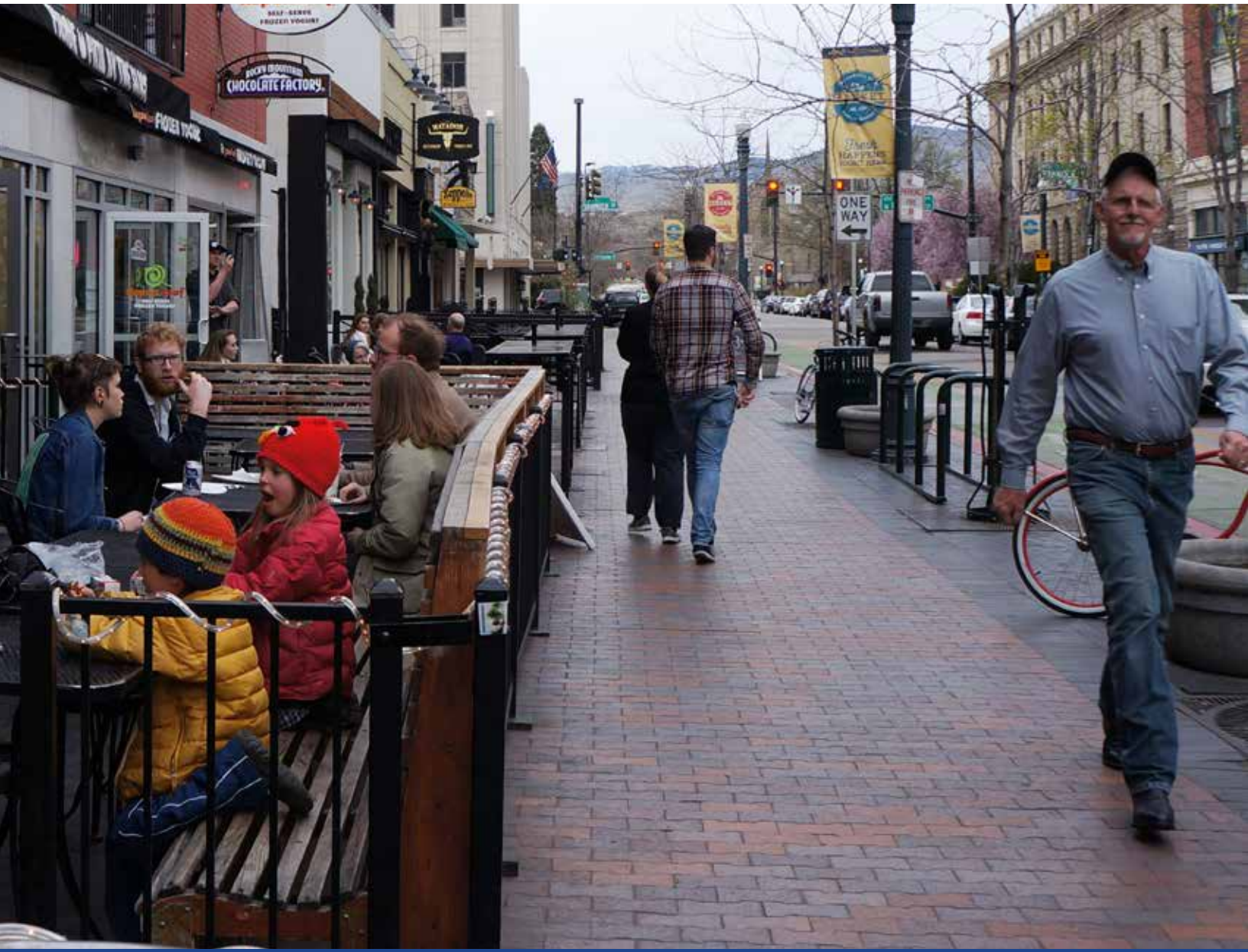


Ideal neighborhood types
People under 30 years old

Ideal neighborhood types
People 30-60 years old

Ideal neighborhood types
People aged 60+

Sources: Transportation for America survey of Millennials; "Who's On Board," TransitCenter, September 2014.



Changes in neighborhood preferences lead to changes in travel modes

With urban living comes a change in travel expectations, namely a desire to travel shorter distances with less time spent behind the wheel of a car. As a result of shifting housing and transportation preferences, **national total vehicle miles traveled on a per capita basis have fallen by more than 10% since peaking in 2005.** Bicycling and walking, meanwhile, although still a small portion of overall trips, continue to grow in popularity.

In many cities across the country, quality transit (high frequency/high reliability) has experienced ridership gains while demand on local bus trips is flat or declining. If Boise wants to increase transit ridership, it may need to consider increasing the frequency and reliability of service along key corridors.

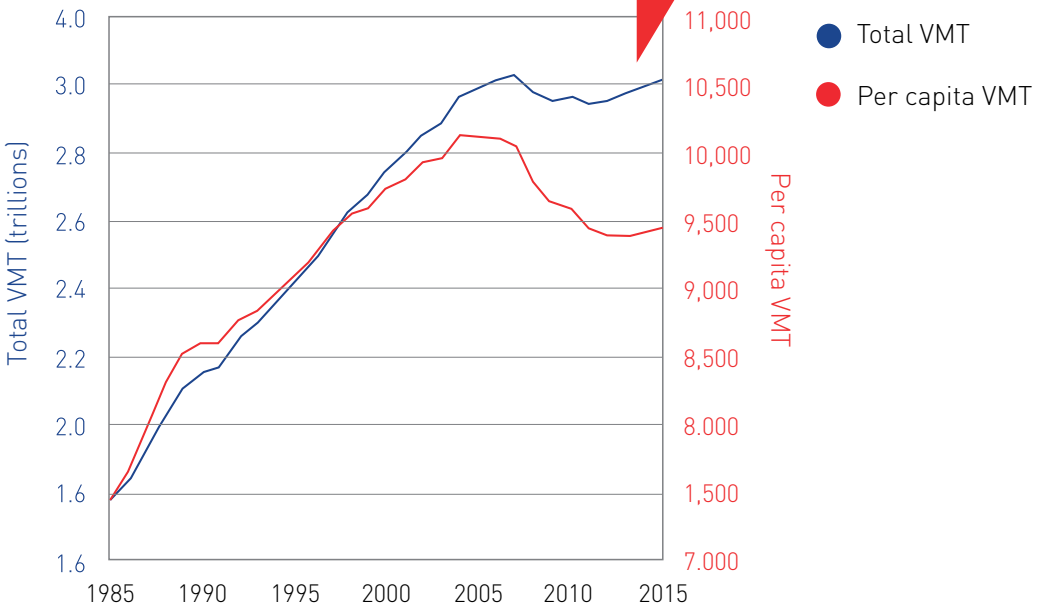
Other cultural trends that are leading to decreases in vehicle reliance include:

- The high cost of driving relative to other modes
- The desire for travel-time reliability, which is significantly higher for biking and walking trips in comparison to driving (and transit)
- Adoption of technology in the "sharing economy" such as car share, bike share, and ride-hail apps—all of which decrease demand for ownership of private vehicles and number of auto trips
- Increased levels of online shopping, which have decreased shopping trips that often occur by car

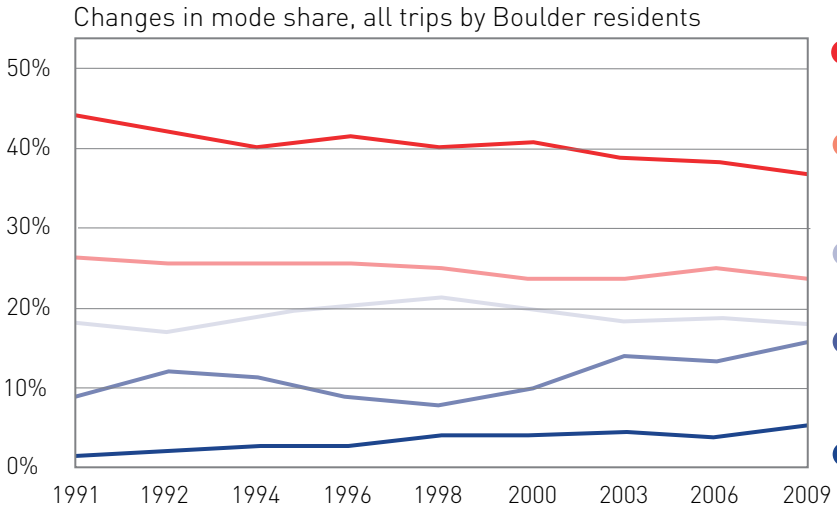
46% of vehicle owners surveyed would consider giving up their car if they could count on a range of transportation options.[1]

Both national and per capita VMT have stopped increasing. Per capita VMT has fallen behind national VMT.

National total and per capita VMT

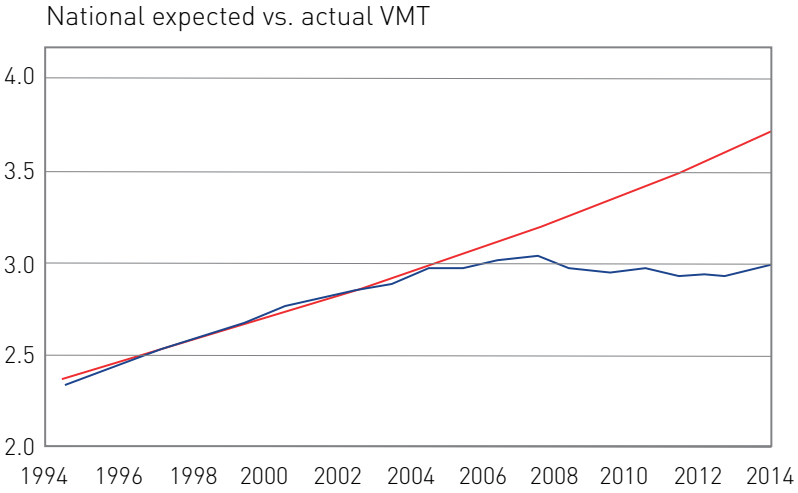


Source: FHWA December 2015 Traffic Volume Trends; US Census Bureau Projections of the Size and Composition of the US Population: 2014 - 2060.



Source: City of Boulder Modal Shift Reports (Travel Diary of Boulder Residents).

Bus trips and bike trips have increased in Boulder, CO while car trips have decreased.

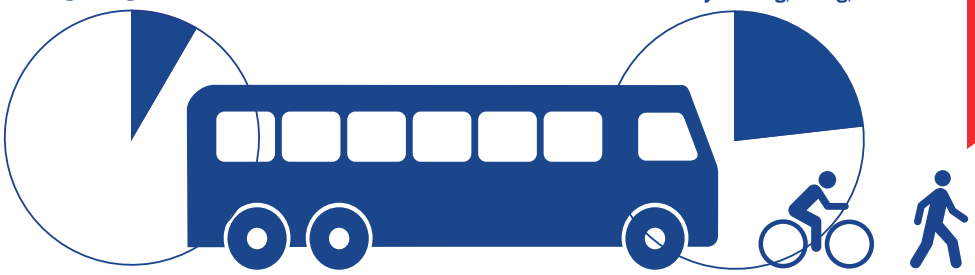


Sources: "Why is US Oil Consumption Lower? Better Gasoline Mileage?" *Our Finite World*, 31 January 2012; 2013 FHWA Traffic Volume Trends.

National VMT was expected to increase. It has actually stayed relatively flat - despite population growth.

8% of national commutes were by walking, biking, or transit

23% of commutes in largest 52 cities were by walking, biking, or transit



In cities, a larger share of commutes are by walking, biking, or transit.

Source: Alliance for Biking and Walking's 2014 report, *Biking and Walking in the United States.*

Boise's young and old want quality alternatives to driving

33%* of 16 to 24 year olds don't have driver's licenses.[1]

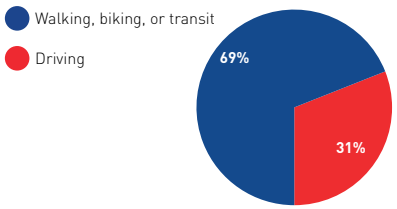
*2011 number , highest rate since 1965.

Younger people are delaying and in some cases eschewing drivers' licenses entirely. Faced with debt from higher education or choosing to spend disposable income on high-tech devices is further delaying or in some cases replacing vehicle purchases. Households that might have in the past owned or leased two or more vehicles at a time are now reducing their need to only 1 or 2 vehicles, and in some cases zero. The growth of the Millennial generation —already the largest in the U.S. labor force—will require investments to attract businesses that employ them, including the ability to safely and comfortably access jobs without the necessity of a personal vehicle.[2]

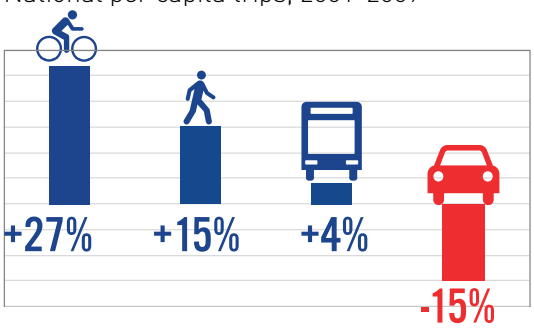
The need and desire for alternatives to driving is not limited to Millennials. Seniors and retirees aged 65 and older are not only Boise's fastest growing age group, but also an age group whose quality and life and mobility depends on access to alternatives to driving. Many elderly are or will be unable to drive due to health issues. Transportation for America predicted that 60% of Boise residents aged 65 - 79 will have poor access to transit in 2015. With poor access to transit comes poor access to jobs, doctor's appointments, errands, and social outings, causing decreased quality of life.[3]

Children aged 0-14 are the largest age group in Boise, and elderly residents aged 65 and older are the fastest growing age group.[4] By investing in alternatives to driving, Boise can retain and attract younger generations while giving greater mobility to elderly residents.

Millennials' preferred travel modes, 2011

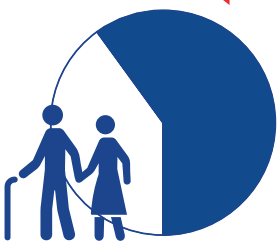


Changes in trips among 16 to 34 year-olds
National per capita trips, 2001-2009



Source for above two charts: U.S. Public Interest Research Group's 2014 report, *Millennials in Motion.*

60% of Boise residents aged 65-79 will have poor access to transit in 2015.



Source: Transportation for America's 2011 report, *Aging in Place – Stuck without Options: Fixing the Mobility Crisis Facing the Baby Boom Generation.*

Case Study

MILLENNIALS AND TRANSIT CHOICES IN DENVER, CO

Millennials move downtown and choose new modes of travel

Denver's downtown is a booming residential market, with 142% population growth between the years 2000 and 2013. Downtown Denver's projected growth rate is five times the national rate and almost twice that of the City and County of Denver. The median age is 33.9, compared with 34.3 for the state of Colorado and 36.8 for the United States.

In concert with this residential growth has been an influx of biking and walking commuters for work trips to downtown. Together, the groups accounted for 8% of all commute trips in 2014, representing increases of 26% for cycling and 15% for walking compared with one year prior. Adding transit to the mix results in a majority of downtown Denver employees who are not driving alone to work—over 60% of employees use transit, walk, bike, or rideshare to work. And 25% of households in downtown Denver have no car.[5,6]

"Access to a variety of transportation options is central to maintaining Denver's status as one of the most desired cities for Millennials."

-Downtown Denver Partnership president and CEO Tami Door

Quality transit alternatives can improve the cultural and economic wealth of cities

Accompanying a decline in driving has been an increase in biking and walking for transportation. Improvements made to bicycling and walking conditions have been shown to have direct and indirect positive impacts on economic measures such as job creation, retail sales, property values, tourism, health outcomes, and decreased traffic congestion (i.e. improved productivity through time savings).

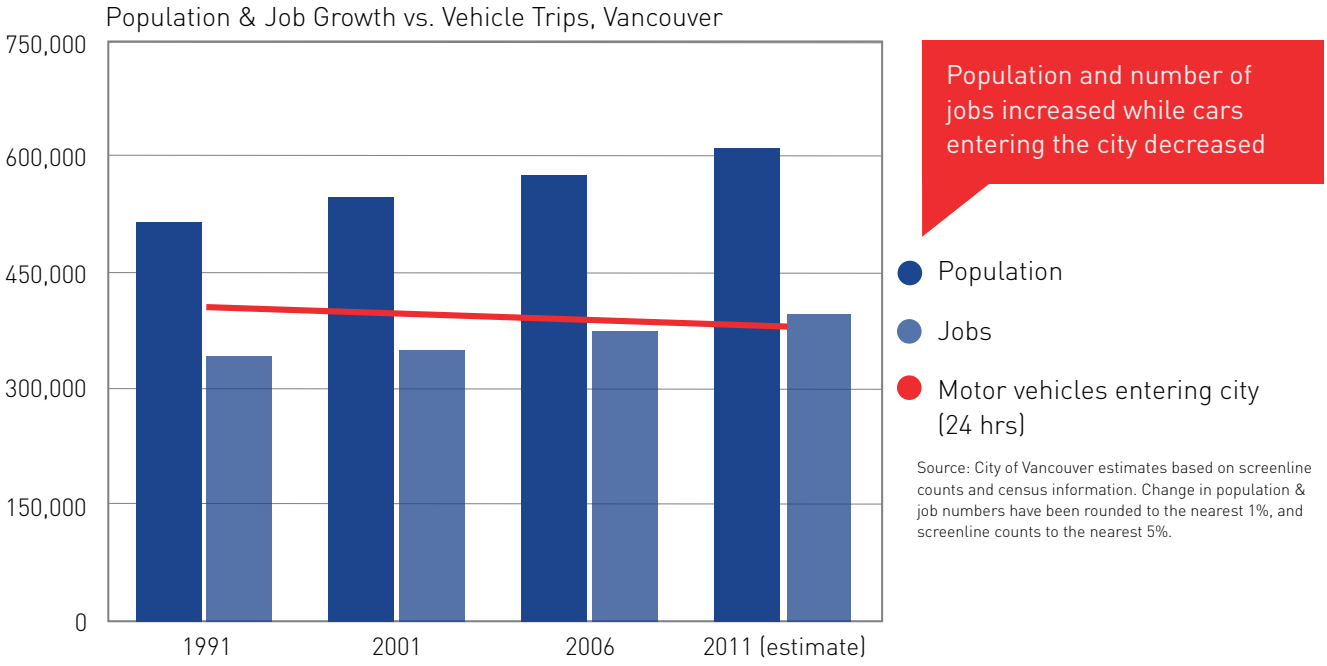
Many cities have demonstrated a causal relationship between improvements in walking and biking and economic benefits. In New York City, safer street designs that include protected bicycle facilities, traffic calming measures like pedestrian refuge islands, and spaces carved out of streets for public seating all tend to see increase retail activity compared with citywide data or comparison corridors without livability treatments. For example, the transformation of an underused parking area on Pearl Street in Brooklyn saw a 172% increase in retail sales for local area businesses, compared with a more modest 18% increase in sales throughout Brooklyn during the same time period.[7]

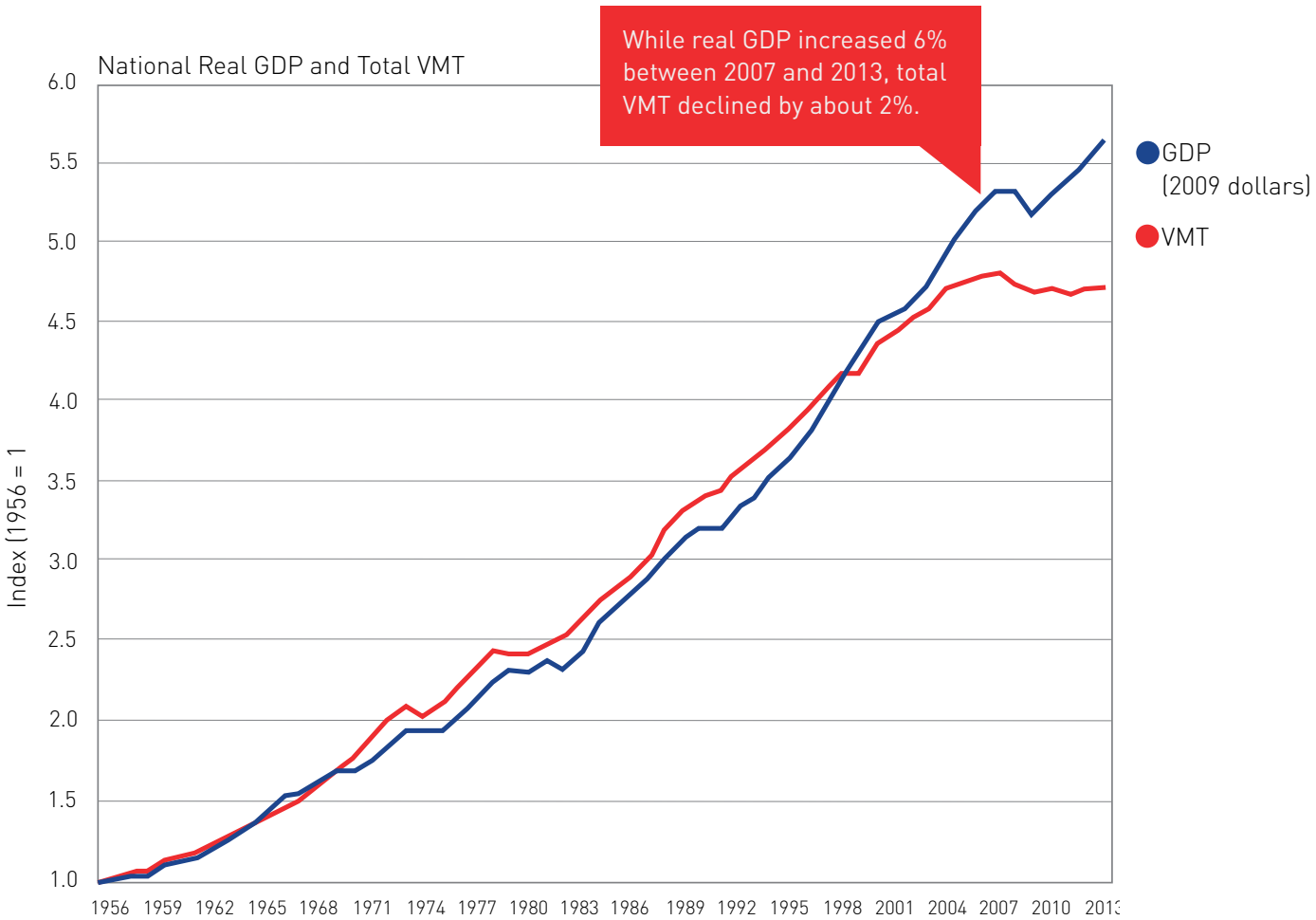
Safer street designs can bring about increases in retail activity.

