Urban River Parkways

An Essential Tool for Public Health

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Executive Summary

As modern life becomes increasingly depleting of physical and mental energy, in part through demands on human capacity for attentiveness, conditions in our "built" environments amplify human tendencies to limit our physical activity. These conditions make us more vulnerable to stress, anxiety, depression, and even aggressive behaviors. This report reviews evidence of contributions to health from green spaces, specifically those along watersides, and even more specifically along urban river parkways. Endpoints examined include physical, mental, community, and environmental health, as well as the overall economic well-being of the population. The report will attempt to address the degree to which creating and maintaining places for respite and recreation improves health. These efforts are aligned with the intentions of the Olmsted Brothers and Bartholomew & Associates, who in 1930 envisioned a Los Angeles surrounded by a coordinated system of easily accessible and connected outdoor spaces and parkways.[1] Many urban parts of the United States, particularly in lower socioeconomic areas of California, have limited open green spaces and trails and also little access to water features.[2] We explore these lost opportunities and consider remedies. We also examine the degree to which ill-considered environments reduce the human capacity to develop and maintain healthy behaviors.

From current evidence, we find that urban river parkways can improve physical, mental, and community health, and that they are particularly important in offering opportunity for "green exercise"- physical activity in the presence of nature. Urban river parkways help to mitigate environmental threats from heat islands, and from air and water pollutants; they have the

[1] Eden by Design: The 1930 Olmsted-Bartholomew Plan for the Los Angeles Region, Hise and Deverell.
[2] Loukaitou-Sideris, A. (2006). Southern California Environmental Report Card.
[3] State of California: The Strategic Growth Council. (2011). Urban Greening Project Guidelines for Sustainable Communities

additional benefit of supporting wildlife and plant diversity and enriching the outdoor experience. There is increasing research regarding negative health impacts from failure to include the components of river parkways in city plans. River parkways consist of trails and park spaces along rivers and other water bodies that connect not just park lands, nature preserves, and recreation spaces, but also residences, schools, civic buildings, retail, workplaces, and transit centers.[3] This report explores how the creation of urban river parkways is an essential tool for improving community health.

In an effort to evaluate the health benefits of river parkways, literature reviews and field observations were conducted to evaluate the effects of communities residing along urban rivers. This report will investigate the influences of urban river parkways on public health, and suggest that there are tremendous health benefits.

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[3] State of California: The Strategic Growth Council. (2011). Urban Greening Project Guidelines for Sustainable Communities

Introduction: How Can Urban River Parkways Provide Health Benefits?

The world's population has more than tripled in the 20th century,[4] and California's population has doubled just in the last 35 years.[5,6] With the majority of the world's population now living in urban areas, access to outdoor spaces is becoming increasingly limited and natural features are under stress. While waterside areas are frequently the first to be converted for transportation, industry, and urban development, the preservation and revitalization of green spaces around waterways demands that we assess their potential to prevent and alleviate environmentally induced health problems.

River parkways – an area of connective trails and natural areas along rivers and creeks that link homes, parks, workplaces, and schools – hold potential benefits for human health. River parkways can offer aesthetic features and help support the ecosystem, but little research has been conducted to assess potential human health benefits of parkways. Urban river parkways may particularly benefit health in urban environments where access to open spaces is limited and adverse health effects such as obesity and depression are prevalent. This report identifies and evaluates if and how urban river parkways affect physical, mental, community, and environmental health.

With adequate levels of physical activity, risks from medical conditions such as obesity and resulting chronic diseases, such as diabetes, can be reduced. River trails can facilitate active commuting via walking and bicycling, which helps meet physical activity recommendations.

[4] World Water Council. (2010). Water Crisis.
[5] Johnson, H. (2007). The Amazing, Changing California Population
[6] Pitkin, J. amd Myers, D. (2012). Generational Projections of the California Population by Nativity and Year of Immigrant Arrival.

Exercise, particularly in nature, can also mitigate mental fatigue and illnesses in urban environments. Urban river parkways have the potential to enable healthful social and community health through their communal design and minimal cost to users. Green spaces along riverfronts can also improve environmental health through cleaning stormwater, improving air quality, and mitigating urban heat effects. At the same time, it is important to evaluate which design elements of urban river parkways best support physical activity and social connection, from open spaces, greenways, bicycle and walkways, to spaces that have recreation equipment and fitness zones. With careful design considerations, urban river parkways can maximize their effectiveness to attract users and ultimately benefit human health. Furthermore, investing in urban river parkways can generate economic benefits for local economies and reduce healthcare spending. Urban river parkways can be effective and efficient prevention tools to improve human health.