The positive effect of increased bicycling and walking transfers to less urban areas as well. In 2012, 128,023 nonresidents took part in tour bicycling while in Montana and spent at least one night in Missoula County. The potential impact of these bicyclists was $19,410,000 ($151.61 per person).[8]

There is also evidence that decreased driving does not cause economic harm. In Vancouver, fewer cars entering the city did not deter jobs from growing, despite an increasing population. Nationwide, GDP continued to increase in the last decade while VMT began to level off—a notable break from historical trends. Moreover, there is a significant correlation negative correlation between states with high per capita VMT and lower relative per capita GDP.

For more than half a century, highway systems were deemed necessary to keep up with the transportation arms race. Now, economic prosperity has been decoupled from personal vehicles, and having a variety of quality alternatives to personal vehicles has been shown to drive economic prosperity in cities.





Source: U.S. Public Interest Research Group's 2014 report, *Millennials in Motion.*

By investing in transit alternatives, Boise can adapt to changing demographics

15 Idaho ranks 15th out of 50 states for percentage of commuters that bike or walk.

Cities must adapt to changing demographic trends and preferences or else risk losing population, and as a result, their tax base and economic competitiveness. **A growing population searching for urban or dense suburban mixed-use neighborhoods requires investment in relevant transportation systems** in the same way that the post-war generation demanded investments in the interstate highway system. This means focusing on transportation needs like flexible transit services, adoption of new technologies for providing information, services, and gathering feedback, comfortable bicycle facilities for all ages and abilities, and a connected pedestrian realm with high quality public spaces that dovetail with a denser, mixed-use lifestyle.

Cities that adapt through smart investments will increase their competitiveness in attracting demographic groups who place a high priority on transportation choices, quality of life and 'sense of place.'

HOW BOISE CAN ADAPT

Idaho is in a good position to offer a range of transportation alternatives. The state already ranks 15th out of 50 in the percentage of commuters biking or walking. However the investment in transportation infrastructure has yet to catch up with this trend. The state's per capita spending on bicycle and pedestrian projects ranks only 41st overall.

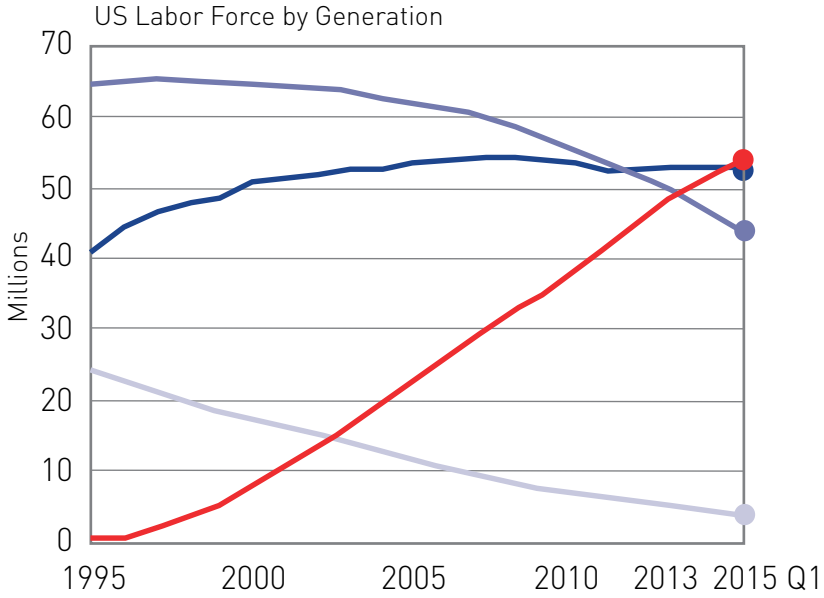
To remain competitive, Boise needs to be more effective in coordinating land use and transportation policy in order to offer the walkable mixed use neighborhoods that Millenials and aging populations desire.

41 Idaho ranks in the bottom 10 states for per capita spending on bicycle and pedestrian infrastructure.

Boise is leading the way in choosing alternatives to car commutes.

Boise ranks 12th among large metro areas for declines in automobile commuting.

Coincident with consistent increases in walking and biking commutes, fewer residents of Boise are choosing to commute by car. Boise ranks 12th among metro areas with populations greater than 50,000 for declines in automobile commuting. Boise saw a decline in car commuting of 2.4% from 2006 to 2013, even with population increases.



Millenials surpassed Generation X as the largest generation in the US workforce. Baby boomers still hold a significant share.

2015 Q1 Estimates

Millennials -	53.5M
Generation X-	52.7M
Baby Boomers -	44.6M
Silent -	3.7M

Source: Pew Research Center tabulations of monthly 1995 - 2015 Current Population Survey, Integrated Public Use Microdata Series (IPUMS).

Six strategies to adapt to changing demographics

1. Plan for the shift.

- Create strategic plans that recognize and anticipate the demographic shift.
- Update predictions and models to account for changing trends in mobility preferences.
- Prioritize projects accordingly.

2. Bring people closer to transit choices.

- Adjust land use codes to allow for higher density, mixed-use development.
- Enable sensible densification in areas that are better served by a range of transportation options.
- Implement incentive structures to encourage development in the areas with transportation and service infrastructure.

3. Provide safe pedestrian connections to link neighborhoods to activity centers.

- Provide safe and well-lit pedestrian facilities
- Implement traffic calming strategies on residential areas
- Reallocate underused streetspace for bulbouts, pedestrian plazas, and wider sidewalks in areas with higher pedestrian volumes.

4. Build a robust bicycle network.

- Ensure the safety and comfort of the segments of the population that choose to commute by bicycle.
- Establish and expand bike share systems.
- Encourage the integration of bike parking and other bike facilities within new development.

5. Create comprehensive transit options that are both fast and reliable for all travel times.

- Invest in more reliable and frequent transit service.
- Invest in technologies and partnerships to simplify and enhance the transportation experience.
- Encourage the integration of transit with bike facilities, car share and taxis to address the last mile challenge.

6. Encourage shared-use options.

- Create an environment where shared use options—bike share/ car share/transportation network companies—can thrive.
- Integrate shared-use options with mass transit networks.
- Dedicate curbside space for car share vehicles.

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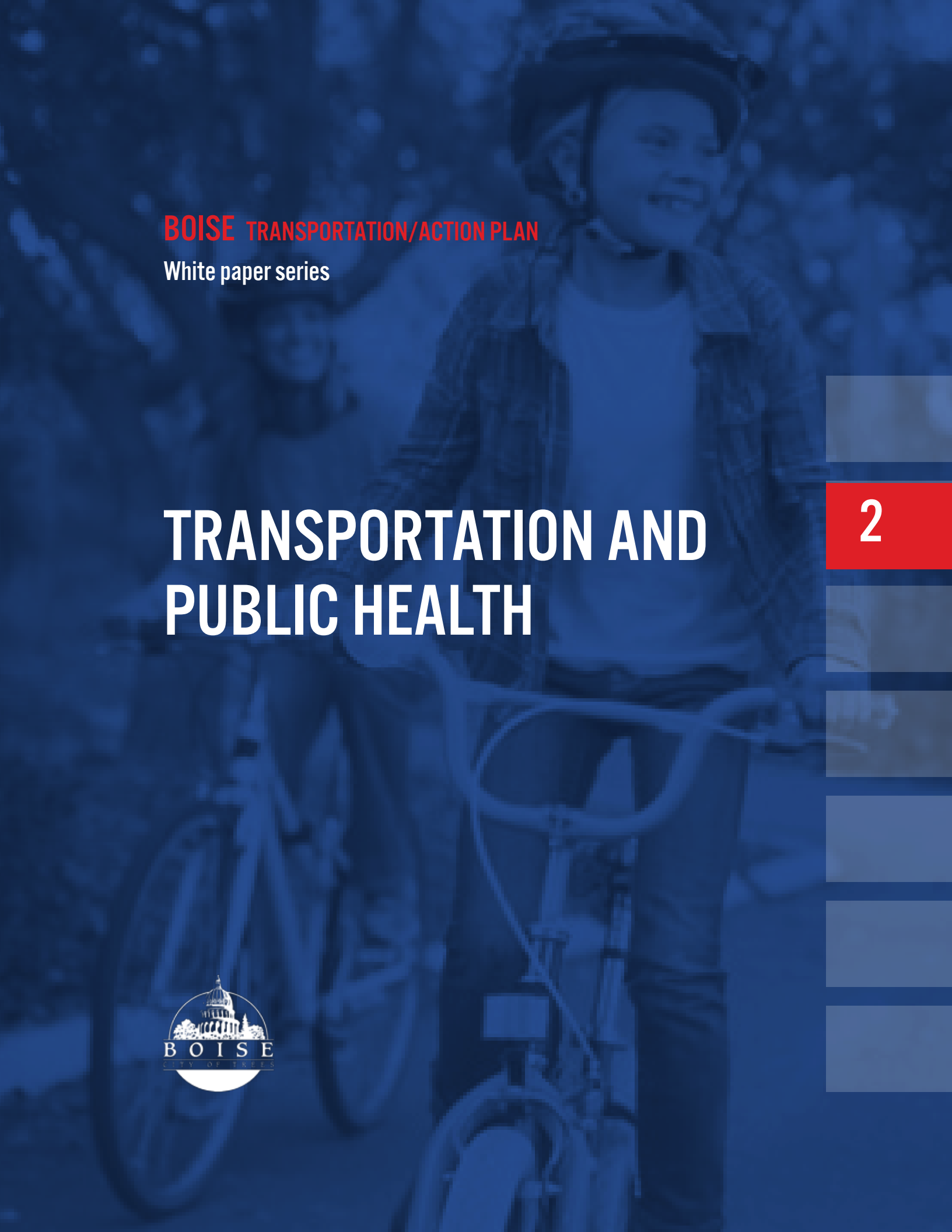


BOISE TRANSPORTATION/ACTION PLAN

White paper series

TRANSPORTATION AND PUBLIC HEALTH

2

BOISE
CITY OF TREES

2

Transportation decisions affect public health

When people have more transit choices, they can choose to drive less. This leads to less traffic injuries and deaths, a cleaner environment, better physical and mental health, increased access to opportunities, and stronger community bonds.

The primary (though not exclusive) lever by which urban transportation affects public health is through automobile use, with higher levels of driving directly related to negative health impacts.[11]

Automobile use is often quantified as Vehicle Miles Traveled (VMT), as well as vehicle volumes and speeds. In growing cities like Boise, it is useful to focus on VMT per capita as the main metric by which to measure effects of auto use on public health.
The causal chain from auto use to public health can be understood through four steps:

1. **Transportation and land use projects and policies increase or decrease individual choices to drive.**

2. **Combined effects of individual choices increase or decrease per capita VMT and traffic volumes.**

3. **The changes in auto travel impact the environment, including the air, water, and safety of our streets.**

4. **The modified environment impacts people's health.**

The factors that affect the level of automobile use can be broken down into demographic and economic characteristics of the population, and the attributes of the transportation and land use system.

The former includes relevant aspects such as population growth, income and vehicle ownership costs, and personal preferences and views (e.g. concern for the environment).

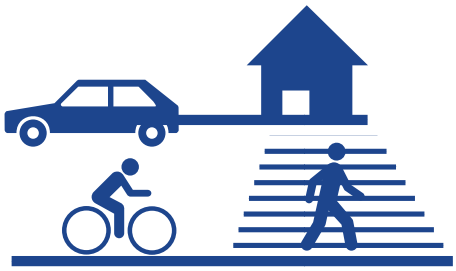
The latter includes aspects related to the Transportation system, including supply-side attributes like the quality and availability of public transit,[1] bicycle and walking amenities, parking and roadway design, and demand-side attributes such as pricing policies, user information, education and enforcement.

As the economic incentives for auto use increase in the form of greater purchasing power, reduced travel times and increased comfort, the greater the likelihood that car ownership and VMT will increase.

On the flip side, as transportation alternatives to the automobile become more competitive, and options to drive reduced or made more difficult (e.g. reduced parking availability, higher driving costs), the more likely it will be that VMT can be reduced in favor of other modes.

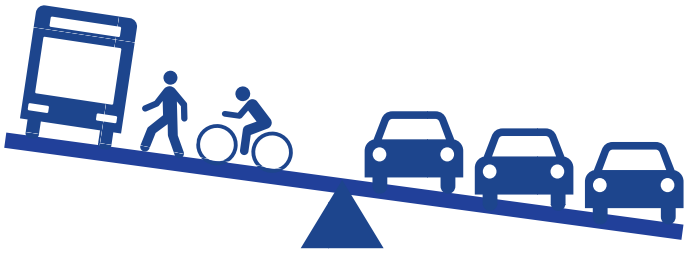
DECISION → INDIVIDUAL CHOICES

TRANSPORTATION AND LAND USE PLANNING DECISIONS



Parking Spaces, Bike Lanes, Road Width, Housing Locations

AUTO TRIPS GENERATED



Versus trips via public transit, walking, biking

COMBINED EFFECTS

REGIONAL: VMT PER CAPITA

Regional Air Quality
Greenhouse Gas Emissions
Time Spent Driving

LOCAL: TRAFFIC VOLUMES

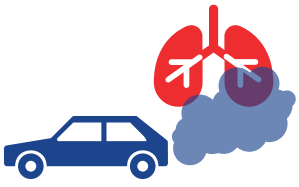
Air Quality: Local Hot Spots
Noise Levels
Livability, Social Cohesion
Pedestrian And Bike Quality And Safety

HEALTH IMPACTS

TRAFFIC COLLISIONS

Traffic injuries and deaths

ENVIRONMENTAL POLLUTION



Asthma
Child Educational Delays
Lung Disease
Water and food-borne
Infectious disease

PERSONAL WELLBEING

Physical Activity
Cardiovasucular disease
Mental Health
Sleep Disturbance
Stress

EQUITY

Women, Children, Elderly, Persons with Disabilites, Low-Income

Heat Related Illness
Asthma
Birth Defects
Child Educational Delays
Obesity
Type 2 Diabetes
Food security

INCREASES IN VEHICLE MILES TRAVELED PER CAPITA

HIGHER RATE OF TRAFFIC COLLISIONS

HIGHER ENVIRONMENTAL AND AIR POLLUTION

DECREASES IN VEHICLE MILES TRAVELED PER CAPITA

INCREASED PERSONAL WELLBEING

INCREASED EQUITY AND ACCESS TO OPPORTUNITIES

Low density increases VMT: This development in Orange County, CA is not person-scaled, but car-scaled. Low-density development encourages a car-centric lifestyle, making it trip distances longer and increasing VMT. Photo credit: David Eppstein / Wikimedia Commons

Human-scaled design decreases VMT: Designing for the human scale encourages people to walk and bike rather than drive. This dense, double row of trees in downtown Boise makes the street a pleasant place to stroll, making it an ideal place for and outdoor market. Photo credit: Mike Powell, Idaho for 91 Days

Density, land use mix, neighborhood characteristics and design, continuity of network, street scale and design are also variables that affect per capita VMT.[11] **The more dense, mixed uses with people-centered scale and design are used, the more likely it is that trip distances are reduced, and that modes like walking, bicycling and transit will be used**.[15,16,17]

It is important to understand how the impacts of automobile use, then seek to mitigate upstream causes and downstream effects through transportation and land use strategies. In many cases, transportation projects will affect land use, and vice versa. Both are crucial for planning an urban transportation system that supports public health, requiring a holistic set of strategies to be applied.

In the following sections, strategies targeted to four categories of upstream and downstream impacts will be discussed:

1. Traffic Collisions and Safety
2. Environmental Pollution and Air Quality
3. Personal Wellbeing
4. Equity and Access to Opportunities.

Case Study

VISION ZERO SAN FRANCISCO, CA

Vision Zero is a multinational traffic safety program. The program began in Sweden, who has reported a 30% reduction in traffic fatalities since adopting Vision Zero in 1997.

Cities adopting Vision Zero pledge to eliminate traffic fatalities within 10 years. Participating cities include San Francisco, New York City, Portland, Seattle, Chicago, Los Angeles, San Jose.

San Francisco began its Vision Zero program in 2013, and has already seen decreases in traffic fatalities. Their strategies include:

1. Education
- Safe Routes to School - increases safety and numbers of children walking and biking to school.
- Safe Streets SF - increases awareness of crosswalk violations and the need to change driving behavior to prevent fatalities.
- Training program for drivers of large vehicles.

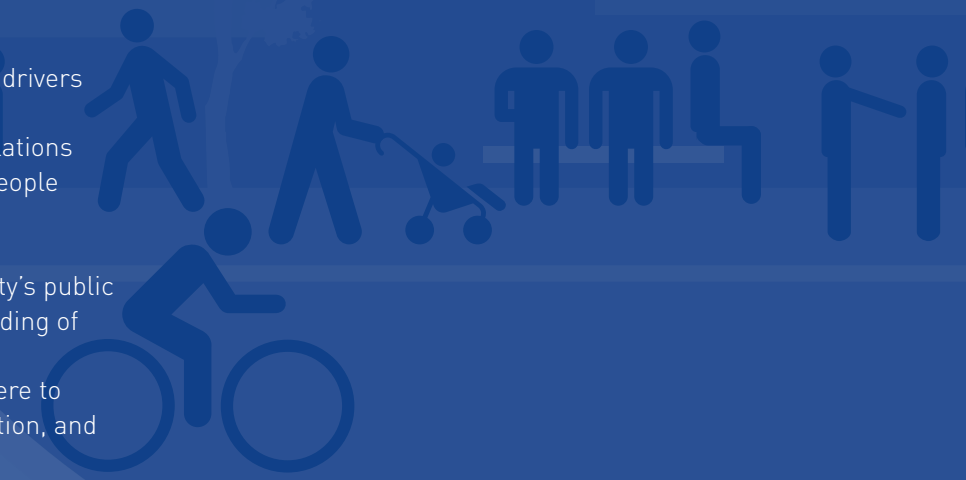
2. Engineering
- WalkFirst - identifies 6% of streets that are responsible for 60% of pedestrian collisions. Develops projects to make these intersections safer.
- New and upgraded bikeways.

3. Enforcement
- Don't Block the Box - a campaign to cite drivers who block intersections.
- Focus on the Five - enforcing the five violations most frequently cited in collisions with people walking.

4. Evaluation
- Online analytical tool developed by the city's public health department to improve understanding of transportation and safety.
- High-Injury Network Map - identifies where to focus investments in engineering, education, and enforcement.
- Injury reporting - accurate, coordinated, and timely monitoring of pedestrian and bike injuries.

"[Walk First] focuses on 6 percent of our roadway network, which is responsible for 60 percent of pedestrian injuries and fatalities, and it uses proven engineering solutions to fix those dangerous streets. The approach will ensure that the best investments are made with limited resources by using cost effective treatments first."

-Walk San Francisco's Executive Director, Nicole Schneider



Traffic Collisions and Safety

Reducing automobile use is a proven strategy to reduce injuries and deaths resulting from traffic collisions.

In the United States, traffic collisions are the leading cause of death for children.[7]

In 2012, traffic collisions killed 33,561 people and injured 2.36 million.[5]

Despite significant improvements in road safety achieved through policies (e.g. state adoption of mandatory seat belt laws), and vehicle and roadway designs (e.g. airbag installation), **injuries and fatalities caused by traffic collisions continue to be the leading cause of death in the United States for people aged below 34, including children.**[7]

Advancements in the last couple of decades have led to an almost two-thirds reduction in traffic collision rates per VMT. However, the constant and rapid increase in VMT (faster than population growth) sustained until recently meant that per capita, collisions only decreased by approximately one-quarter.[1,10] Even so, at a disaggregate level, states like Idaho showed an increase for a total of 184 traffic fatalities in 2012, a 10% increase from 2010 and way above the 3% national average.[5]

The nature of the problem is complex and needs to be contextualized.