The Impact of Urban River Parkways on Health

Issues Affecting Health
Physical Inactivity
Mental Health
Children's Health
Sense of Community and Health

Physical Inactivity

The Centers for Disease Control and Prevention (CDC) reports that less than half of U.S. adults attain the minimum recommended levels of 2.5 hours (150 minutes) of aerobic physical activity per week,[7] and over one-third of all adults (35.7%) are considered obese.[8] One of the major objectives of the past *Healthy People 2010* report was to lower obesity prevalence to 15%, but no state has met this objective. In 2010, the CDC reported that every state had recorded a population obesity prevalence of over 20%. Obesity is a substantial risk factor for heart disease, stroke, type 2 diabetes, and some cancers.[9] Body mass index (BMI) is a measure based upon individual height and weight (weight divided by height-squared), which is used to determine obesity. Under this classification, a BMI of 18.5-25 kg/m^2 is considered normal weight, over 25 is overweight, and greater than 30 is obese. As BMI increases, so does the risk of diabetes. The relative risk of diabetes increases significantly (42.1 for men, and 93.2 for women) for individuals with a BMI in the 30-35 obese range (Fig. 1).[10] Between 1980 and 2010, the

[7] CDC Vital Signs. (2012). More People Walk to Better Health.
[8] CDC. (2012). Adult Obesity. Overweight and Obesity.
[9] Warburton, D., Whitney Nicol, C., and Bredin, S. (2006). Health benefits of physical activity: the evidence
[10] Chan et al. (1994). Obesity, Fat Distribution, and Weight Gain as Risk Factors for Clinical Diabetes in Men.

incidence of diabetes more than tripled.[11] For people who develop diabetes before age 40, life span is shortened by 38% for females and 33% for males.[12,13] Not only does diabetes shorten life expectancy, it diminishes the quality of life and increases health care costs. U.S. males who develop diabetes at age 40 lose on average 12 life-years and 19 quality-adjusted life years.[7,9]

The relative risk of death for people who are inactive is greater than those who are active. In a retrospective study conducted on nurses comparing physical activity and mortality predictions, inactivity (less than 3.5 hours of exercise per week) raises the risk of death by approximately 50% regardless if a person is obese or lean. Those who were obese and inactive had a 60% higher risk of death than obese persons who were active.[14] A person who is obese has a 90% higher age-adjusted risk of mortality compared to a non-obese person.[15]

[11] A Report of the Surgeon General. (1996). Physical Activity and Health.
[12] Zykofsky, P. (2011). Toolbox for Healthier Schools, Towns and Cities: Complete Streets and Safe Routes to School
[13] Jackson, R. Good Solutions Solve Multiple Problems.
[14] Hu et al. (2004). Adiposity as Compared with Physical Activity in Predicting Mortality in Women
[15] Ibid.

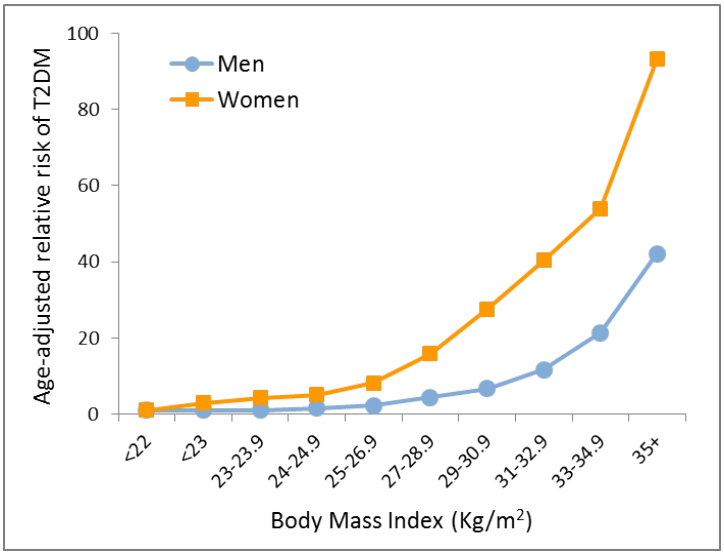


Figure 1. The relationship between BMI and Type 2 Diabetes (T2DM).

Health Benefits of Exercise

Physical inactivity is one of the most important causal factors in the obesity epidemic and related health conditions.[16] It is clear that these health consequences can be lessened by increasing physical activity levels; benefits include better weight management, increased life span, decreased risk of cardiovascular disease and diabetes, better management of hypertension and diabetes, improvement of mood and mental health, strengthening bones and muscles, and lower likelihood of cancers such as breast and colon cancer.[17] Regular exercise has preventive effects that work against diabetes.[18] For example, physical activity has been shown to increase sensitivity to insulin, and regular exercise helps with weight loss and improved glucose tolerance.[19,20] Frequent physical activity also helps reduce atherosclerotic factors - the deposition of plaques of matter on the inner walls of arteries. Even modest amounts of

[16] Hu, F. (2003). Sedentary Lifestyle and Risk of Obesity and Type 2 Diabetes.
[17] CDC. (2011). Physical Activity and Health.
[18] National Diabetes Information Clearinghouse (NDIC). (2008). Diabetes Prevention Program. NIH Publication
[19] Goodyear, L.J. and Kahn, B.B. (1998). Exercise, Glucose Transport, and Insulin Sensitivity.
[20] Bradley et al. (2008). Voluntary exercise improves insulin sensitivity and adipose tissue inflammation in diet-induced obese mice.

exercise, such as brisk walking (walking faster than 3.5mph), has health benefits[21] including increased bone and joint health and cardiovascular functional capacity, and reduced risk of high blood pressure, heart attacks, and stroke.[22] In one study, 3,234 people with pre-diabetes who walked and exercised five times a week for 30 minutes lost 5-7% of their body weight and reduced their risk of diabetes by 58%.[23] Increasing physical activity through frequent exercise burns additional calories, which helps maintain a healthy body weight and reduces the risk of obesity.[24] Urban river parkways offer excellent opportunities to increase physical activity through many types of exercise, which has net benefits on public health.

Active Commuting

In addition to recreational physical activity, trails and pathways along rivers facilitate "active commuting", traveling to and from workplaces and schools in ways that include walking or bicycling. Active commuting offers time-saving ways to exercise as part of daily routine. The benefits from active commuting are evident when considering the calories burned and muscle mass developed. The body does not distinguish between recreational and purposeful exercise (such as commuting), making any exercise good exercise. For example, a person weighing 170lbs. biking at a leisurely rate (<10mph) will burn about 300 calories in one hour – but bicycling with moderate effort (12-14mph), perhaps to get to work on time, will result in about 620 calories burned in one hour. With a one hour round-trip commute, this would result in 3,100 calories burned per week just for traveling to work. Considering that there are 3,500

[21] U.S. Department of Health and Human Services. Your Guide To Physical Activity and Your Heart
[22] Statement on Exercise: Benefits and Recommendations for Physical Activity Programs for All Americans
[23] National Diabetes Information Clearinghouse (NDIC). (2008). Diabetes Prevention Program. NIH Publication
[24] Statement on Exercise: Benefits and Recommendations for Physical Activity Programs for All Americans

calories in a pound of human fat, a 3,100 calorie deficit per week is about what doctors recommend for sustained fat reduction.

Some studies have concluded that active commuting to school or work can meet physical activity recommendations, and indicate that active commuters may be healthier than other commuters. A study of bicyclists in Portland, Oregon tracked the number of bicycle trips over the course of a week and discovered that 59% of participants reached the recommended 150 minutes of physical activity per week, and most of the bicycle trips were for non-exercising purposes.[25] Urban river parkways can provide efficient and pleasant routes for active commuting, which can be conducive to meeting physical activity recommendations. Assuring available places for playing and exercising outdoors is not only the easiest way to improve physical health, but it is a well-supported preventive strategy.

[25] Portland Office of Transportation. (2007). SmartTrips Southeast.

Spotlight: American River Parkway, Sacramento, CA

Photo Credit: http://www.runcim.org/page/show/245418-beneficiaries-history

Many people in Sacramento, California use the 23-mile American River Parkway as a travel route for their daily commutes to and from California State University Sacramento, State office buildings, Downtown, Old Sacramento and other areas. Pedestrian paths and bicycle trails help commuters increase their physical activity and avoid the stress of commuting on highways via personal automobiles, motorcycles, and other forms of motorized transport. Highway traffic delays in urban areas average 51 hours annually and continue to increase, so commuting by bicycling through pathways and trails along the American and Sacramento River offers a way to reduce the amount of stress associated with motorized commutes.

In addition to enhancing physical health through the use of river parkways for travelling to and from the workplace or school, designated bicycle trails also reduce the chances that bicyclists will be involved in a collision with an automobile. By providing safe bike trails with highly visible road crossings creates a safer environment for bicycle travel. The Parkway's safe routes linking residential, commercial, and industrial areas offer to its users a means of promoting health and fitness, reducing pollution and road congestion, and saving money and often time.

According to the County of Sacramento, the American River Parkway serves about 8 million visitors each year and generates about $364 million annually for the local economy.

http://www.regionalparks.saccounty.net/Documents/American%20River%20Parkway%20Fact%20Sheet_REV%202009.pdf.