Of the 33,561 people killed in 2012, only 3% were pedestrians.[5] **However, traffic collisions in urban environments tend to affect pedestrians and cyclists at a higher proportion than in rural areas.**

San Francisco, a highly urban environment, had approximately 30 pedestrians killed in 2014, representing nearly 50% of all traffic fatalities.[8]

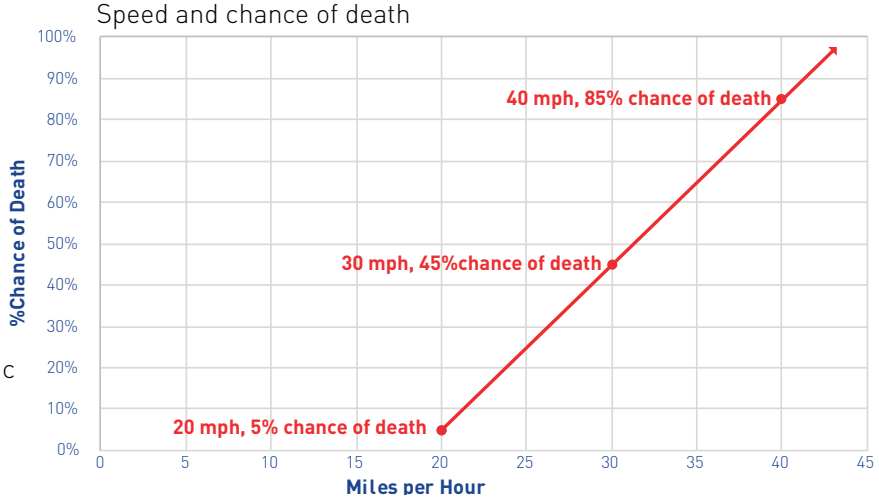
Even though urban environments tend to have higher collision rates than rural settings, because of the higher levels of interaction between road users, the severity of crashes is lower.[1] This can be understood due to lower average vehicle speeds and higher user visibility due to numbers – also known as "safety in numbers."[19]

Land use patterns also have an impact on the rate at which collisions occur. Of a survey over 240 countries, **the ten smartest growth communities had about one-fourth the per capita traffic fatality rate than the ten most sprawled**.[20]

These trends point to the three main determinants for the frequency and severity of traffic collisions:[11]

1. **Traffic Speeds - higher speeds cause more severe and more frequent crashes.**
   At a speed of 40 mph, there is approximately an 85% chance of death when a pedestrian is hit by a car. At 30 mph, this probability lowers to 45%, and at 20 mph it reduces to a mere 5%.[11] Higher traffic speeds leads to more severe and more frequent crashes.[11]

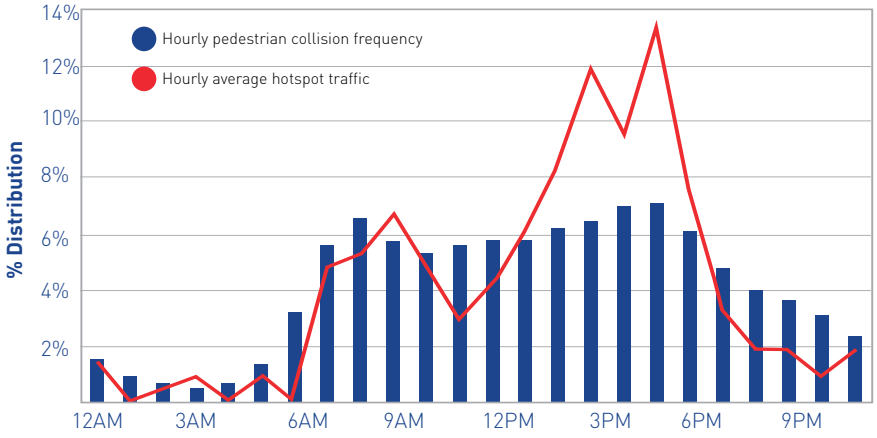
Speed and chance of death



Source: Dannenberg, et al. – Use of Health Impact Assessment for Transportation Planning – Transportation Research Record No. 2452, 2014

2. **Traffic Volumes - greater traffic volumes lead to greater opportunities for exposure to collisions [9].**
   Total traffic volumes (frequency of travel, distance) are directly related to the total cost of vehicle collisions. Overall reductions in VMT achieve total reductions in collision costs.[11a]

Collision frequency and traffic volumes in Philadelphia



2008 - 2011 numbers. Source: Park, S. and Trieu, V. Transit Bus and Pedestrian Safety Analysis in the Context of Operator Improvements and Traffic Volume Assessment. Open Journal of Civil Engineering, 2014

3. **Street Environments –vibrant street life leads to less frequent collisions.**
   Street environment affects the likelihood and severity of vehicle collisions as well. Higher levels of public life, induced by streetscapes designed to encourage people to linger, leads to lower collision rates, again based on the "safety in numbers" principle.[11]

   Designing streets and public space for people can decrease traffic collisions.

A street environment that encourages people to stay leads to safer streets. In New York City, making streetscape conditions more inviting for public life resulted in a **30% reduction in traffic fatalities** from 2000 - 2010.

Higher transit ridership leads to lower per capita traffic deaths.

Public transit has only about 5% the passenger fatality rate as automobile travel.

Design strategies for reducing traffic collisions

Street and land use design strategies that target these three determinants can help reduce traffic collisions and their impacts. Proven strategies to slow traffic and improve safety include: [11,8]

- Narrower lanes and roadways[11]
- Curbside parking
- Center medians
- Streetscape elements that create a sense of enclosure
- Intersection traffic control measures
- Access points (e.g. driveways)
- Traffic calming measures (e.g. chicanes)
- Pedestrian countermeasures (e.g. crosswalks)

Reducing automobile use is also a clear strategy to improve traffic collisions. This can be accomplished by shifting users to more sustainable modes like walking, cycling and especially public transit.

There is evidence that higher transit ridership leads to lower per capita traffic deaths, and that public transit has only about one-twentieth the passenger fatality rate as automobile travel.[1]

Narrow lanes and curbside parking by Directors Park in Portland, Oregon, encourage drivers to drive more slowly and cautiously.

Pedestrian countermeasures such as crosswalks slow traffic and improve safety. This crosswalk in downtown Boise also functions as public art.

Center medians can slow traffic and take on a greater role as a plaza, seating area, and refuge.

Streetscape elements that create a sense of enclosure can be as simple as planters and bright paint that sets pedestrian seating areas apart from traffic lanes.

Environmental Pollution and Air Quality

Growing VMT per capita has lead to sustained negative impacts on the environment.

During the 1996 Summer Olympics, Atlanta provided 24-hr enhanced transit service and Travel Demand Management measures.

This lead to a reduction in peak morning traffic of 22%.

It also reduced acute asthma cases between 11-44% . [11]

Despite significant advances in vehicle fuel efficiency and emissions standards since the Clean Air Act of 1970, extensive use of the automobile and a growing VMT per capita has led to maintained significant environmental impacts.

The impact of automobile use on the environment can be grouped into the following five areas:[10]

1. Degradation of air quality
2. Degradation of water quality
3. Greenhouse Gases (GHGs)
4. Traffic Noise
5. Upstream Impacts

1. Degradation of air quality

Vehicles emit most of the National Ambient Air Quality Standards (NAAQS) "criteria" pollutants, established by the Environmental Protection Agency (EPA) to protect public health. These pollutants, which include CO, NO_2, O_3, SO_2, PM_{10} and $PM_{2.5}$, Pb, VOC, and NOx, are all harmful to people´s health and can lead to the following health problems shown on the facing page.

Prolonged exposure to high concentrations of these criteria pollutants and others released from vehicle tailpipes has been shown to reduce lung capacity, generate severe asthma, impacts on life expectancy and also trigger heart attacks among the elderly.[11]

These effects could be mitigated through continued improvements in emissions standards and vehicle technology. However, these benefits would likely be voided by rapid increases in motorization and world population.[11] **It is necessary where possible to reduce per capita VMT.**

Air quality has a disproportionate effect on children. Children living next to busy roadways had more respiratory problems than those living further away, associated with asthma hospitalizations and poorer lung functions.[9]

Transportation is not the only source of criteria pollutants, but as a sector contributes a significant portion, with estimates that cars and trucks contributed nationwide around 77% of CO, 56% of NOx and 28% of $PM_{2.5}$. These figures remain similar today. [10]

	HEALTH EFFECTS
CO Carbon monoxide	• Interferes with oxygen absorption, impairing the cardiovascular and nervous system • Symptoms: chest pain, dizziness, fatigue, slower reflexes • Impairs visual perception, work capacity, manual dexterity, learning ability • Affects fetal growth and tissue development
O_3 Ozone	• Short term: lung irritation, minor eye irritation, coughing, pain upon inhalation • Long term: structural lung damage, lung disease, lung cancer, increased respiratory infections such as bronchitis and pneumonia • May interfere with immune system, exacerbates allergies • May be agent for infectious disease by producing more receptors for viruses
PM Particulate matter	• May cause coughing, lung tissue damage, alteration in immune system, and • Long term: structural lung damage, lung disease, lung cancer, increased respiratory infections such as bronchitis and pneumonia • May interfere with immune system, exacerbates allergies • May be agent for infectious disease by producing more receptors for viruses
SO_2 Sulfur Dioxide	• Constricts bronchial passages, symptoms include difficulty breathing, asthma, respiratory illness • Combined with particulates, puts people with chronic lung and heart diseases at increased risk for illness or premature death • Contributes to particulate matter formation
Pb Lead	• May cause increased blood pressure and heart disease • Impairs children's brain development and mental functioning • Causes neurological impairment such as seizures, mental retardation, and behavioral disorders

Transportation is a primary source for improving Public Health through improvements in Air Quality, focusing not only on improving vehicle emissions standards but also on reducing VMT through both improvements in the transportation system and land use changes. **Improvements including favoring infill development over greenfield, which has been estimated to produce between 39-52% lower VMT and criteria pollutants from transportation**.[11]

2. Degradation of water quality

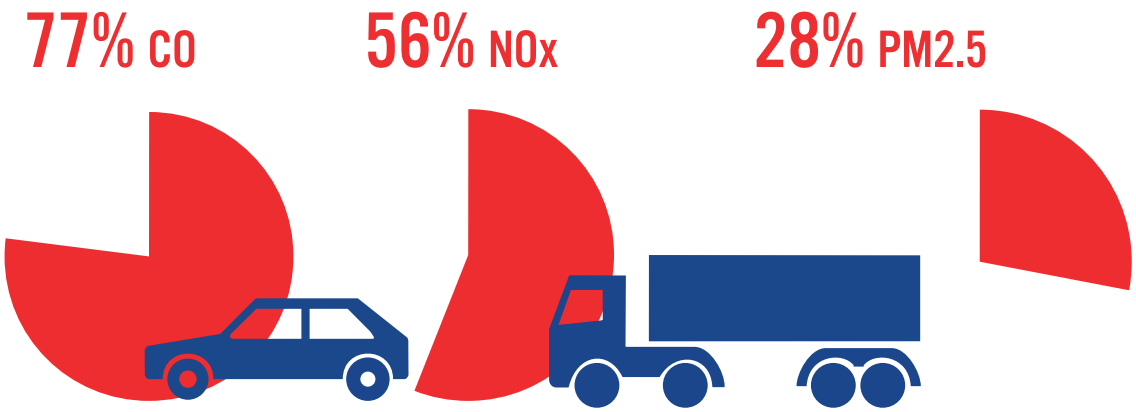
Air pollution generated from vehicle tailpipes has been related to water quality degradation, as measured through the input of atmospheric nitrogen and metals into the Chesapeake Bay and the Great Lakes.[10]

3. Greenhouse Gas Emissions

Vehicle emissions generate three key greenhouse gases that contribute to global climate change, or global warming. The first is CO_2, and it is projected to continue its upward growth trend, particularly that generated by transportation.[10] The contribution from the sector has been significant for quite some time, generating 32% of total U.S. CO_2 emissions from fossil fuels in 1997.[10]

The effects of global warming on Public Health are indirect but severe. They can include significant alteration of ecosystems that would ultimately affect the stability of food and water supplies, the rise in diseases (e.g. malaria) and extended heat waves.[10] Global warming could also lead to

In 1996, cars and trucks were responsible for:



These figures remain similar today.[10]

increased exposure to ground-level ozone and aeroallergens, making pulmonary and cardiovascular illness worse.[9]

4. Traffic Noise

Noise emitted from engines, wind, tire traction and others can be a major problem in urban living when it exceeds certain thresholds for a sustained period of time. A 1980 study found that 37% of the U.S. population was exposed to noise from road use that was greater than 55 db (the desirable upper limit of outdoor noise), quantifying the estimated annual costs of vehicle-generated noise somewhere between $2.7-9 billion. [10]

Recent studies have found that moderate levels of traffic noise have a negative impact on stress, and are associated with higher risk for hypertension, blood pressure and heart disease.[9a]

5. Upstream Impacts

Impacts that occur upstream of auto use take place during fuel production and transportation, motor vehicle manufacture, and maintenance.

Oil spills incurred during fuel production and transport cause great environmental degradation.

Motor vehicle manufacture degrades the environment via air pollution, and the release of solid and liquid wastes.

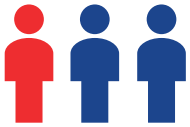
Highway maintenance involves the release and use of toxic chemicals that can have a negative impact on the surrounding environment, including the use of de-icing and road salting, the former of which was estimated to cost society somewhere between $0.826-2 billion a year in 1999 dollars.[10]

In order to address these areas of impact, strategies need to be applied that reduce not only emissions rates, but also exposure (how close people are to pollution emitted), and per capita VMT.[1]

Personal Wellbeing

Active lifestyles support personal wellbeing. Encouraging people to use public transit, walk, and bike can contribute to improved physical and mental health.

Over one third of all U.S. children will develop Type 2 diabetes.[11]



Personal wellbeing has both physical and mental dimensions, both of which are impacted by auto use.

PHYSICAL WELLBEING

The Center for Disease Control (CDC) recommends that adults get 150 minutes of moderate aerobic activity every week in order to stay healthy.[11] Physical activity is correlated with reduced risk in developing coronary heart disease (similar to not smoking), reduced risk in developing adult diabetes, in becoming obese, in developing hypertension, reduced osteoporosis and falls in the elderly.[11]

Less than 50% of American adults meet this physical activity target, resulting in high levels of excessive weight and obesity, which in turn has been reported to account for over **300,000 premature deaths annually**.[11] As of 2002, up to 60% of American adults were overweight, with 30% to be obese.[6] Children face a similar chronic problem, with one estimate pointing that **over one-third of all U.S. children will develop type 2 diabetes** at some point in their lives – a condition associated with being overweight.[11]

Large number of trips that are currently made by auto could be shifted to more sustainable modes like walking, cycling and public transit. This shift can help adults and children achieve their needed levels of activity to stay healthy.

Nationwide, around 27% of trips are less than one mile long, and 14% take place within half a mile from home[11]. Many short trips are currently served by auto, and could be encouraged to shift modes through adequate transportation strategies.

Public transit users get closer to meeting their physical activity needs - the median transit user spends 19 minutes a day walking, which is close to the recommended 22 minutes and above the national average of 6 minutes achieved when auto users are included.[1d]

Other studies support these findings in a variety of contexts. An Atlanta travel survey found public transit users were more likely to walk more than non-transit users by a factor of 10, and were more likely to meet their physical activity targets. Other studies found this factor to be as much as four. [1e]

One study found that New York City residents that live closer to both subway and bus stops, and in areas with higher population density and mixed land use, had lower Body Mass Index (BMI) than their counterparts. Access to transit encourages people to walk more.[6]

Smart growth communities such as Portland, Oregon, emphasize density, access to transit, and public space. These communities tend to have higher walk levels with reduced rates of asthma, diabetes, hypertension, and obesity.

Conversely, for each hour spent in a car each day, a person's risk of obesity increased by 6%, while this risk decreased by 5% for every hour walked each day.[2a] Enhancing public transit, walking, and cycling also increases people's opportunities to access recreational activities that are not described here or usually accounted for in the literature, but can lead to health benefits as well.

Mode shift is not the only way to achieve desired levels of physical activity. Land use strategies can help to reduce trip distance and lead to higher levels of walking, bicycling and transit use.

Smart growth communities tend to have higher walk levels, with residents showing lower levels of obesity and hypertension than in sprawled communities.[1] Other reports have shown similar benefits for people living in walkable neighborhoods as compared to those living in urban sprawl, finding **reduced rates of asthma, diabetes, hypertension and other chronic medical conditions** even after controlling for other factors like income, race, education and age.[1]

There are a combination of transportation and land use strategies that can help travelers move by foot or bike. These include strategies related to density, land use mix, neighborhood characteristics and design, continuity of the transportation network, street scale and design, and others. [11]

For each additional ten minutes of driving spent in daily commuting, community affairs were reduced by 10%.[11]

MENTAL WELLBEING

Mental wellbeing is also impacted by people's transportation choices. The primary and most cited effect is through social capital and feelings of social cohesion (bonding, informal and formal connections), initially described by Jane Jacobs in the Death and Life of Great American Cities.

Research has since found that **time spent driving correlates directly with a loss in social capital.** For example, Putnam found for each additional ten minutes of driving spent in daily commuting, community affairs were reduced by 10%.[11] Appleyard found that residents who lived on high traffic streets tended to have fewer relationships with their neighbors than those that lived in low volume traffic streets. The negative effects of driving impact not only drivers, but communities through which auto traffic moves.[18]

On the flip side, an increase in walkability and public space availability can improve social ties[11], and can lead to reduced symptoms of depression.[1] **This can be explained by the opportunities to connect and share a common urban space with others that walking, cycling and public transit offer, enabling much needed spontaneous interactions between individuals.**

Transportation can also **enhance feelings of personal security, through "eyes on the street"** effects generated not only by residents, but also by those walking and using public transit.[1]

Finally, many commuters find driving stressful. Road rage and aggressive driving have been documented extensively, showing that **longer commutes predicted higher blood pressure levels**.[11] Even single-occupancy drivers were found to have significantly higher levels of hostility and anxiety than did carpool drivers, suggesting that solo travel negatively impacts well-being.[11]

Aggressive driving behavior can clearly lead to higher stress levels, and in the extreme, to higher accident rates, injuries, and fatalities, with one study pointing to **aggressive driving as a factor in 56% of fatal crashes**.[11] The same study also found that **in cities with higher public transit and walking levels, lower levels of aggressive driving death rates were predicted**.[11b]

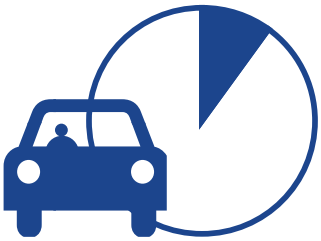
22 MIN. OF WALKING

DAILY WALKING TIME
Recommended by CDC

19 MIN. OF WALKING

MEDIAN TRANSIT USER
in America

06 MIN. OF WALKING



AVERAGE PERSON
in America, includes drivers

Source: Litman, T. Evaluation of Public Transportation Health Benefits, Victoria Transport Policy Institute (VTPI), 2015.

Equity and Access to Opportunities

Driving dependent lifestyles disproportionately disadvantage vulnerable groups, including women, children, elders, low-income populations and people with disabilities. More options for transit, biking, and walking can increase access to opportunities, leading to a more equitable city.

Traffic fatalities are the leading cause of death for children.[11]

Driving-dependent lifestyles disproportionately affect different vulnerable groups, including women, children, elders, people with disabilities, and low-income populations. These effects are derived from driving's impact on traffic collisions, environmental pollution, personal wellbeing, but also through its effects on giving all groups equitable access to opportunities.

WOMEN

In the case of women with families, a high amount of their time is spent running errands and trip chaining, leading to **higher exposure to accidents and stress**.[11]

CHILDREN

Children are also affected disproportionately, as they are exposed to pollution at an early age which can hinder their development, as well as chronic diseases resulting from obesity, estimated at one-third in 2012 (CDC, 2015). The National Personal Transportation Survey reports that as of 2002 1 in 7 children walked to school, compared to 50% in 1965.[11] Not to mention their exposure to traffic fatalities – the leading cause of death for this group.

OLDER ADULTS

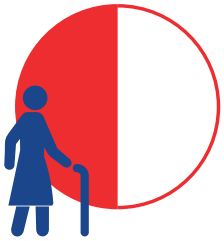
Elders are also affected disproportionately higher than other groups, especially air quality hazards resulting given their vulnerability. But more importantly, **access to opportunities is declining with age for Americans.**

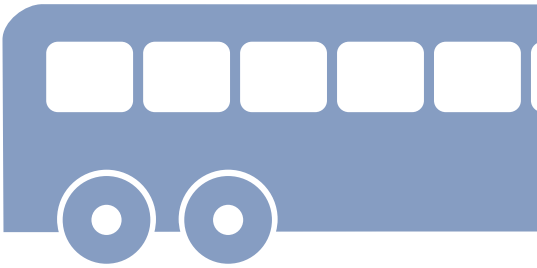
As they age, many can no longer drive but cannot find alternative means of travel either. Older non-drivers, when compared to older drivers, make 15% fewer trips to the doctor, 59% fewer shopping trips and visits to restaurants, and 65% fewer trips for social, family and religious activities.[11] The estimated percentage of seniors that do not drive because of physical impairment and health concerns is 21%.[11] These older populations will use public transit when available, however **only half of older Americans have access to it to meet their daily needs.[11]**

In 2013, traffic accidents caused 1 out of 5 deaths for children aged 1 to 18.

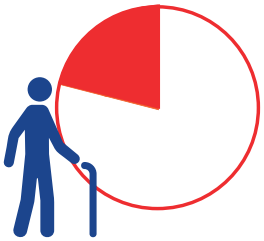
Source: National Center for Health Statistics (NCHS), National Vital Statistics System

50% of older adults cannot access transit

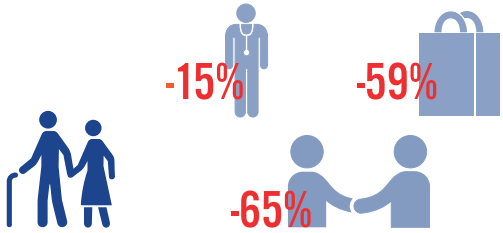




21% of older adults cannot drive



Older non-drivers make fewer doctor's visits, fewer shopping trips, fewer social outings.



Source: Ewing, R. et al – Understanding the Relationship Between Public Health and the Built Environment, 2006

Research:

SPATIAL MISMATCH

The spatial mismatch hypothesis states that a person with inferior access to jobs is likely to have worse job search outcomes - to be unemployed for longer, and to be less likely to make as much money as their previous job. Using a measure of job accessibility that is weighted by commute time and mode of transportation, the National Bureau of Economic Research found support for spatial mismatch. They found that:

- Better job accessibility decreases duration of joblessness for lower-paid displaced workers
- African Americans, women, and older workers are most sensitive to job accessibility

The study suggests that increasing job accessibility can help job searchers find a job faster, and will have a significant impact on African Americans, women, and older workers. Improved transportation alternatives increases job accessibility, especially for African Americans, women, and the elderly.[15]

Transportation affects job accessibility.

Of nearly 2 million people with disabilities who never leave their homes, over 500,000 never leave their homes because of transportation difficulties.[14]

Residents of low-income communities are three times less likely to live within walking distance of a grocery store.[2b]

PEOPLE WITH DISABILITIES

People with disabilities rely on accessible transportation in order to work, shop, and participate in community life. Of nearly 2 million people with disabilities who never leave their homes, over 500,000 never leave their homes because of transportation difficulties.[14] It will be important for Boise to continue to support its paratransit service to ensure that it offers high service quality and adequate capacity for temporarily and permanently disabled individuals. Fixed route public transit systems should also be improved with an eye beyond ADA - such as ensuring that accessible stations are frequent enough so that public transit does not become prohibitive.

Beyond public transit and paratransit, streets themselves should be designed to allow people with disabilities to safely access transportation and to participate in street life. Design considerations serve more than people with disabilities - **a street that accommodates a person with a disability will provide comfort and safety benefits for other users.** Complete streets provisions can be helpful in providing safe and comfortable rights-of-way for all modes of transit.[14]

LOW-INCOME POPULATIONS

Low-income populations need to spend a higher proportion of their incomes to meet basic mobility needs like traveling to jobs[11]. **This results in higher stressors for this community, often depriving them of opportunities for social advancement[11].**

Poor access also leads to a lack of opportunities for healthy eating, a phenomenon often termed "food deserts" whereby low-income communities often have to travel outside of their boundaries to access healthy eating options. In the case where communities are auto dependent, this can be hard to achieve for those without access to a car. Overall, residents of low-income communities are less likely to own a car but also three times less likely to live within walking distance to a grocery store.[2b]

Making improvements in sustainable transportation alternatives not only helps to mitigate the impacts described above, but also leads to a more equitable city.

Tool Box

HEALTH IMPACT ASSESSMENT (HIA)

An evidence-based tool that connects transportation to health

As public health impacts of transportation and land use projects become better understood, professionals and researchers are finding new ways to introduce an analytical approach into planning practice. HIAs provide evidence-based recommendations to promote health outcomes and minimize negative consequences.[13]

Between 2004 and 2013, seventy-three HIAs were conducted in over 22 states, reflecting the growing adoption of this type of analysis. HIAs are different from Environmental Impact Statements (EIS) and other traditional environmental reviews in that they account for factors beyond those considered in the traditional approach. The types of transportation projects and impacts analyzed are varied, ranging from highway corridor redesigns, bridge replacements, Bus Rapid Transit construction, Streetcars, and road diets (HIA TRB 2014). Their execution is also being defined, in some cases being conducted by non-profit and research centers, and in others with close collaboration with public agencies

The Center for Disease Control (CDC) provides a Transportation HIA Toolkit framework, with 6 overall transportation and land use strategies that can be used to achieve better public health outcomes. The HIA toolkit connects analysis with transportation planning practice. These six strategies are summarized on the following pages.[13]

Six strategies to achieve better public health outcomes

1. Reduce VMT per capita

Reductions in per capita VMT will positively impact traffic collision levels, the environment, and personal wellbeing, as well as emphasize the need to provide quality transportation alternatives.

Strategies: User-based feeds (taxes, congestion pricing), parking pricing schemes and parking supply management (especially off-street), and land use incentives for developers.

Examples: San Francisco's Transportation Sustainability Program, Chicago Skyway

2. Expand public transportation

Adding alternatives to driving is key, particularly for vulnerable populations.

Strategies: Transit Oriented Developments and corresponding transit improvements, increasing local connectivity for walking (access to public transit), bicycle parking and multi-modal integration, reducing safety hazards at key transit nodes, and encourage employer incentives schemes to promote transit use

Examples: San Francisco's Commuter Benefits Ordinance

3. Promote active transportation

Improving active transportation can lead to multiple positive outcomes beyond increasing levels of activity. It also supports public transit use, and creates more vibrant city spaces.

Strategies: Improvements to walking and bicycling infrastructure and connectivity, streetscaping and beautification in the street environment, complete streets, active fronts and mixed land uses, and enhancing safety at high injury locations.

Examples: Safe Routes to Schools Programs

4. Plan land use for health

Land use strategies can have important upstream impacts on public health.

Strategies: Incorporate complete streets - street design that meets the needs of all modes. Encourage adequate connectivity and block size, high-density and mixed land uses. Locate residents away from transportation generated vehicle emissions and noise pollution.

5. Improve safety for all

Traffic collisions should be addressed through comprehensive efforts like Vision Zero in addition to other indirect efforts to reduce VMT and improve land use that favors walkability and transit use.

Strategies: Traffic calming measures, crime reduction and surveillance at transit stops, lighting along paths and trails, and other infrastructure safety improvements (e.g. pedestrian bulbouts, road diets, etc.).

6. Ensure equitable access to all transportation users

Auto-dependent transportation disproportionately affects vulnerable populations. Providing walking, bicycling and transit alternatives increases equitable access to opportunities.

Strategies: Ensure public participation in transportation planning, conduct regular equity analyses during transportation planning, increase safety, user-friendliness and inclusion, and encourage mixed-income affordable housing in mixed-use neighborhoods.

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BOISE TRANSPORTATION/ACTION PLAN

White paper series

THE HIGH COST OF BUSINESS AS USUAL

3

BOISE
CITY OF TREES

3

The High Cost of Business as Usual

Continuing to allocate scarce transportation dollars to costly roadway expansion projects is an inefficient use of funds both today and in the future.

"We're the ones [who have to maintain the new roads we build]. Look in the mirror. We're not going to pay to rebuild that entire system. And my personal belief is that the entire system is unneeded. And so the reality is, the system is going to shrink."
-Iowa State DOT Director Paul Trombino (2015)

Constrained budgetary resources are a common challenge for almost any U.S. jurisdiction. With little help coming from the federal government, cities, counties, and states are often left with the responsibility to maintain and improve transportation infrastructure well beyond what they are capable of. As a result, trade-offs and difficult decisions are inevitable. Moving forward with "Business as Usual" in terms of transportation investment decisions imposes high costs on society, in several forms:

1. **Monetary Costs –** Roadway projects are typically much more expensive than pedestrian and bicycle projects, and are more costly to maintain in the long-run as well.

2. **Economic Development Costs –** Places that continue with "Business as Usual" will be at an economic disadvantage compared with places that broaden their transportation spending to include a more diverse range of projects. Today, private investment is more likely to follow projects that focus on walkability and the human scale, rather than traditional roadway expansions in low-density, sprawling locations.

3. **Social Costs –** "Business as Usual" focuses almost exclusively on moving people in single occupancy vehicles, often at the expense of other modes of travel. Increased time behind the wheel leads to social isolation, poor health outcomes, and a lack of engagement with one's community. Cities that reject "Business as Usual" are better positioned to invest in projects that improve social well-being.

4. **Environmental Costs –** Planning transportation expansion around the automobile will lead to increased emissions and pollutants in the air caused by increased auto travel. Even most new vehicle fuel technologies are indirectly responsible for resource depletion and environmental degradation.

On a per-mile basis, expansion projects are incredibly costly.

Although some (but not all) can be "simple" from an engineering standpoint, a roadway widening project or highway extension is one of the costliest transportation investments that a city can undertake.

The grand scale of highway building – which can include acquisition costs for right-of-way, environmental remediation costs, capital equipment costs, labor costs stretched out over a lengthy project timeline, and many others – does not lend itself to thriftiness or efficiency. Even projects that merely expand an existing roadway to accommodate more travel lanes quickly becomes an expensive proposition.

In comparison, pedestrian and bicycle projects are orders of magnitude cheaper than building new roadways on a per mile basis.

What Is A "Business As Usual" Approach To Transportation?

When a jurisdiction employs a "Business as Usual" approach to its transportation policy and funding decisions, it is continuing to hold onto values that governed much of the our investment in the latter half of the 20th century. During this time, the nation embarked on an aggressive expansion of the roadway network and prioritized investments geared to automobile travel. This occurred often at the expense of other modes, like walking, biking and public transit. Project prioritization for highway expansion and road widening was – and still is – based on projections of ever-increasing levels of vehicle miles traveled (VMT) and the desire to extinguish traffic congestion. Although VMT has leveled off and even started to decrease on a per capita basis, transportation investment in most places in the United States still focuses on building new roadway capacity, first and foremost. Continuing to build our transportation infrastructure around the needs of motor vehicles while ignoring most everything else represents a "Business as Usual" approach.

What does $60 million buy?

The entire city's bicycle network

1 mile of a 4-lane urban freeway

Source: Kullgren, I. – Portland Mayor Sam Adams says Portland has spent on its bike infrastructure what it would normally spend on a single mile of highway, 2011[3]

How much does it cost per mile?

A mile of a 6 lane urban interstate costs 100 times more than a sidewalk of the same length.

$110,000
Sidewalk construction[1]

$211,000
Bi-directional shared use path[1]

$445,000
Urban protected bike lane[2]

$1,829,000
Construction of additional lane on urban arterial[1]

$4,181,000
New construction of 4 lane suburban road[1]

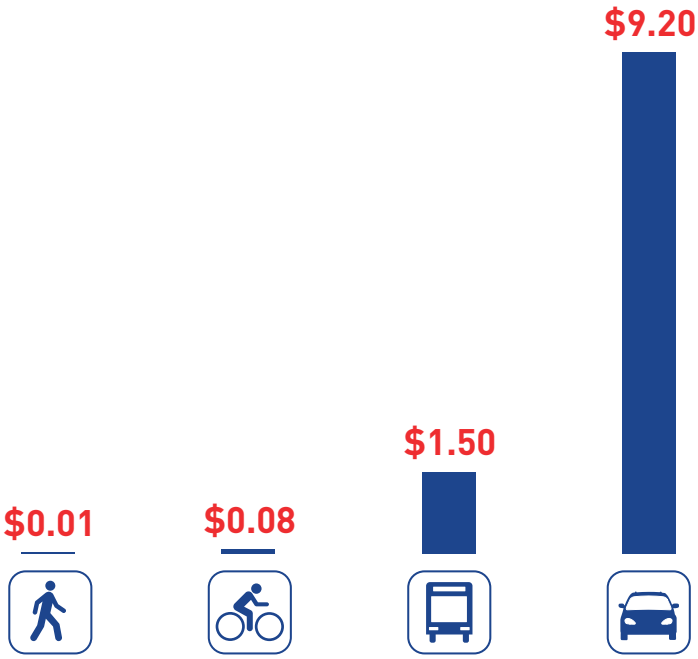
$5,198,000
New construction of 5 lane undivided urban arterial with center turn lane[1]

$7,438,000
Widen a 6 lane urban interstate to 8 lanes[1]

$10,265,000
New construction of divided 6 lane urban interstate[1]

Source: FDOT[1], Andersen, M[2]

How much does society pay if it costs you $1 to commute?



For example, when you ride the bus you pay a fare - money into the system. Your burden on the system includes the cost of operating the bus, and also less obvious impacts like emissions and noise pollution.

Every time you travel you put money into the system, but you also cost the system and society some amount - an amount that is not immediately clear to the general public. Your contribution to and burden on the system differs depending on how you travel.

By looking at the ratio of what we put in versus what we cost the system, we see that different ways of traveling are more subsidized than others.

Source: Discourse Media, data by George Poulos.

The benefits of roadway expansion – namely increased capacity and decreased congestion – are generally short-lived.

"Business as Usual" projects might be heralded as congestion-busting saviors, and, temporarily, they often can be. A major arterial or urban highway that is at capacity during peak periods might benefit in the short-term from an expansion of capacity. However, due to the nature of how development patterns and people's behavior adjust in response to available infrastructure, that added capacity will almost always be "filled in" with additional traffic during peak periods to return the roadway to its "equilibrium" (or congested) state.[4]

What is "Induced Demand?"

Roads that are currently congested during peak times can be defined as having reached a state where no additional traffic can fit into that portion of the network.

When we engage in a "Business as Usual" project to expand the road's capacity (through a widening to create an additional travel lane, for example), new capacity becomes available, and all of those drivers who might have avoided the route in the first place because it was too congested will suddenly find it more attractive.

So drivers will start using the new road capacity, for various reasons:

1. Some will divert from other, slower routes, to use the improved and initially uncongested route;

2. Others will shift their trips into the heart of the peak hour, which was formerly a time they avoided because of congestion;

3. And still others will abandon other modes (walking, biking, or transit) and begin driving because of the perceived convenience of the new capacity, making a car trip more palatable.

These factors all work together to form **induced demand,** and contribute to a general increase in traffic levels to the point that, eventually, the roadway is fully congested once again.[4]

Evidence: In the Long Run

ADDING CAPACITY DOES NOT REDUCE CONGESTION

All too often, lane increases or highway widenings only briefly alleviate congestion, and a roadway soon returns to its prior congested state:

1. Handy and Boarnet performed a critical evaluation of various induced travel studies. They conclude that the best estimate for the long-run effect of highway capacity on VMT is an elasticity close to 1.0, implying that **in congested metropolitan areas, adding new capacity to the existing system of limited access highways is unlikely to reduce congestion...in the long-run**.[4a]

2. One study found an elasticity of vehicle travel with respect to lane miles of 0.5 in the short run, and 0.8 in the long run. This means that **half of increased roadway capacity is filled with added travel within about 5 years, and 80% of the increased roadway capacity will be filled eventually.** Urban roads, which tend to be most congested, had higher elasticity values than rural roads, as would be expected due to the **greater congestion and latent demand in urban areas.** [4b]

3. A statistical analysis of congestion in 228 United States Metropolitan Statistical Areas (MSAs) found that "[VMT] increases proportionately to [the number of] highway [miles available]" and that **"an increase in lane [miles] induces an exactly proportional increase in [VMT]."** As a result, **"an increased provision of roads ...is unlikely to relieve congestion."** [5]

4. In London, "traffic counts carried out by the Greater London Council on five road schemes... show... that traffic increases on the sections [of road] with extra effective capacity have been greater than the reductions (if any) on other roads for which relief was expected." As a result, **"ultimately, any possible benefit of road expansion is offset by increased traffic."** [6]

Up to a point, congestion itself is not always a bad thing.

Addressing traffic congestion requires nuance and the recognition of the value that density brings to create a thriving city and strong regional economy.

"Business as Usual" projects all have one thing in common: they aim to eliminate, or at least mitigate, traffic congestion. We know the promise of a "Business as Usual" project usually falls short (see section above on Induced Demand), but what often goes unexplored is congestion reduction is a priority to begin with.

No one wants to be stranded in a car, running late for work, of course. But traffic congestion can tell us something about a city's economic success and about how a region with agglomeration economies makes trade-offs.

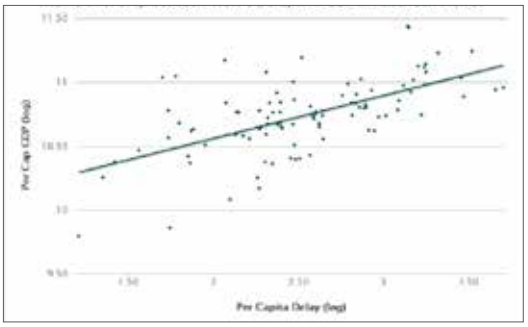
Congestion and Productivity

Congestion and economic productivity tend to go hand in hand. While congestion itself doesn't cause people to be productive – in fact, it does the opposite – there is a strong but indirect link between the two.

Congestion occurs when people choose to live and work in an area where others choose to do the same. When enough people cluster together in relative density, and when a city produces enough jobs to attract a critical mass of workers from afar, road congestion occurs.

As a result, **"regional GDP and traffic congestion are tied to a common moderating variable - the presence of a vibrant, economically-productive city. And as city economies grow, so too does the demand for travel."** [7]

The Relationship Between Traffic Delay and GDP in American Metros



Source: Dumbaugh, E. – Rethinking the Economics of Traffic Congestion, 2012 [7]

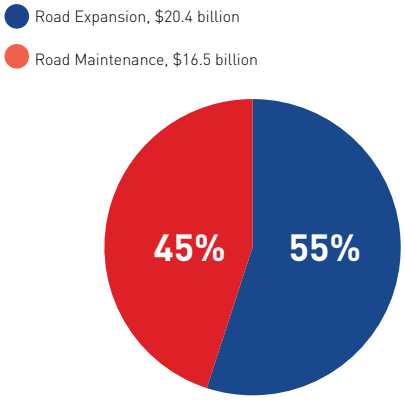
Every dollar spent on roadway expansion is one less dollar available for maintaining existing infrastructure and assets.

Meanwhile, roadway expansions create new assets that are added onto the list of existing infrastructure needing to be maintained, exacerbating the State of Good Repair backlog problem. "Business as Usual" projects cost a lot of money, but worse yet make it more difficult for a jurisdiction to deal with pressing maintenance needs for its existing infrastructure. With limited amounts of funding available, roadway expansion projects can suck up great chunks of a jurisdiction's maintenance budget. Deferring regular maintenance to pay for new roadway capital projects only leads to higher maintenance costs down the line, when problems become more severe and require greater investments to fix – often with a bigger disruption to the roadway network.

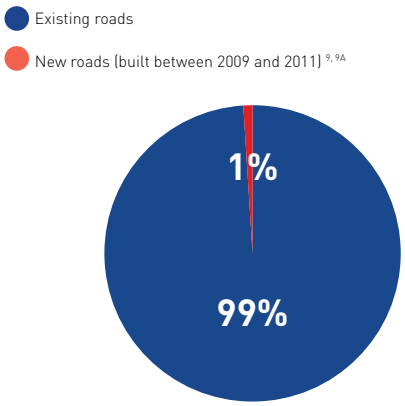
It would be questionable enough to defer maintenance and build new roads if our maintenance needs were marginal, but they're not. In fact, according to the National Economic Council and the President's Council of Economic Advisers, **65% of the nation's major roads are in less than "Good" condition, and 25% of the nation's bridges require significant repairs.** [8]

When our roadway spending focuses on capacity expansion, we end up dedicating too great a proportion of dollars to "Business as Usual" projects than what our maintenance needs would otherwise dictate. In turn we saddle ourselves with a continually growing, overwhelming backlog of maintenance requirements necessary to upgrade structurally deficient assets:

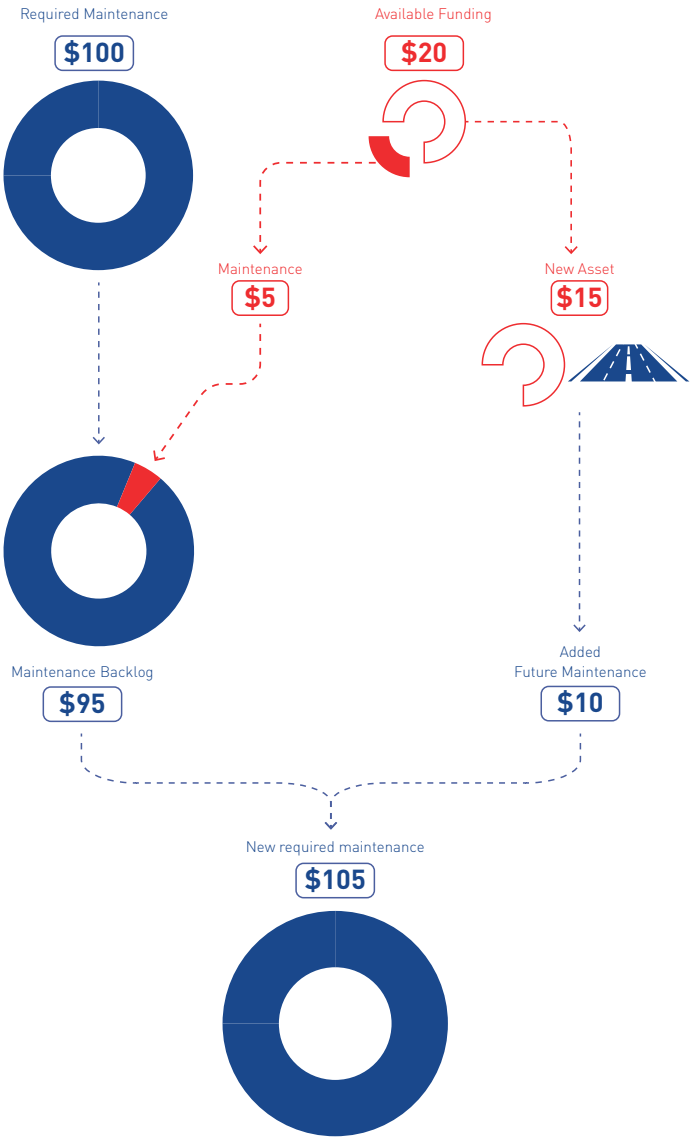
Annual State Spending on Road Project (2009 – 2011)



Roadway assets as percentage of total lane miles, 2011



A hypothetical new roadway asset both slows down funding for existing maintenance and then makes it worse down the line as overall maintenance requirements grow.



New Assets Mean New Maintenance Needs

Beyond the simple idea that a dollar for new expansion projects prevents a dollar from going to maintenance, there is a domino effect to "Business as Usual" projects.

Every new expansion project adds assets to the backlog that must be maintained, effectively increasing the size of the "maintenance pie" without making a dent in it. Larger and larger maintenance needs that get ignored feed into a vicious cycle of a larger and larger backlog; this cycle won't be reversed or even slowed until "Business as Usual" projects are put through greater scrutiny in the prioritization process with an acknowledgment of how they will affect the maintenance backlog.

Case Study

THE CITY OF MILWAUKEE, WISCONSIN

The City of Milwaukee is a prime example of how embarking on "Business as Usual" projects at the expense of maintaining existing roadway assets can hurt cities.

The State of Wisconsin chose to rebuild a major freeway interchange in downtown Milwaukee and is now planning to rebuild another nearby. **Megaprojects like these have taken up a large swath of the state's transportation budget and have resulted in severe gaps elsewhere.**

The State of Wisconsin spent 61% of its highway dollars on capacity expansion (higher than the national average) from 2009-2011, while 71% of its roads are in mediocre or poor condition. [9A, 10]

The state has also "killed plans for light rail, commuter rail, high-speed rail, and dedicated bus lanes on major highways, so there is almost no public transportation connecting Milwaukee to its suburbs;" all the while a plan to widen Route 94 at the cost of $250 million per mile is in the works "despite fierce local opposition." As maintenance needs grow and grow, the state has continually sought out "Business as Usual" projects that provide only marginal benefits. "When so much cash and concrete gets poured into the spaghetti bowl of freeways around Milwaukee, other needs tend to get neglected." [10]

Allocate limited funds to focus on critical maintenance needs, improving multi-modal connectivity, and serving all street users – all without expanding the road network and inducing more demand and strain upon it.

Simply put, "Business as Usual" projects may result in temporary congestion relief, but their high costs come at the expense of important maintenance needs and tend to ignore other projects that aren't aimed solely at expanding auto capacity but can provide multiple dimensions of benefits. Projects that move beyond new road construction can create multi-modal cities that ultimately work better for all people. Places that recognize how to break out of the "Business as Usual" rut will not only save money but realize a host of other benefits.

Benefits of Moving Beyond "Business as Usual"

1. **Clearing the Maintenance Backlog** – By not engaging in an expansion project, a jurisdiction can use funds for maintaining existing assets in a smarter manner. And one less new asset created is one less asset to maintain.

2. **Economic Benefits** – Studies have shown the higher economic impact that pedestrians and cyclists have on a city's economy – although they may not purchase as much per trip, these street users are more likely to spend more dollars over multiple trips. [11] People shopping on foot or by bike are also, by nature, traveling at a slower speed and will have more opportunities to make ad hoc purchases, which can benefit a city's "Main Street" and encourage small, local business growth.

3. **Health Benefits** – "Business as Usual" investments by definition only consider the needs of people traveling by automobile (or potentially on a bus, if indirectly). Investments in walking and biking projects are needed if better health outcomes can be incorporated into the way we spend money on transportation.

4. **Tourism and Other** – Almost nothing about a "Business as Usual" transportation project, whether it be a road widening or construction of a new highway interchange, will serve to attract tourists or make a city well-known culturally or otherwise. On the other hand, spending transportation dollars on targeted placemaking initiatives like pedestrian plazas or on safe, comfortable bicycle facilities that connect to a shopping district or tourist attraction will result in more goodwill for a city, and following that, more local investment and community engagement.

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BOISE TRANSPORTATION/ACTION PLAN

White paper series

MOVING BEYOND LEVEL OF SERVICE

4

4

Moving Beyond Level of Service

Alternative metrics to traditional vehicular Level of Service can more effectively measure a street's quality, efficiency, and impact on all people – those driving, walking, taking transit, and riding bicycles. 21st century streets deserve 21st century evaluation criteria.

"Traffic comprises people and goods – not vehicles: In order to achieve efficient and sustainable traffic flows, the city must change focus from moving vehicles to moving people and goods."

With the exception of freeways, streets serve much more than just one function. Along with moving private automobiles, they often move transit, pedestrians, bicyclists, and freight. And along with moving people, they are often the public space for relaxation, socializing, shopping and (intentionally or unintentionally) getting exercise. Moreover, beyond their transportation function, streets serve as critical elements of a City's environmental, cultural, and public utility infrastructure.

Traffic professionals focused on designing and subsequently evaluating our streets have traditionally used a focused measure of evaluation: vehicular Level of Service (or LOS). For decades, this measure has been one of the ways – if not the only way – in which a street's success or failure was measured. However, in tandem with evolving considerations of street design (see the Evolving Nature of Street Design section of this report), traffic engineers and transportation planners are moving beyond evaluation methods like vehicular LOS.

New measurements of street performance include updates to the LOS concept with a wider focus on all street users (not just those behind the wheel) along with more universal frames of measurement like economics, environmental resiliency, and general livability.

FUNCTIONS OF A STREET

TRANSPORTATION

Motor vehicles
Transit
Walking
Biking
Freight

PLACEMAKING

Economic Vitality
Social Vitality
Civic Vitality

INFRASTRUCTURE

Urban Forests
Utilities
Stormwater

Streets have the potential to be much more than surfaces for vehicular travel. Streets should serve all modes of travel, and contribute to placemaking and sustainability. LOS does not capture the full potential functions of a street.

What is Vehicular Level of Service?

Vehicular LOS refers to a standard measurement used by transportation officials which reflects the relative ease of traffic flow on a scale of A to F, with free-flow being rated LOS A and congested conditions rated as LOS F.[1] LOS is used to translate complex numerical performance results into a simple A-F system representative of the travelers' perceptions of the quality of service provided by a facility or service. The LOS letter result hides much of the complexity of facility performance to simplify decision-making about whether facility performance is generally acceptable and whether a change in this performance is likely to be perceived as significant by the general public. One of the strengths of the LOS system, and a reason for its widespread adoption by agencies, is its ability to communicate roadway performance to laypersons.[2]

Vehicular Level of Service is only one measurement of street performance, and reliance on it represents a measurement tool that is based on a different era of street design.

The vehicular LOS concept is only reflective of the relative traffic flow, and is not an accurate predictor of drivers feel driving down that street.

Since streets have been traditionally designed to maximize vehicle throughput and minimize delay for motorists, it is only natural that traditional evaluation criteria followed suit. (See White Paper #5, The Evolving Nature of Street Design, for more information on changes to prevailing approaches to street design). **A focus on minimizing delay is the most paramount outcome from using traditional LOS**, and if no other criteria are used for measurement then no other outcomes (such as the economic success of a corridor, access provided to people using various modes of transportation, and others) will be prioritized.

As we change the way we design streets, why should vehicle delay be the only metric of how a street functions? The vehicular LOS concept is only reflective of the relative traffic flow, and is not an accurate predictor of how drivers feel driving down that street. **Neighborhood streets with active street life and economic vibrancy might naturally attract traffic** and congestion, causing "poor" Level of Service outcomes (E/F). Meanwhile, a desolate street with store vacancies and a foreboding character might process traffic very well, with high a LOS of A/B.

A vehicular LOS metric will penalize the LOS F example on the facing page, potentially through the perceived need to invest in a bypass road or widen the existing street to process more vehicular traffic. This type of evaluation does not match with new ways of thinking on street design. Alternate metrics are needed to measure success for 21st century streets.

FOLLOWING PAGE: The contrast between traditional LOS A and LOS F is clear: open roads for drivers don't always equate to successful streets for people.

Photo sources
TOP: PlanPhilly.com, BOTTOM: virtualtourist.org

Level of Service grade : A (high-performing)

Level of Service grade : F (low-performing)

Street performance for people in vehicles doesn't have to only be based on maximizing speed or minimizing delay during peak hours.

Research has shown that removing unpredictable elements that come from delays can reduce stress resulting from congestion.[4]

Vehicular LOS ignores external considerations such as other street users and the street's general aesthetic. It also ignores many considerations that might directly affect a driver's evaluation of how a street is performing. While most people driving generally want to minimize delay at red traffic signals or reduce their commute time as much as possible, those are not the only indicators of a desirable trip.

FOCUSING ON RELIABILITY OVER SPEED

Travel time reliability for drivers could be a substitute metric for level of congestion or delay. Most drivers expect some form of congestion during trips, especially during peak hours when road networks are overwhelmed.[3] However, while it is common for drivers to expect congestion, they are typically "less tolerant of unexpected delays."[3] Research has shown that removing unpredictable elements that come from delays can reduce stress resulting from congestion.[4]

Many motorists prefer a more comfortable slow and steady commute in comparison to a stressful one full of speeding and stops.[4]

Using travel time reliability as an evaluation metric rather than average speed could provide benefits to drivers and other street users alike. For example, a corridor with traffic signals optimized for a slow but steady speed of 25mph might be more desirable than a 45mph corridor that requires frequent stops. Many motorists prefer a more comfortable slow and steady commute in comparison to a stressful one full of speeding and stops.[4]

THE NEGATIVE IMPACTS OF PEAK HOUR LOS

A particular problem with traditional vehicular LOS analysis is the tendency to focus on a particular hour, or even a particular 15- or 30-minute window during which traffic volumes are at their highest. During these times, traditional LOS values may indicate a street is performing poorly, but during a majority of the remainder of the day and night, the street may be much less congested. **As a result, streets designed for peak intervals of traffic may fail to provide a safe and attractive environment during other portions of the day.**

A solution to designing only around the peak time period is to understand how traffic volumes trend over the course of the day and then balance motor vehicle capacity against other needs. Instead of using windows of one hour or less, **engineers can rely on average LOS over a larger portion of the day** when making decisions about street improvement projects and capacity requirements. This approach also makes fiscal sense, as **it is economically inefficient to design infrastructure for a short period** to accommodate peak capacity, only to have that infrastructure sit well below capacity for a vast majority of the time. Looking at vehicular traffic in the context of 24 hours – and not just peak hours – is a simple alternative to relying solely on peak hour LOS without abandoning the general concept entirely.[5]

RELIABILITY VS. SPEED

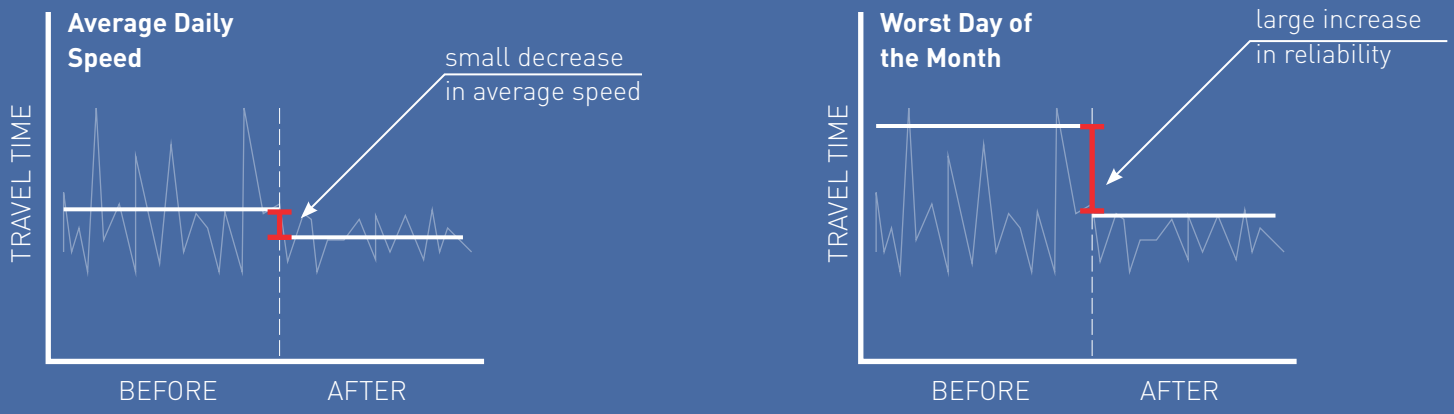
Average speeds do not capture the entire picture of a street's level of service.

Average travel times or average speeds are one measure of a street's ability to move vehicles. Travel time reliability is another. The two do not always tell the same story.

Some jurisdictions are prioritizing travel reliability over top speed or even average speed. For example, the City of Stockholm's 2012 Urban Mobility Strategy states that states "predictable and reliable accessibility has priority over higher average travel speeds."

A small improvement in average speed or travel times can hide a large improvement in travel time reliability,

SPEED VS. TRAVEL RELIABILITY
Two ways of evaluating the same street improvement



Source: Federal Highway Administration

Levels of Service can be used to measure a street's success if they are expanded to include other modes beyond vehicles.

HCM has encouraged a Multi-modal LOS approach, however it merely consists of evaluating each mode's LOS concurrently, rather than produce a blended LOS that considers all modes.

The Highway Capacity Manual (HCM) mentions the temptation for some users to blend LOS results reported by mode (automobile, pedestrian, bicycle, transit) into one single LOS value and cautions that "each mode's travelers have different perspectives and could experience different conditions while traveling along a particular roadway."[2] **However, many practitioners have traditionally used vehicular LOS as a catch-all for how a road performs.**

Pedestrian, bicycle, and transit LOS are options that are provided by HCM but bring focus onto other users of the street. These calculations, however, are still generally focused on volumes and speeds and lack contextual elements that may also affect the user's experience of a street.[6] HCM provides factors for determining LOS for non-automobile travel modes. These factors are summarized in the table below.[2]

A first step in moving beyond vehicular LOS is to recognize LOS measures for other travel modes and evaluate them in conjunction with vehicular LOS. HCM has encouraged a Multi-modal LOS approach, however it evaluates each mode's LOS concurrently, rather than produce a blended LOS that considers all modes.[2]

Further criticism of pedestrian, bicycle, and transit LOS measures include that they **are too vehicle-centric:** applying narrowly focused metrics on speeds and volumes might not make sense for pedestrians and bicycles, for example.[7]

HCM Level-of-service factors for non-automobile modes

Mode	Factors
Pedestrian 	• Pedestrian density • Sidewalk width • Perceived separation between pedestrians and motor vehicles • Motor vehicle volume and speed • Street crossing delay • Pedestrian exposure to vehicle turning conflicts • Intersection crossing distance
Bicycle 	• Perceived separation between bicycles and motor vehicles • Pavement quality • Automobile and heavy vehicle volume and speed • Driveway conflicts • Intersection crossing distance.
Transit 	• Service frequency • Perceived speed • Pedestrian LOS.

Source: Highway Capacity Manual (HCM) 2010

LOS IGNORES SAFETY

Road diets bring safety benefits not captured by LOS

A road diet could cause net benefits in safety ranging from $2.6 million to $37 million over the 20-year lifespan of a road. [9] These benefits were found in multiple scenarios by a study on New Brunswick, New Jersey. The study used traffic simulations to weigh the costs and benefits of a road diet on Livingston Avenue, a four-lane road with parking on both sides that sees high pedestrian and traffic counts. **They found that Level of Service was barely decreased by the road diet - amounting to just 1 got 3 minutes of total delay and additional travel time.** [9] Authors factored in these delays into a cost-benefit analysis using standard economic costs of delay, as well as conventional estimates of the costs of a road injury or death to society, as well as the costs of construction.[9] The costs of delays and construction were overwhelmingly outweighed by injuries prevented and lives saved.

A previous version of the study released in March 2014 failed to move the city to take urgent measures. Two months later, 3 children were hit by a car and injured on Livingston Avenue, the very road used in the study.[9] Study authors stated that city officials were cautious about suggesting a plan that would likely be opposed by voters.[9]

Road diets have been found to decrease collisions by an average of 19% in places in places like New Brunswick.[9] Using only Level of Service to assess roads and improvements to roads ignore the social value of injuries prevented and lives saved by road diets and complete streets plans. To fully quantify and better communicate benefits, cities should move beyond level of service and use metrics that account for the value of safety, injuries prevented, and lives saved.

Livingston Avenue, existing conditions

Livingston Avenue, proposed road diet

Photo credits: thecityofnewbrunswick.org

Measuring outcomes of a street user's experience requires tools beyond traditional Level of Service metrics for automobiles, pedestrians, bicycles or transit vehicles.

A significant drawback of HCM's Pedestrian LOS method is a lack of criteria that relate to the holistic context of the street and the walking experience.

Planners and engineers are increasingly realizing that LOS or similar street evaluation criteria need not be so mathematical, quantitative, and impersonal. How people experience the street can be just as – if not more – effective, and can also resonate more with local stakeholders and the public. Rather than measuring pure numerical performance, these tools aim to measure outcomes that affect the user experience.

Measuring Pedestrian Experiences through "Walk Audits"

A significant drawback of HCM's Pedestrian LOS method is a lack of criteria that relate to the holistic context of the street and the walking experience.[7] No information about much of a pedestrian's surrounding is included in LOS analysis.

For example, the following features could be included in a more holistic "walk audit" exercise, and could still be combined into a letter grade for ease of comprehension:

- Buffer between traffic and sidewalk
- Sidewalk interruptions by driveways or parking lot entrances
- Presence and condition of functional pedestrian signals and/or pedestrian push-to-walk buttons
- Condition of crosswalk marking
- Curb ramps at all corners for all crossings, aligned to crosswalks
- Drivers respect pedestrian right-of-way at crosswalks
- Drivers stop behind stop bar, and not in crosswalks
- Distance between crosswalks, crossing opportunities
- Presence of shade or trees
- Opportunities for public seating or interactions in the public realm
- Presence of pedestrian-scale lighting
- Women, children, and seniors walking

FOLLOWING PAGE: Currently very little information about the pedestrian experience is conveyed by HCM's Pedestrian LOS. There are many important factors that could be combined into one letter grade to assess the pedestrian experience more holistically.

12 features for measuring pedestrian level of service

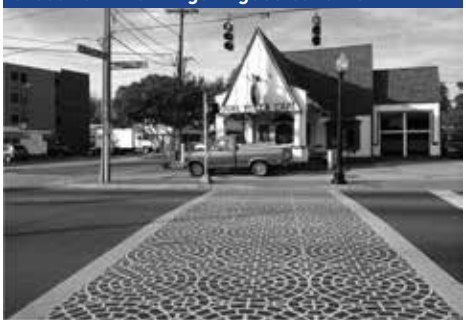
Features that increase pedestrian level of service

Buffer between traffic and sidewalk

Public seating

Women, children, and seniors walking

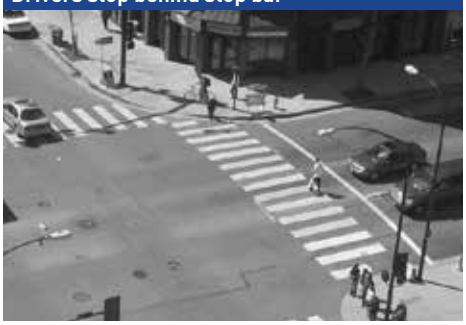
Crosswalk markings in good condition



Curb ramps

Drivers respect pedestrian right-of-way

Drivers stop behind stop bar



Pedestrian-scale lighting

Shade and/or trees

Features that decrease pedestrian level of service

Sidewalk interruptions by driveways

Long distances between crossings

Wide streets without pedestrian refuges

Comfort Level Analysis goes beyond traditional LOS to better evaluate bicycle user experience

Traditional measures such as HCM's Bicycle LOS may not capture all of the nuances that go into developing a connected network that fits the low-stress criteria.

A bicyclist's experience on a street is influenced by a multitude of factors that go beyond the type of facility (separated bike lane or travel lane shared with vehicles, for example). A key focus of planners and engineers creating 21st century bike networks is the concept of a "low-stress" or "all-ages" network. **A low-stress bike network is accessible and useful to bicyclists of all ages and abilities.** Creating a network that serves children, adults, and seniors alike involves more than just striping paint on the ground, and traditional measures such as HCM's Bicycle LOS may not capture all of the nuances that go into developing a connected network that fits the low-stress criteria.

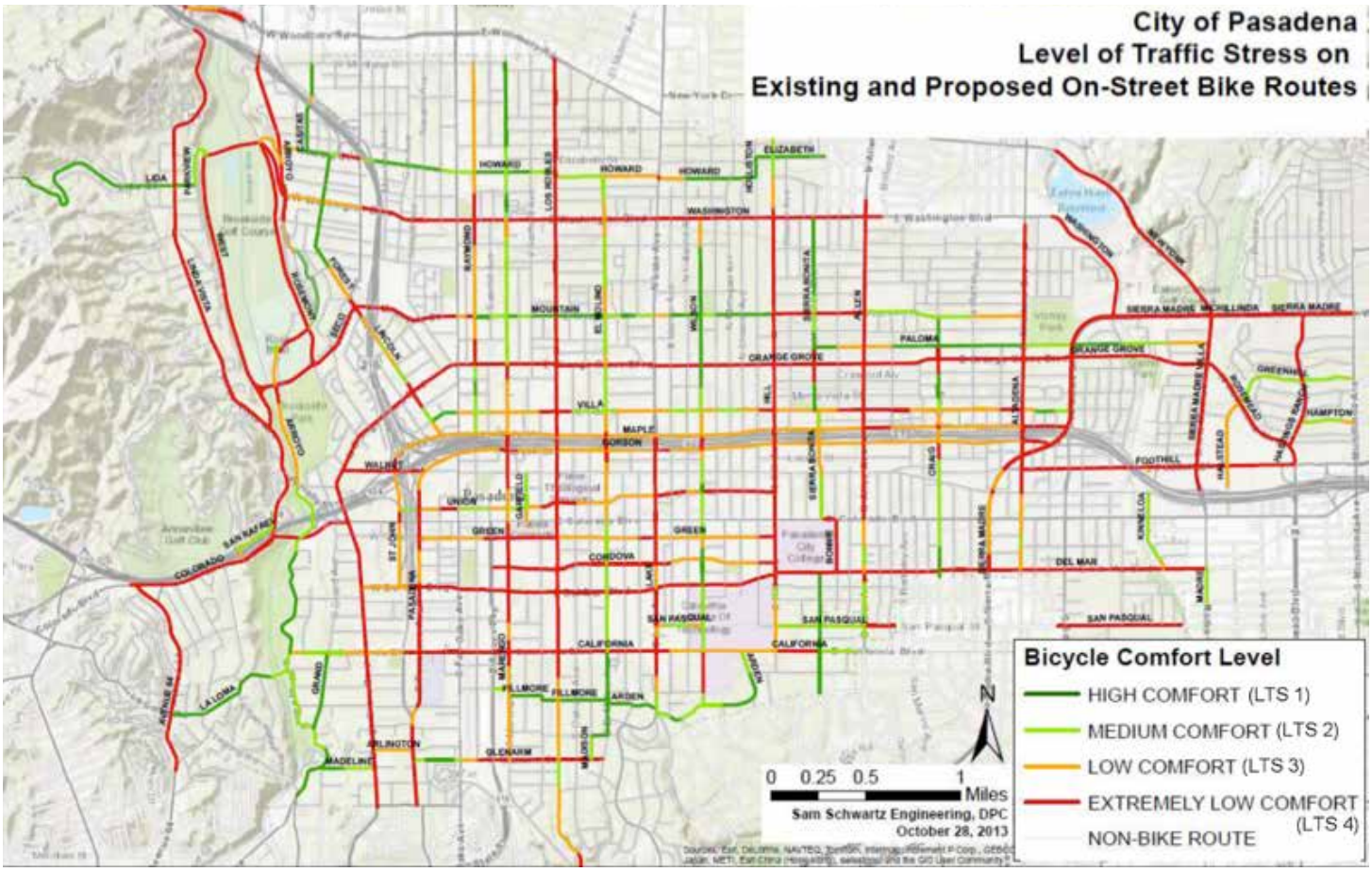
Using new methods of analysis such as a Level of Traffic Stress (LTS) framework – often called a "stress level" or "comfort level" analysis – can paint of better picture of the effectiveness of a community's bicycle investments, or help a community identify gaps in the low-stress network that should be addressed.[8]

An LTS approach looks at several of the factors found in a traditional HCM Bicycle LOS analysis – vehicle speed and intersection crossing distance, for example – but also looks at factors such as:

- Width of bicycle facilities
- Number of vehicle travel lanes adjacent to the bike facility
- Treatments to bring bicyclists safely and comfortably across intersections, which can include dedicated bicycle signalization, a "pocket" bike lane to avoid "right hook" turn conflicts, and others
- Speed limit or prevailing vehicle speeds of a street being crossed without a traffic signal
- Adjacent land uses and likelihood of bike lane blockage.[8]

Like HCM's Bicycle LOS analysis, an LTS analysis distills street segments and intersections into a rating from 1 to 4 (1 being the most comfortable/least stressful) for simple interpretation. **By introducing other factors into the analysis, however, an LTS methodology will better capture the experience of the bicyclist using the facility with a less narrow focus on his or her speed or level of delay.**

A developed low-stress network should feature high-quality bike infrastructure (i.e. separated bike lanes or cycle tracks) on streets where high-stress conditions exist otherwise, and clearly marked bicycle boulevard priority streets through residential areas to facilitate low-stress connections to "mainline" bike facilities on arterial streets. Additionally, any existing off-street trail network would be considered a part of a low-stress network and would factor into an LTS map and analysis accordingly.



A bicycle comfort or stress-level map for Pasadena, CA demonstrates the use of a different metric, Level of Traffic Stress, for evaluating the performance of streets.

Source: Sam Schwartz Engineering

Using other factors to evaluate streets can bring the analysis beyond one travel mode versus another.

Using more holistic evaluation standards for streets opens up a range of criteria that are better suited for a street's many functions of transportation, place, and infrastructure.

By dividing a street's outcomes into effects on various travel modes, planners and engineers often "miss the forest for the trees." Certain elements of a street affect all users, whether they are in cars, on foot, on a bus, or pedaling on two wheels. Using more holistic evaluation standards for streets, without breaking up one travel mode versus others, opens up a range of criteria that are better suited for a street's many functions of transportation, place, and infrastructure.

Factors such as a street's economic impact on local businesses and the local economy, its environmental benefits or storm resiliency features, its ability to foster social interaction among diverse groups of people, and the way its urban design features contribute to a varied and interesting streetscape are all valid measurements of 21st century streets.

Communities should not be fearful of developing their own evaluation criteria that relate to the outcomes they are trying to achieve in a particular place. For example, a new street that serves to access a newly created industrial business park will naturally have different needs than a road diet put in place to revitalize a walkable Main Street of a rebounding downtown.[7] A wider lens of thinking on street evaluation and performance measures for streets is part and parcel of the new and evolved practices occurring with street design.

Through design flexibility that accommodates all users, American streets are undergoing a generational transformation, and evaluation criteria must follow suit.

Improved Metrics for Evaluating Streets

Instead of using...	...use this measure instead:
Peak Hour LOS	Multiple Hours for LOS calculations
Peak Period LOS	Whole Day LOS
Automobile Only LOS	LOS for Multiple Modes
Multi-modal LOS that Separates Modes	Integrated Multi-modal LOS
Transportation Measures	Other Measures Including Economic, Environmental, and Social (see facing page)

These 12 Place Quality Criteria can also be used to evaluate streets:

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BOISE TRANSPORTATION/ACTION PLAN

White paper series

THE EVOLUTION OF STREET DESIGN

5

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5

The Evolution of Street Design

American transportation engineers and planners are fundamentally rethinking how our streets are designed. With a renewed focus on safety and serving the needs of all street users, everything from overarching design standards to decisions about appropriate lane widths is evolving.

Why does street design need to evolve?

"On average, a pedestrian [is] killed every two hours and injured every seven minutes in traffic crashes."

– National Highway Traffic Safety Administration (2014)

Street design in the United States is a relatively new field. Automobiles appeared at the dawn of the 20th century, and only became the primary mode of transportation for most Americans following World War II. In the years since, traffic engineering grew into an established practice with its own body of literature, guidance and institutions, and a primary goal of designing streets and freeways to move vehicles as efficiently as possible.

For 21st century practitioners, this paradigm is rapidly shifting. **No longer is vehicle capacity and flow the dominant consideration**, particularly not in urban areas. Today, the numerous other functions of streets are gradually attaining parity, spanning economic, environmental, public health, civic and social equity outcomes. Practitioners are developing a broader array of design approaches and performance metrics that can help design for such as less tangible goals, creating a vibrant public realm. What is not yet widely known is that this new paradigm has already made its way into received official engineering guidance and has the blessing of the U.S. Department of Transportation (US DOT), among others.

New mandates from the federal government are changing the way we approach street design from a policy level.

FHWA supports the use of NACTO and ITE guidelines to further develop non-motorized transportation networks.

USDOT unveiled its "Safer People, Safer Streets" campaign in late 2014. It seeks to increase focus on the safety of non-motorized travel through pedestrian and bicycle safety improvements and "road safety assessments in every state." [1] The agency notes that with the increase seen in rates of walking and biking since 2002, there has been a related increase in the number (although not necessarily the rate) of bicyclist and pedestrian injuries and fatalities. Through a study framework involving multiple agencies including the Federal Highway Administration (FHWA), the National Highway Traffic Safety Administration (NHTSA), and others, the campaign also seeks to promote the use of public transportation and other non-automobile travel modes. USDOT describes walking and biking as being able to "provide critical first and last mile connections to transit" in addition to more and more often being "primary modes of travel." [1]

Programs that Challenge Traditional Design

Growing out of the "Safer People, Safer Streets" campaign are programs and positions that have an effect on the way we design our streets:

1."Everyone is a Pedestrian"

NHTSA has placed focus on pedestrian safety issues and created a program that provides associated statistical information. The program provides grants to municipalities to "influence the safety of pedestrians through public education and enforcement initiatives." [2] NHTSA has made "Pedestrian Safety Action Plan" guides available as part of the program.

2. FHWA's Mayors' Challenge

FHWA launched a program in March 2015 in which participating cities attempt to "raise the bar for bicyclist and pedestrian safety." [3] Included in this program is a goal of implementing "designs appropriate to the context of the street and its uses." This includes a directive for cities to "go beyond designing walking and bicycling facilities to the minimum standards".

3. FHWA's Memorandum on Bicycle and Pedestrian Facility Design Flexibility

Although released prior to the "Safer People, Safer Streets" program, this directive provides a building block for implementing changes to street designs as encouraged by Secretary Foxx in 2014 and 2015. The memo acknowledges the primacy of the American Association of State Highway and Transportation Officials (AASHTO) Bicycle and Pedestrian Design Guides that are generally used for planning and designing pedestrian and bicycle facilities. However, it stresses that the National Association of City Transportation Officials' (NACTO) Urban Bikeway Design Guide along with the Institute of Transportation Engineers (ITE) Designing Walkable Urban Thoroughfares guide "build upon the flexibilities provided in the AASHTO guides, which can help communities plan and design safe and convenient facilities for pedestrians and bicyclists...FHWA supports the use of these resources to further develop non-motorized transportation networks." [4]

Updated street design guidance presents new methods for planners and engineers to shape the right-of-way.

"So many things have changed in 50 years, but our streets haven't, and our design guidance certainly hasn't."
– Janette Sadik-Khan, NACTO President, on the importance of the release of NACTO's Urban Street Design Guide (2013).

With the official support of FHWA, municipalities, counties, and states are now encouraged to apply design guidance for pedestrian and bicycle facilities as featured in NACTO's Urban Bikeway Design Guide[4] and NACTO's Urban Street Design Guide[5] Using a flexible approach, these guides provide far more options in street design than traditional guidance such as AASHTO's "A Policy on Geometric Design of Highways and Streets" (commonly referred to as the "Green Book") and its pedestrian and bicycle guides. None of the guidance in NACTO's guides, however, specifically conflicts with that promulgated by AASHTO or MUTCD – they build upon it to provide more options. In most cases consulting all of these guides concurrently to determine the most appropriate, context-sensitive solutions is helpful.

Transportation Secretary Anthony Foxx announces details of the "Safer People, Safer Streets" campaign in Pittsburgh in September 2014.

Evolving guidance has resulted in innovative facilities.

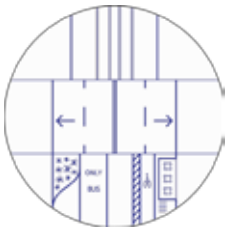
Safer street designs can bring about increases in retail activity.

As the state of the practice evolves with guidance to match, traffic engineers and planners are designing and implementing new facilities that represent a departure from traditional street design. Such designs include streets with separated bike lanes, pedestrian plazas, curb extensions or medians that can feature green stormwater infrastructure such as bioswales, slow streets, and a wide variety of others.

Six guiding principles are provided for street design:

1. Streets Are Public Spaces
They're fundamental to public life, not just a corridor for transporting oneself from point A to point B.

2. Great Streets Are Great for Businesses
Streets that encourage foot and bicycle traffic result in greater retail profits and higher home values.



3. Streets Can Be Changed
Many city streets were designed 50 or 60 years ago, in an entirely different context with a different set of values and assumptions. Engineers can make big changes even while working "within the building envelope" of a street.

4. Design for Safety
More than 34,000 people were killed in traffic crashes [in 2012] in the United States. Streets need to do a better job of ensuring the safety of people in cars, on foot, on bikes, etc.

5. Streets Are Ecosystems
Sustainable design elements like permeable pavements and shade trees help the built environment interact in a healthier way with the natural environment.

6. Act Now!
By using low-cost and removable materials, cities can test out new designs, helping people visualize changes and determine whether or not to make them permanent.

NACTO's Urban Street Design Guide [6]

The release of NACTO's Urban Street Design Guide (the "Guide") in 2013 formalized much of the work that was already occurring in many cities across the country. Through low-cost projects to create pedestrian plazas out of excess road space to simple interventions to calm traffic such as re-striping or creating neighborhood "slow zones," the Guide provides a menu of design recommendations appropriate for 21st century streets.

The Guide offers cities a "permission slip" to use innovative designs while still enjoying the endorsement of FHWA, which "'supports the use of the Urban Street Design Guide in conjunction with' standard engineering manuals such as AASHTO's Green Book and the Manual on Uniform Traffic Control Devices (MUTCD)." [7]

The Separated Bike Lane Explosion

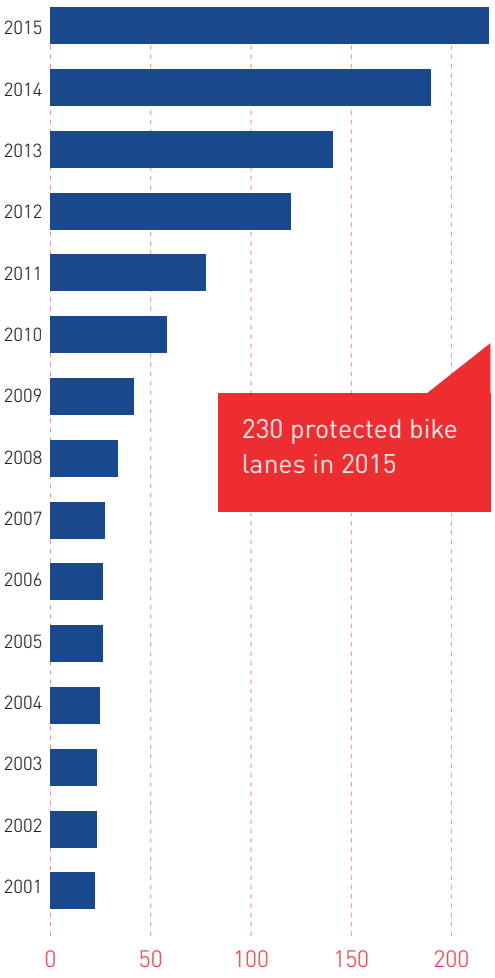
A particular change to designs on many of our nation's urban streets has been separated bike lanes (also known as protected bike lanes or cycle tracks). A separated bike lane is defined as "an exclusive facility for bicyclists that is located within or directly adjacent to the roadway and that is physically separated from motor vehicle traffic with a vertical element." [8] The number of these facilities has increased drastically to over 200 in 2015 from less than 50 only six years prior. [9] This comes despite the fact that separated bike lanes have yet to appear in official AASHTO guidance in its "Guide for the Development of Bicycle Facilities," although the organization has indicated that **these facilities will appear in its next update scheduled for 2018 or later.**[9]

Separated bike lanes have received official recognition from FHWA.

Separated bike lanes have recently received official recognition from FHWA through its "Separated Bike Lane Planning and Design Guide", released in 2015. The guide provides a full overview of separated bike lanes, with best practices for all phases of planning their installation, making design choices on context-sensitive issues like intersection treatment and buffer type selection, and subsequent evaluation of their impact from a safety, mobility, economic, and quality of life perspective.[8] It provides an expansion in detail on design elements compared with NACTO's Urban Bikeway Design Guide but otherwise complements it; it is also compliant with the Manual of Uniform Traffic Control Devices (MUTCD).

US Streets with Protected Bike Lanes

Source: =Andersen, M. – Another Breakthrough: AASHTO Moves Toward Endorsing Protected Bike Lanes [9]



Source: Sergio Ruiz via Streetsblog.sf

Case Study

SEPARATED BIKE LANES AND A PROTECTED INTERSECTION, SALT LAKE CITY, UT

Bike lane with raised curbs, planters and colored paint

Salt Lake City has aggressively increased its number of bike facilities in recent years – by 87% between 2008 and 2014. [10] Some portion of this increase has been because of the city's willingness to embrace new guidance like NACTO's Urban Bikeway Design Guide, which it used to support several pilot projects that placed separated bike lanes on its streets using only paint and inexpensive plastic flexible delineators. A positive reception from the community has now resulted in a capital construction project along one street (200 West), where raised curbs, planters and colored paint will create a robust long-term design for a separated bike lane. [11]

In fact, one intersection along this corridor will feature one of the country's first "protected intersections" where two separated bike lanes meet. Markings that guide bicyclists, pedestrians and vehicles are all MUTCD compliant, and although this type of intersection isn't featured in AASHTO's "Green Book," it does not conflict with guidance contained therein but is simply more creative and appropriate for the context.

Specific design concepts are evolving that affect all roadways – not just those with bike lanes.

Quickly evolving design considerations seek to provide the best possible outcomes among multiple dimensions, including for those in cars and those utilizing other modes.

Changing Default Choices on Lane Widths

Past engineering practice centered on 20th-century roadway design generally recommended wide (12-foot) travel lanes regardless of context. With wider lanes, the theory was that roadways could accommodate minor driver errors and not result in crashes with vehicles in adjacent lanes. However, recent research has shown that on urban streets, **lane widths of 11 feet or as low as 10 feet function just as well as lanes that are 12 feet wide, with no measurable decrease in urban street capacity.** [12, 12a] In fact, narrower lanes create safety benefits by serving as traffic calming elements that discourage speeding and decrease crashes. Research has also shown that lanes of 10- or 11-foot width also do not pose a threat to traffic volumes or constrain the movement of large trucks. [12] AASHTO also has begun to recognize the flexibility afforded from narrower lanes, stating that **"lane widths on many roads are greater than the minimum values required – the Policy on Geometric Design of Highways and Streets provides significant flexibility to use travel lanes as narrow as 10 feet."** [13]

By re-purposing portions of streets to users other than those in vehicles, a municipality can save money and the environment: [12]

- Smaller right-of way costs;
- Reduced costs for utility easements;
- Reduced construction costs;
- Reduced environmental mitigation costs;
- Less use of pavement (asphalt or concrete), less runoff, and less land consumed.

Reducing lane widths also can provide the opportunity to improve the right-of-way with other elements such as pedestrian crossing islands, landscaped medians, curb extensions, or dedicated transit or bus lanes. For example, re-purposing unnecessary roadway space and clearly demarcating narrower lanes calmed traffic, formalized a midblock pedestrian crossing point between two parks, and allowed for the installation of a median island and bike lanes on the photo below.

Source: NACTO

Higher design speeds decrease driver's peripheral vision while increasing stopping distance and crash risk.

Driving Speed and Risks

Source: NACTO

Designing Proactively for Target Speeds

In the past, speed limits were generally determined based on the geometry of a roadway and its "operating speed" – i.e. the speed that vehicles in the 85th percentile of all traffic were traveling at. The posted speed limit would therefore typically be set at the 85th percentile of observed speeds, with little regard to context. As street design evolves, planners and engineers are adopting the concept of **target speed (the highest operating speed given desired conditions) to work backwards towards the most appropriate street design rather than designing in reaction to existing operating speeds.** In doing so, streets are designed proactively so the typical 85th percentile speed is at a level that fits into the context of surrounding land uses, the level of pedestrian activity, and other safety issues.[14, 15]

To reach desirable operating speeds on streets where current speeds are higher than targeted, municipalities can use traffic calming elements to reduce operating speeds such as medians, pinch points, chicanes, lane shifts, speed humps, roundabouts, and neighborhood traffic circles. Closer traffic signal spacing with a slower signal progression can likewise bring speeds down. Other "softer" elements can have an equally significant effect on drivers' behavior, such as street-oriented buildings (i.e. a consistent street wall with little setback and parking lots located in the rear), on-street parking, and the presence of streets trees to narrow a driver's visual field. [15]

We as practitioners have the ability to effect change through our street designs.

The exponential growth of innovative design treatments on American streets in the last decade has expanded our vision of how streets can function in the future as both transportation corridors and public spaces. The most current design guidance, increasingly supported by research and real-world experience, provides a much more flexible approach to making design decisions, expanding on – and in some cases turning on their head – standards and assumptions that have been in use for decades. As a result, one consistency that does exist in the evolving guidance is the idea that **design flexibility and context-sensitive solutions must be employed so that every street receives the treatment that makes most sense for the situation and location.** Similarly, there is a common theme of adopting a proactive stance: **designing with intention to achieve a particular set of desired outcomes rather than in reaction to the conditions of yesterday or today.**

Another trait of recent street design is the idea that **all users should be accommodated,** relative to not only their current usage but also the community's vision for the future. If we design our streets to only serve vehicular traffic because there are few people walking, taking transit or biking there now then, through a vicious cycle, those who might otherwise take advantage of a wider array of transportation choices will feel uncomfortable doing so, creating a self-fulfilling prophesy. This negative feedback loop can hurt local economies and keep cities stuck in the 20th century. To truly succeed going forward, street design needs to evolve with a more proactive approach that looks forward as well as backwards to create the space – physically, psychologically, and visually – for achieving the triple bottom line of financial, social and ecological benefits.

Municipalities that have had success with changing their street design practices have tended to embrace the idea of **flexible design through pilot projects using inexpensive materials**. Doing so allows them to make changes when certain interventions don't function as planned, with a relatively limited financial hit.

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BOISE TRANSPORTATION/ACTION PLAN

White paper series

INTERIM STREET DESIGN

6

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6

Interim Street Design

Through low-cost, temporary interventions that encourage innovation and public participation, Interim Street Design offers a strategy for effective investment in public space.

Interim Street Design allows for city planners to deliver positive changes faster, and to test, refine, and evaluate the impacts of a design.

Interim Street Design (ISD) is an approach to improving the public realm that applies low-cost, incremental changes to help guide a place towards longer-term transformations.

Essentially, ISD seeks to turn on its head the traditional approach of project delivery where large capital projects would take years to plan, design and deliver. Instead, by allowing cities to implement temporary changes to a street or open space in a short amount of time, ISD enables planners to gather data, track metrics, test alternatives, and deliver positive changes faster. The public enjoys benefits earlier, and planners have the data and evidence to be sure that an intervention accomplishes the intended goals, prior to investment and permanent installation.

This approach relies on a toolbox of easy-to-implement interventions like movable materials, paint and street furniture to carry out the various types of ISD projects available. The majority of ISD projects are based on **Moving the Curb** and reassigning the protected space (usually on-street parking) to other uses such as:

- Bus Lanes
- Bike Lanes
- Parklets
- Bike Corral
- Sidewalk Widening (planter beds, bollards, epoxied gravel)
- Traffic Calming Devices (chicanes and offset islands)
- Bike Share Stations

Larger reallocations of the street right-of-way involve **Temporary Street Closures,** whereby a street is temporarily, albeit regularly, restricted to uses other than vehicle traffic, including:

- Play Street
- Pedestrian Street
- Market
- Open Streets

In some cases, **Interim Public Plazas** can also be created using the strategies of ISD. These are appropriate for small scale, temporary situations to quickly secure public spaces from changing conditions over the year. Interim public plazas allow for data collection, improve public buy-in, and increase public awareness of existing problems (for example, the need for improved pedestrian conditions).

FACING PAGE: Interim Street Design projects can take many forms, from creating public spaces such as parklets and plazas, to testing out lane configurations and bike infrastructure.

Photo credits: Sidewalk Widening, Traffic Calming, and Bike Corral from nacto.org. Protected Bike Lane from chpn.net

Sidewalk Widening

Traffic Calming

Bike Corral

Protected Bike Lane

Parklet

Interim Public Plaza

Interim Street Design offers many benefits

Because these tend to be low-cost and quick to implement, ISD projects allow for a city to realize part of the benefits of a larger capital project in a shorter timeframe

There are multiple benefits to ISD that depend on the type of intervention and its duration. However, all share common advantages when used to supplement a longer-term project. Because these tend to be low-cost and quick to implement, ISD projects allow for a city to realize part of the benefits of a larger capital project in a shorter timeframe (for example, exclusive bicycle lane stripping while a full street design project is approved), helping to build momentum for the full project early on.

In addition, the early implementation of an ISD project allow for planners to learn how the street and open space actually performs – which is not always as anticipated – and can use this newly gained information to **build a better long-term project.** The same goes for community feedback, which can be more accurately gained from having a pilot on the ground, and then reflected in a more **widely accepted full project design**.

There are many cases where ISD can be used to advance and more importantly inform a city's vision and direction.

The current status of city planning with tight public budgets, an evolving civic culture of engagement, and rapidly growing cities makes ISD an effective tool. The ability to test concepts before making high-cost investments, while at the same time providing greater transparency and openness, is increasingly attractive.

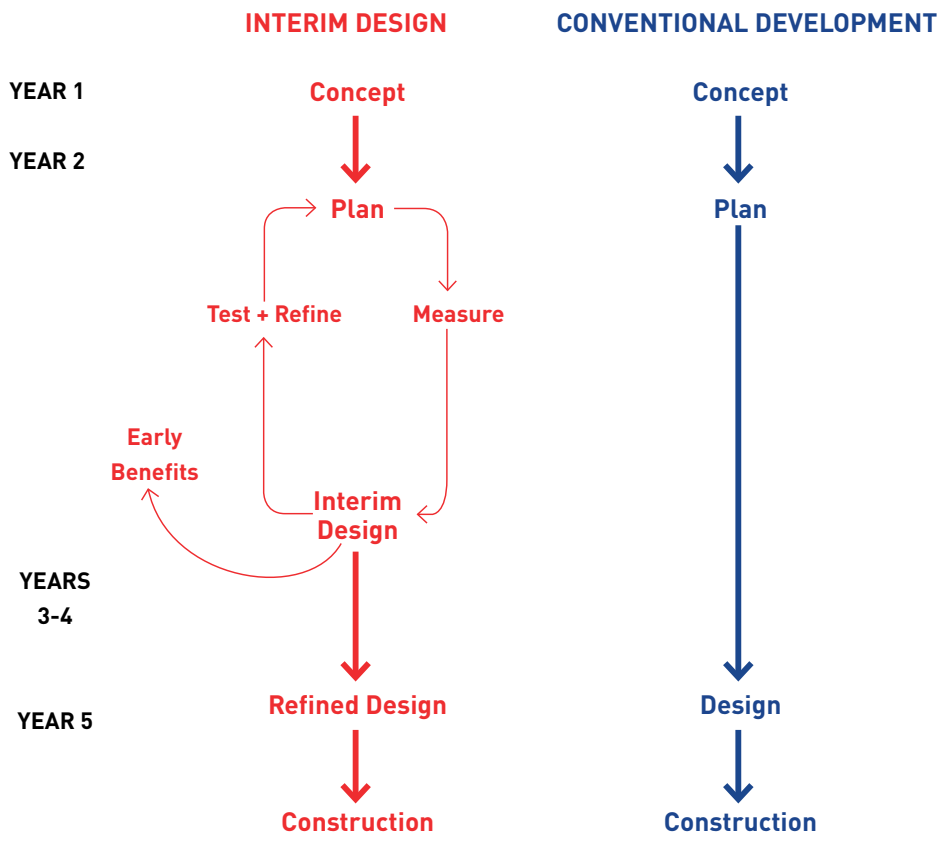
Considerations for successful use of Interim Street Design

Interim Street Design is not always appropriate, and cannot take the place of formal planning and approval processes that ensure high-quality projects consistent with a city's vision and goals. However, there are many cases where ISD can be used to advance and more importantly inform a city's vision and direction, often improving the longer-term projects in the pipeline.

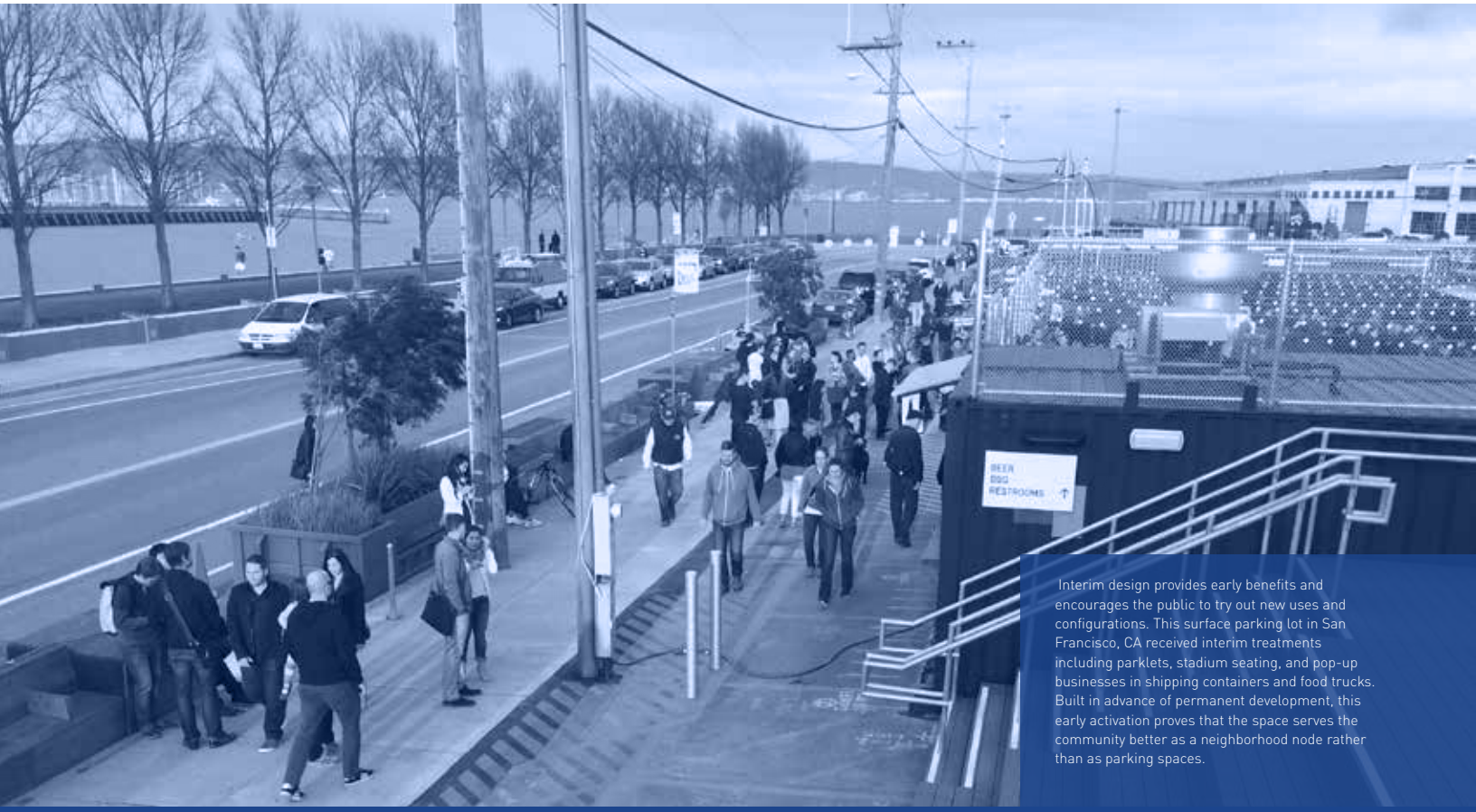
One opportunity arises when ISD projects replicate parts of a longer-term project and **can provide public benefits early on.** Such is the case with temporary bulb outs while larger transit corridor improvements take place. **Another opportunity where ISD is especially helpful is when testing innovative and new projects** that are not necessarily proven yet, but are highly promising. Such is the case of a Parklet program, where cities and businesses study their performance and effects before making permanent interventions.

Lastly, ISD is helpful with projects that are contentious and planners anticipate a high level of **community involvement**. By using an interim approach, community members can more easily provide feedback on the project and eventually obtain critical buy-in for a project to move forward.

It is important to clearly **communicate the level of permanence** expected of an Interim Street Design project. Planners using ISD should pay particular attention to stakeholder engagement opportunities, and use a process that not only informs with the community and private businesses, but leverages their interest and strengths to help implement and even maintain, steward, and program improvements.



Adapted from NACTO's Urban Street Design Guide. [1]



Interim design provides early benefits and encourages the public to try out new uses and configurations. This surface parking lot in San Francisco, CA received interim treatments including parklets, stadium seating, and pop-up businesses in shipping containers and food trucks. Built in advance of permanent development, this early activation proves that the space serves the community better as a neighborhood node rather than as parking spaces.

Interim Street Design Case Studies

Cities throughout the country are using Interim Street Design strategies to innovate, provide early benefits, engage the public, and make more effective long-term investments. Two case studies are presented here.

Boulder, CO-
Living Laboratory Bike Safety Pilots

"We have a pretty split community, and I think we need to try something, but we need to try one thing and see if it works."

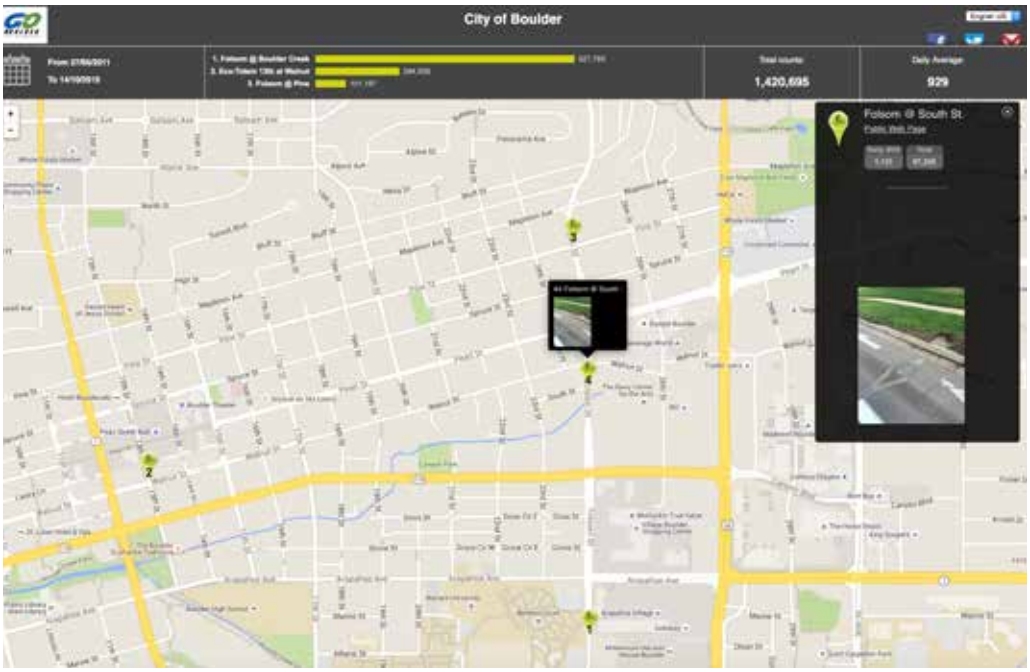
-Matt Applebaum, Mayor of Boulder, quoted by *Daily Camera* Boulder News, June 15 2015

The City of Boulder's Transportation Master Plan (TMP) called for the creation of a series of pilot projects that would test a number of possible Complete Streets configurations. These configurations were designed to provide safe and comfortable travel choice to those walking, bicycling, riding transit or driving their vehicle.[2]

As a result, the Living Laboratory program was implemented starting off with pilots on three streets. City planners will analyze the results before going to City Council for further expansion of the program. In particular, "right-sizing" projects seek to temporarily re-stripe 4 lane roads into what is commonly referred to as a 4:3 conversion. This re-purposes one lane of traffic into two 7ft-wide buffered bicycle lanes (where previously there was only a 5 ½ ft-wide bicycle lane, without buffer protection), and re-purposes another travel lane as a center turn lane median.[3]

These changes are expected to significantly improve safety on a corridor that has been dangerous for pedestrians and cyclists, without compromising traffic conditions. The pilots will look at safety improvements, especially for cyclists and pedestrians, as well as changes to travel time and bicycle and vehicle volumes.

Thanks to the Interim Street Design approach taken, public and community stakeholders and are able to test different strategies, learn from the pilot projects, and modify the proposals based on the actual performance the designs on the ground.



LEFT: A screenshot from the City of Boulder's public online interface that displays bike counts updated daily at key points relating to pilot installations. Much of the success of Boulder's Living Lab pilots is tied to good communication and feedback channels with the public, and zealous tracking of performance metrics.

Photo credits
TOP: eventbrite.com, MIDDLE LEFT: Cliff Grasnick for the Daily Camera, MIDDLE RIGHT: gannet-cdn.com, BOTTOM: eco-public.com

Richmond, VA - Church Hill North Better Block Project

During the pilot, there was a 30% decrease in average vehicle speeds.

Since its start in Dallas, TX in 2010, the Better Block Project has been a community-led initiative throughout the country seeking to revitalize and rethink forgotten urban spaces into more livable places, by using Interim Street Design strategies.

In 2014, two blocks in the Church Hill North neighborhood of Richmond, VA were temporarily transformed through the addition of improved pedestrian and bicycle amenities, active public spaces and pop-up activities in the adjacent buildings.[4]

Through a series of community walks and workshops, a bottom-up vision was created that would guide the temporary interventions. It included the use of bicycle lanes (650ft.), parklets (2), new public space (3000 sq. ft), pop-up shops, planters, food trucks, decorative crosswalks, outdoor café seating, public art, an activated alley and a temporary road closure using barricades.[4]

In less than 3 months and with the help of nearly 100 volunteers, the vision was implemented in a two-day event on Friday and Saturday, June 13-14 of 2014. During the pilot, there was a **30% decrease in average vehicle speeds (from 20mph to 14 mph) in the surrounding area, with a 10% decrease in noise levels as well. [4] Perceptions of safety greatly improved** with all those surveyed and participating in the event claiming it felt safer with the temporary interventions.

FACING PAGE: The Better Block Project in Church Hill North, Richmond, VA, engaged the community in piloting sharrows, crosswalks, protected bike lanes, parklets, pop-up retail, and plazas.

Photo credits
TOP: betterblock.org, MIDDLE LEFT: activera.org, MIDDLE RIGHT: kerryriley.com, BOTTOM: chpn.com

Keys to Successful Interim Street Design

1. Embrace Interim Design as a city planning tool.

More cities are using Interim Design as a strategy to track data and communicate a design's efficacy. Interim Design has evolved beyond citizen-led projects, and is used to support city-led initiatives as an part of the development cycle. City planners should add Interim Street Design to their toolbox of strategies. Interim Design allows for controlled experimentation and valuable feedback that can lead not only to community buy-in, but also higher quality, more cost effective long-term investments.

Photo credit: erprealestate.com

2. Use Interim Design when and where it is appropriate.

Care should be taken to distinguish when it is appropriate to use ISD. Not all communities, locations and types of projects are suitable. ISD is especially appropriate and effective when trying new and innovative treatments, when community perspectives are divided, or when project benefits can be delivered earlier through temporary improvements.

3. Set clear expectations

The goals, timeline and feedback processes should be clearly established from the outset and communicated with the community, so that there are clear expectations from the start. It is also helpful to make evaluation, tracking, and metrics publicly available.


Photo credit: dwell.com

4. Partner with the community

Where possible, planners should seek partnerships with local organizations and businesses not just in the design of ISD projects but particularly in their implementation and upkeep. Often, these partnerships can also help diversify funding sources for these projects.


Photo credit: chpn.net

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BOISE TRANSPORTATION/ACTION PLAN

White paper series

TRANSPORTATION AND PLACEMAKING IN LOW-DENSITY ENVIRONMENTS

BOISE
CITY OF TREES

7

7

From low density to critical mass

Low-density development locks people into a cycle of car dependence. By providing people with improved comfort, safety, and connectivity, retrofits of low-density environments can provide enough critical mass to short-circuit the cycle, offering more transportation choices and higher quality of life.

A critical mass of pedestrian friendly development can offer enough comfort, safety, and connectivity that people feel free to choose alternative modes of transit.

The central problem with low-density development is that it locks people in a dependency of auto-travel, which in turn encourages further sprawl. While low-density development has other complex demographic and economic considerations, car-dependence in suburban areas simply boils down to a problem of scale.

Large surface parking lots, long stretches of unbroken blocks, and wide roads are designed for fast-moving cars. High speeds, lack of frequent crossings, and lack of shelter makes walking and biking uncomfortable and dangerous. **As a result, more people are dependent on driving, and more driving creates a cycle of market demand for even more low-density development.** Feeding this cycle encourages the type of sprawling development that looses value over time.

The goal of retro-fitting low density development is not to turn suburban neighborhoods into highly urbanized areas. Rather, bringing human scaled environments short-circuits the cycle of car dependence and provides neighborhoods the chance to build a distinct identity. A critical mass of pedestrian-friendly development can offer enough comfort, safety, and connectivity that people feel free to choose alternative modes of transit. A side effect of creating human-scaled areas that are accessible by multiple modes is increased convenience, economic opportunity, and social cohesion, and ultimately, a greater sense of place.

FOLLOWING PAGE: This street in Belmar, CO is a retrofit of what was a declining mall and parking lot. Pedestrian lighting, safety features, and active street frontage have transformed this place from a car-centric mall lot to a lively main street that invites walking and lingering.

Urban form affects transportation choice and sense of place

"If a space is designed for people — if it's welcoming, safe and comfortable — they will walk. If a place is designed for cars, people will drive if they can."
-SPUR, Getting To Great Places[17]

Urban form – block size, street width, setbacks, street grid (or lack of grid) – determines how people move about and where they spend time in the built environment. Urban form dictates whether people are restricted to driving or if they can choose alternative modes of transport.

Where urban form encourages people to drive, it has a negative impact in the sense of place. Individuals' self-reported areas of 'home territory' - the part of your neighborhood you feel you can call 'home' - have been shown to shrink when living on high-traffic streets compared to low-traffic streets. Moreover, people living on high-traffic streets report fewer relationships with their neighbors.[15] **Streets that encourage high traffic volumes shrink people's sense of home territory, and reduce social cohesion.**

In Salt Lake City, a high proportion of first-floor windows, active uses along street frontage, and high imageability invited more pedestrian activity.

In contrast, places that encourage alternate modes of transportation, especially walking, increase home territories, social cohesion, and public life. Walkability is more than the sum of physical interventions, and emerges from a successful mix of land use, density, building form, transit, safety, street design, and programming. Thus, **walkability is an indicator of successful placemaking**.[17]

To create great places, start with streets

Streets are not just transportation infrastructure. Street right-of-ways and street frontages affect how people move and determine the character of a place.

To encourage successful placemaking, streets should have a human scale and be walkable. Our ability to recognize another person's face breaks down when she is farther than 40' away from you, so if we want to encourage community vibrancy **40' is a good limit on street width.**[12] A block will feel walkable if you can get from corner to corner in 1 to 3 minutes, which works out to **blocks between 300 ft. – 500 ft. long**.[14]

Beyond street width and block length, active and memorable street frontages are the main factor to encourage walking. Studies show that the proportion of first-floor windows, active uses, and street furniture can predict pedestrian activity.[13]

There are similar findings in Salt Lake City, a more auto-dependent community. A high proportion of first-floor windows, more active uses along street frontage, and high imageability invites more pedestrian activity.

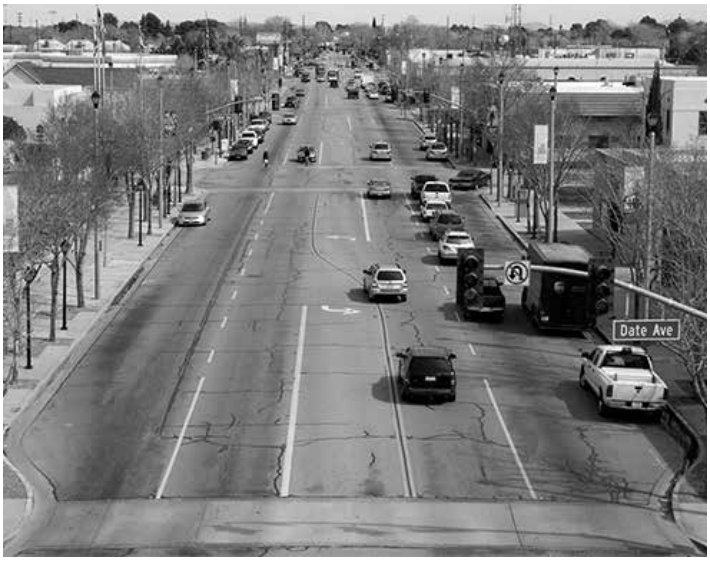
Even in a city that is largely auto-dependent, memorable streets invite people to walk more and spend more time in public space, contributing to vibrant public life.

FOLLOWING PAGE: Examples of retrofitting urban form to encourage walking and improve sense of place.

TOP: Cinderella Mall in Englewood, CO, was transformed into Englewood City Center, a mixed-use community centered around a civic heart.

MIDDLE: An old Sears in San Diego, CA, was invigorated by a walkable street network and a pedestrian-only residential level, forming the uptown Hillcrest neighborhood.

BOTTOM: Retrofitting Lancaster Boulevard in Lancaster, CA, brought a downtown to Lancaster. Parking was moved off-street to garages, the medians are generous and planted, sidewalks are wider, bikes share the travel lanes, and the street frontage is activated by storefronts, furniture, and public art.


Date Ave

Retrofits of low-density places are sound investments

Suburban retrofits and infill have reduced infrastructure and capital costs compared to traditional suburban development. They result in communities with better market resilience, higher property values, and increased tax bases. These economic benefits can be attributed to the desirability of higher walkability, a mix of uses, and proximity to transit.

Infill projects are better able to retain their value during economic downturns than other regions. [1]

Retrofit and infill projects have been shown to have reduced infrastructure and capital costs, and to be a more dependable long-term investment compared to traditional suburban or new urban greenfield development.

Reduced infrastructure and capital costs

One analysis of smart growth development showed reduced infrastructure costs – over 5 years for 25 million units, developers and new occupants could save $200 billion.[1]

It's also possible to save on capital costs for parking. In one case study of a mid-rise project, a 50 percent reduction in parking would reduce capital costs for parking by 25% and allow 20% more residential units on site. [1]

Improved market resilience

Infill projects are better able to retain their value during economic downturns than other regions. This was shown in the last housing recession. A nationwide analysis of 269 metropolitan regions showed that **the greater a community's distance from a central business district, the greater the decline in home values** during the housing market collapse, and the less values recovered by 2011.[1]

Economics

NASHVILLE, TN

Of three development strategies, infill has the best economic outcomes

A study of three different development strategies in Nashville-Davidson County compared an infill development, a New-Urbanist greenfield development, a conventional suburban development. [4]

The infill project, The Gulch, is 76 acres on a brownfield location, including 4,500 housing units and 6 million square feet of retail and office space.

The New Urbanist-style greenfield development, Lenox Village, is 185-acres with 1,700 residential unit and 67,000 square feet of retail and office space.

The traditional suburban development, Bradford Hills, is 185 acres with 538 housing units and 39,000 square feet of retail and office space.

Study authors calculated the net general fund impact of providing services on the residential component of each project. Upfront infrastructure cost was not included. Conclusions included the following:

Infill development had lower service costs.

- Infill service costs per unit per year: $1400
- Urban greenfield service costs per unit per year: $1300
- Suburban service costs per unit per year: $1600

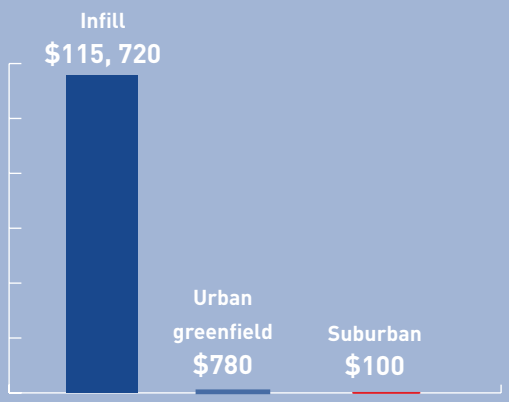
Infill development generated the largest surplus.

- Infill per acre: $115,720 in net revenue (almost 1,150 times the net revenue generated by suburban!)
- Urban greenfield per acre: $780
- Suburban per acre: $100

Infill development generated the most revenue per unit.

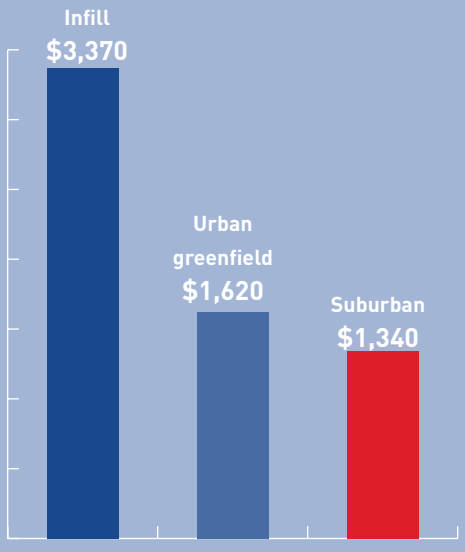
- Infill: $3,370 per unit (more than twice as high as suburban)
- Urban greenfield: $1,620 per unit.
- Suburban: $1,340 per unit

The infill development generated 1,150 times as much net revenue per acre as the traditional suburban development.



SURPLUS (NET REVENUE) PER ACRE

The infill development generated twice as much revenue per unit as the traditional suburban development.



REVENUE PER UNIT

Walkability provides economic benefits

In Michigan, decreased car dependence saved commuters who live in infill sites about $3,000 to $4,000 in transportation costs yearly. [3]

Infill and retrofit projects result in higher walkability, which contributes to higher property values nationwide. The WalkScore metric is a validated measure of walkability that rates locations from 0 (car dependent) to 100 (most walkable). An office/retail property with a walk score of 80 has a market value of 54% more than a comparable property with a walk score of 20 (4200 properties nationwide).[1] **For cities, a 10-point increase in Walk Score is associated with a 5% increase in housing prices** (nationwide analysis of 259 cities).[1]

Regional case studies show that **walkable neighborhoods are more economically resilient.** In the Rocky Mountain West, compact, walkable communities retained a price premium of 12.5% after the recession even as housing prices declined overall. In Jefferson County, Alabama, land values and sale prices increase with walkability and declining car dependence, and these premiums hold up over time.[1]

The Brooking Institution found that each step increase on a five-step walkability scale correlated with an 80% increase in retail sales.

Increased walkability also leads to increased retail sales. Using a five-step walkability scale to rate 201 walkable neighborhoods in metropolitan Washington D.C. They found that for each step increase, neighborhoods saw an 80% gain in retail sales.[16]

Access to transit provides economic benefits

Proximity to a transit station also provides economic benefits. In Santa Clara County, retail and office property values are 23% higher than comparable properties far away. In commercial business districts, they command an even higher 120% premium. Residential properties were 45% higher than the mean property value in the county and 28% higher than the value of all properties within 4 miles of a station. Compared to single use neighborhoods, properties with a balance of jobs, employed residents, and a mix of uses show price premiums.[1]

In addition to higher property values, infill and retrofits also increase jobs and generate tax capacity. In Minnesota, suburban retrofits funded through the Livable Communities Demonstration Account created 7,182 new jobs and generated $7.94 million in new net tax capacity. Projects included the conversion of shopping centers converted to housing, commercial development, and a mixed use communities.[2]

Evidence: Infill projects in Idaho

TREASURE VALLEY, ID

In Treasure Valley, infill developments defy stereotypes

From 2004- 2007, 12 residential infill developments in Treasure Valley were studied and compared.[5] Major findings included:

Infill did not increase traffic in surrounding neighborhoods.
In 9 out of 12 of the developments, traffic was flat or down. In the remaining 3 developments, traffic increase attributed to lack of roadway connectivity.

Infill did not lower surrounding property values.
Many neighborhoods enjoyed proximity to services and centers, drove values up. Many houses in the study areas were smaller in size, resulting in lower sales prices but higher prices per square foot.

Neighbors' opinion of infill depended on access to amenities and quality of design.
Providing public amenities that are available to the public, and not just to project residents, helped infill projects gain acceptance from neighbors. These included neighborhood pathways and crosswalks. In addition, projects that had high quality of design had higher acceptance, while projects that had poorer design quality were more critiqued.

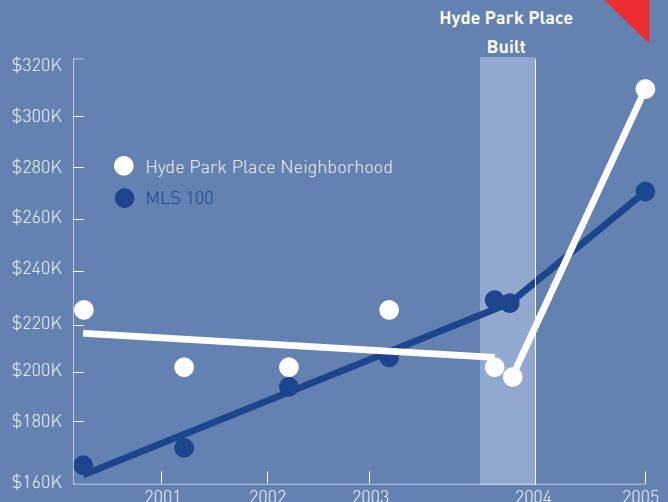
Neighbors' opinions of infill did not depend on density.
There was no correlation between the density of the development and public acceptance.

In the Hyde Park Place infill project, residents take fewer car trips. Total car trips decreased by 1000 trips per day.

HYDE PARK RESIDENTS
.75 car trips/day

SURROUNDING NEIGHBORS
2.32 car trips/day

Since the infill project was built, average sale prices in neighborhoods surrounding Hyde Park have increased.



AVERAGE SALE PRICES

Suburban retrofit case studies

Three case studies are presented here. Each demonstrates the importance of increasing transportation choices to achieve a sense of place in a low-density environment. Despite being located in areas with cold winters, each emphasizes improved walkability and shared outdoor public space.

Columbia Pike, Arlington, VA

"The streetcar vision was tied to future real estate development with the goal of preserving affordable housing amid dense, mixed-use development on the promise of fixed rail."
-wamu.org, September 2015

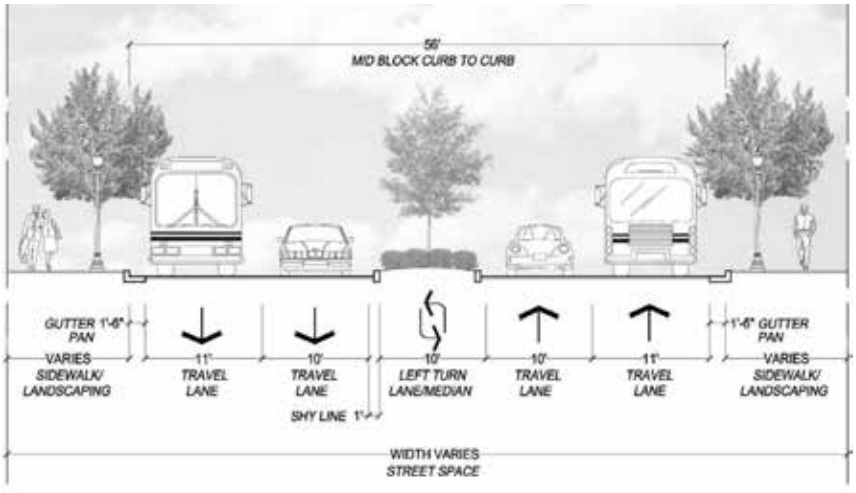
Arlington is using form-based codes that will encourage retrofitting a 3-mile stretch of Columbia Pike, a major arterial. The form-based codes allow community control over design preferences. The form-based codes also allow developers to build at densities higher than the surrounding neighborhoods. **The project is unique in that it began with high-quality transit as the goal**, and viewed retrofitting as a way to encourage densities along the corridor that would justify plans for a five-mile streetcar transit system to augment bus service along the Columbia Pike.[6,7]

The planned streetcar system was canceled in late 2014 due to political opposition. However, **form-based codes have been successful in incrementally changing stretches of the arterial to be more walkable**, and to have higher-quality bus stops. Transit advocates have not given up on BRT as an alternative to the street car, and form-based codes ensure that there will be nodes to connect along Columbia Pike.

Similar to Boise, the Columbia Pike neighborhood seeks high quality transit, mixed use centers with a variety of amenities, and streets and neighborhoods that are safe and multi modal while preserving the Pike's character and identity.[8]

Their criteria for mixed-use centers can be applied to activity centers for Boise's neighborhoods:

- Street frontage at a pedestrian scale with ground-floor retail
- Buildings oriented to Columbia Pike
- Buildings built close together forming a continuous "street wall"
- Parking located underground or to the rear of buildings



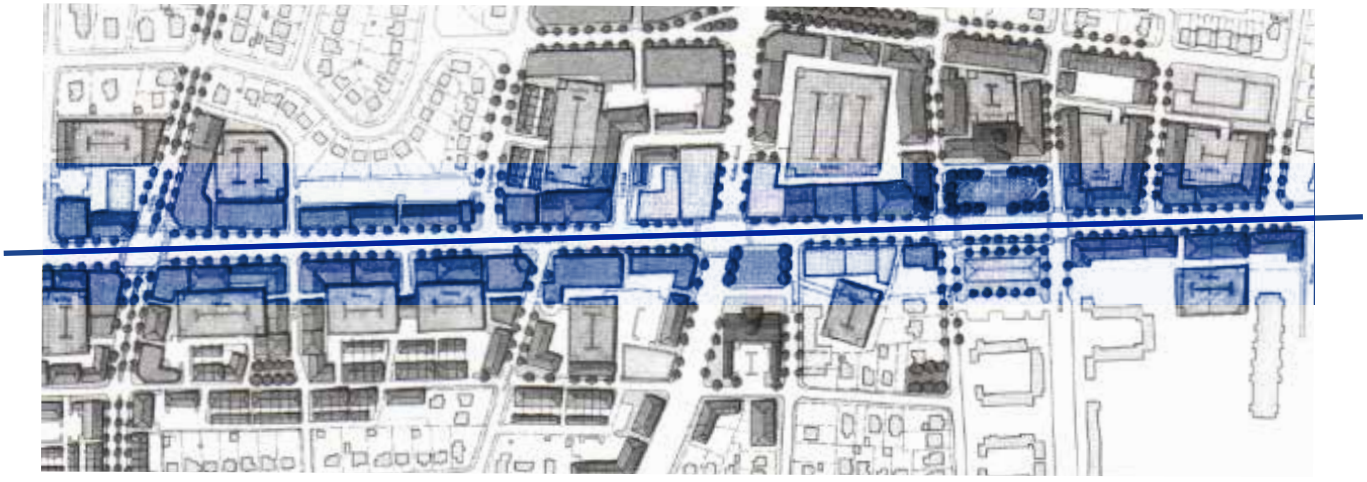
ABOVE: Columbia Pike Multi-Modal Street Improvements, Proposed Near-Term Typical Cross-Section, Columbia PIke Implementation Plan Team Meeting 2011. Section by Kimley-Horn and Associates, Inc. for Arlington County, VA.

HOW TO: Use mixed-use infill to support transit on a vehicular arterial.

LEFT: The Penrose Square apartments feature ground floor retail that fronts the street, and a public square. In the foreground, a curbless road edged with bollards and treated with plaza-like pavers is closed to traffic, promoting walking.

BELOW LEFT: Penrose Square is activated by many community events, such as movie nights during the summer.

BELOW RIGHT: Columbia Pike views mixed-use infill as a means to an end. The planning department began with the goal of improving transit along the material, and views infill as a way to create nodes and densities that support transit development. High quality transit stops, and pedestrian lighting on Columbia Pike are shown below.
In the background, the Arlington cinema stands preserved, demonstrating that historic buildings should be incorporated into vibrant streestcapes.



ABOVE: Plan by Dover Kohl & Partners, Geogrrey Ferrel Associates. Form-based codes required that buildings wrap around the edges of the block, providing a continuous streetscape.

Belmar, Lakewood, CO

"Designed to be an ever-changing project, Belmar was on the forefront of a national trend of creating high-density, mixed-use development that clustered along transportation corridors with an emphasis on getting around without a car."
-The Denver Post, May 2014

Belmar replaces a mall and parking lot with 22 blocks of mixed-use buildings, ground floor retail with residences above, and a neighborhood square. The 22-block area is home to 2000 of the development, and 4,000 people live within walking distance.

The Belmar project also brought light-rail and a magnetic, downtown-like center to the suburb of Lakewood. **Transit is a major cause of Belmar's success and continued appeal,** featuring a major transfer center, bus routes along arterials, direct shuttle services to a light rail station.

In addition, a concentration of housing and services make Belmar walkable for residents and visitors, who can take transit or park once. Cultural programming in the neighborhood square and active street life, including street furniture, street trees, inviting building facades and other human-scaled elements.

Economic benefits from Belmar include:

1. $200 million a year in retail sales and 2.5 percent of Lakewood's total sales tax revenue.[10]

2. Belmar property values have increased 700 percent from 2004 to 2012. **Property values of the surrounding corridor increased 36 percent from 2001 to 2013**.[10]

3. Belmar reached its financial targets in its first year. From the official opening in May 2004 through April 2005 Belmar has contributed nearly $800,000 in sales taxes, plus $882,000 in construction and use taxes." [11]

BELOW: The main square becomes an ice rink the winter. Photo credit: Todd Carpenter.

HOW TO: Transform a mall and parking lot into walkable downtown

LEFT: View down a walkable main street in Belmar, with ground floor retail, pedestrian lights promoting safety and neighborhood identity, and crosswalks with plaza-like paving treatments.

MIDDLE ROW: Belmar was transformed from a mall and parking lot into 22 city blocks. A new street grid healed the divide between the mall and the adjacent neighborhood.

BELOW: The main square in Belmar is used for dining, performances, neighborhood gatherings, and an ice rink in the winter.

Mashpee Commons, Cape Cod, MN

"[Mashpee Commons is] an 'attachable fragment of urbanism'...

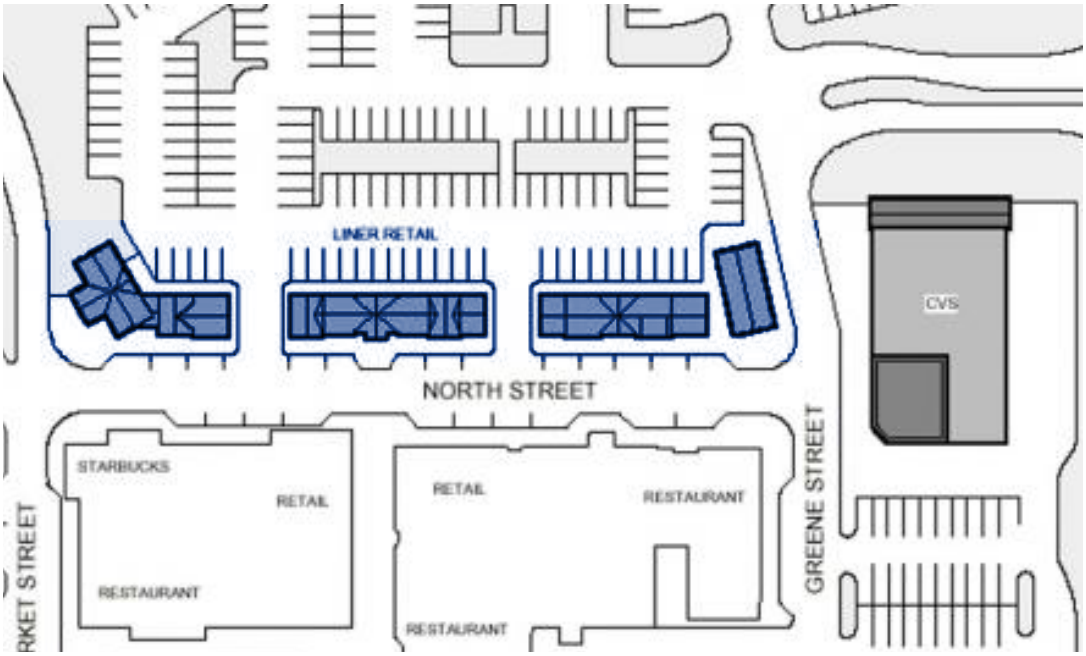
[the strategy is] building the commercial core first, the 'attachable fragment,' and then using its success to support adjacent, higher-density residential development." [2]

Mashpee Commons has just celebrated a 20 year anniversary, a landmark in an incremental retrofit that replaced a 1960's strip with a place that centers the community. Already residents, business owners, and adjacent neighborhoods have established a cultural identity for Mashpee Commons, creating community events that have become traditions. **It is a prime example of how to retrofit a strip center into a walkable place of place of critical mass.** There are enough goods and services for residents to be able to walk for their daily needs, and where visitors can park once to access the neighborhood's amenities.

Mashpee Commons features mixed use apartments above retail stores. It also embeds civic spaces such as a post office, achieving a balanced mix of uses. **By focusing on developing the commercial core first, Mashpee Commons was able to leverage the success of the commercial core to support adjacent denser residential development.** Parallel development of compact residential neighborhoods could easily plug into the Mashpee Commons core. It has created a demand for compact housing that is changing the neighborhood form of adjacent areas, demonstrating how an activity center of critical mass can encourage walkable development beyond its edges.

Formally, Mashpee Commons makes use of shallow liner buildings to screen parking lots. These liners, about 20' - 24' (the length of a parking space) do not take away many parking spaces, and favor mom-and-pop retailers. Moreover, they complete 2-sided retail streets in the core, giving a continuous and engaging face to to the streetscape.

Mashpee Commons is positioned on an existing transit line. **It serves as a node and anchor for emerging transit services.** As in Boise, transit improvement will be necessary to support the mobility requirements of a growing population of seniors.



ABOVE: A plan of Mashpee Commons demonstrates liner buildings 20-24' deep that screens the parking areas. Image from bettercities.net, August, 2010.

HOW TO: Turn a shopping strip into a thriving neighborhood center with active street life.

LEFT: The 1960's strip was surrounded by a large parking lot.

MIDDLE LEFT: Liner buildings screen the parking lot and give a continuous streetscape to a two-sided retail street. The buildings are 20' - 24' deep, and are attractive to mom-and-pop stores as well as places to incubate small businesses.

MIDDLE RIGHT: In addition to active store fronts, cafe seating and outdoor furniture activates the street frontage.

BOTTOM: Mashpee Commons is pleasantly walkable both for residents and visitors. Buildings are welcoming to pedestrians, thanks to windows, awnings, shading structures, and articulated facades. Street furniture and plantings make the sidewalks comfortable places to participate in street life.

Strategies for transportation and place-making in a low-density environment

1. Balance mode share on arterials

With multiple lanes, long stretches between crosswalks, and lack of quality infrastructure for pedestrians, bicyclists, and people waiting for transit, most people would choose to drive on arterials. Below are some ways to balance mode share:

- Use expanded ROW's for transit stops, transit lanes, bike lanes, planted medians, wide sidewalks, bulbouts, and pocket plazas.
- Provide amenties for transit customers and pedestrians, such as lighting, shade, furniture, and high-quality shelters.
- Break up long stretches of arterial roadway with signaled crosswalks.
- Connect interior pedestrian networks to arterials.
- Consolidate driveways and reduce curb-cuts.
- Lower speed limits.

2. Make streets memorable

Memorable streets invite people to create shared experiences on streets - working, playing, shopping, dining, people-watching, or participating in cultural activities. In order to invite people to participate in street life:

- Change windows and building facades to be visually permeable.
- Add street furniture.
- Use store fronts, pocket plazas, and parks to activate the street frontage.

3. Retrofit large surface lots to be walkable

Surface parking lots are deserts for pedestrians. A monotonous stretch of asphalt, without interest, shade, or resting points would convince most to drive and park as close as possible to the main destination. Simple retrofits of big-box parking lots can make it pleasant to cross a parking lot desert on foot:

- Create comfortable, safe, and clear connections from crosswalks to building intersections.
- Consolidate driveways and reduce curb-cuts.
- Provide places of respite with shade and seating.

4. Use retrofits to support improved transit.

Retrofits can provide the improved density, jobs, residences, and mix of uses to support improved transit. When framed as a means to achieve greater mobility rather than as an end in itself, retrofits can be better designed to integrate with transit improvements.

- Site major transit stops adjacent to activity centers.
- Integrate higher density developments to serve as nodes along transit lines.
- Use commercial cores and activity centers as transit nodes. Leverage activity centers economically and culturally to support transit development that would connect activity centers.

See Columbia Pike, VA, pg. 10

5. Infill at the corners. Use infill building liners to screen large surface lots.

Block corners are important anchors for a sense of place in a neighborhood. Where street corners are vacant or have surface parking, infill with mixed-use, human-scaled buildings.

For long stretches of surface lots, buildings that wrap around the block, and shallow liner buildings (as wide as 1 parking stall) can be used to provide a continuous streetscape.

See Mashpee Commons, MN, pg. 14

6. Create walkable centers with a critical mass of destinations and services.

One strategy is to focus on an existing commercial hub, improving its density, diversity of services, and achieving a balance of residences, jobs, and civic institutions. The goal with such a center is that it achieves a critical mass of both places and people that makes it a walkable neighborhood. Within this improved neighborhood center, residents are able to walk for their daily needs. Visitors need only park once, and are able to access the entire center on foot or on transit.

See Belmar, CO, pg. 12

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