Healthcare Costs

In 2011 total health expenditures in the US were $2.7 trillion, or an estimated $8,680 per person,[26,27] which is equivalent to 18% of the U.S. gross domestic product (GDP).[28,29] Chronic diseases – specifically obesity, diabetes, and cardiovascular disease – account for a large

[26] National Health Expenditures 2010 Highlights.
[27] Kaiser Family Foundation. (2008). Health Care Costs and Election 2008.
[28] Wilson, K. (2012) Health Care Costs 101. California Healthcare Foundation
[29] National Health Expenditures 2010 Highlights.

percentage of health care costs and for the majority of deaths in the U.S. each year.[30] A 2012 Cornell University study estimated that obesity accounts for 21% of total health care expenditures, and on average people who were considered obese incurred $2,741 more in healthcare costs than normal-weight individuals.[31] Diabetes costs in the US totaled $218 billion in 2010,[32] most of which is attributed to direct medical costs. Cardiovascular disease is one of the most costly diseases in the U.S.[33] In 2010 it cost $503.2 billion in the U.S.[34] This figure includes direct costs, such as doctors' visits and medications, and indirect costs, including lost productivity due to morbidity and mortality.[35]

The enormous medical costs related to obesity, diabetes, and cardiovascular diseases demand cost effective prevention options; an underutilized one is development of physical infrastructure that reduces the barriers to and induces physical activity. For example, the construction of the Ludlam Trail in the Miami, Florida, region will save the community $1.68 to $2.25 million annually on health care costs due to physical inactivity. These savings are in part due to the 4,931 to 6,579 area residents who became exercisers and due to the expected population weight loss of between 32,664 and 109,939 pounds annually by exercising on the Ludlam Trail.[36]

The costs of riverfront trails and park spaces include those for both construction as well as ongoing maintenance. In one study, the cost per mile of bicycle and pedestrian trails ranged from $5,735 to $54,017, and the annual cost per user was $235, though the range is from $83–

[30] Environmental Correlates of Physical Activity: A Review of Evidence about Parks and Recreation
[31] Cornell University. (2012). Obesity accounts for 21 percent of U.S. health care costs, study finds. *ScienceDaily*.
[32] Urban Residential Environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces
[33] CDC. (2009). Chronic Diseases and Health Promotion. Chronic Disease Prevention and Health Promotion.
[34] Lloyd-Jones, et al. (2010). Executive Summary: Heart Disease and Stroke Statistics.
[35] Ibid.
[36] AECOM. Miami-Dade County Trail Benefits Study: Ludlam Trail Case Study

$592.[37] This amount compares to the $622 per capita annual medical cost of inactivity.[38] The range of construction and maintenance costs fit a wide range of budgets, and trails are considered a viable health amenity for most communities. The creation of 1 mile of trail is, at the top of the range, still less than the cost for health expenditures relating to obesity and diabetes. One study calculated a cost-benefit ratio of 2.94, meaning that "every $1 investment in trails for physical activity led to $2.94 in direct medical benefit."[39] Urban river parkways can be viable, cost-efficient health interventions that help direct efforts toward prevention and not treatment, and increased public utilization increases the benefits with only small increases in the cost of maintenance.

While increased physical activity promotes individual and population well-being, often the first obstacle for the individual is a personal change of attitude, and for populations, a change of culture. These changes cannot be attained merely by chiding, even with the charisma of health providers – they require appealing and safe options for physical activity. Attractive destinations and cost-effective commuting such as those afforded by river parkways can facilitate changing a culture to encourage healthier and more active and productive lifestyles.

Mental Health

By many estimates, the mental health of the U.S. has been deteriorating. The CDC reports that the use of selective serotonin reuptake inhibitors (SSRIs) in young Americans has increased

[37] Wang, G. (2004). Cost Analysis of the Built Environment: The Case of Bike and Pedestrian Trials in Lincoln, Neb
[38] Ibid.
[39] Wang, G., Macera, C., Scudder-Soucie, B., Schmid, T., Pratt, M., and Buchner, D. (2005). A Cost-Benefit Analysis of Physical Activity Using Bike/Pedestrian Trails

400% since 1988, with a majority being taken to treat depression and anxiety.[40] In addition, the number of Americans who are depressed increased to nearly one in ten in 2010.[41,42] Furthermore, since depression is a known risk factor for a range of chronic physical illnesses, such as asthma, arthritis, diabetes, stroke and heart disease,[43] activities that help reduce and prevent depression are particularly important. Since the 1990s, mental health problems have accounted for approximately 2.5% of the U.S. GNP. Mental illnesses are responsible for 59% of economic costs related to injuries and illness-related loss of productivity.[44]

Exercise and Mental Health

Exercise helps to alleviate depression, anxiety, and stress, improve self-esteem, mood, and mental capability, and to lead to benefits such as fewer missed days of work and school. Some research has shown that "green exercise" may confer mental health benefits in addition to improving physical health. A series of studies from the University of Essex demonstrate that exercising with views of nature led to more consistent mental health improvements compared to exercise with no view, or with an unpleasant view.[45] This finding has been replicated in several other studies. One study concluded that exercise in all types of green environments improves self-esteem and mood, and the presence of water led to even greater improvements.[46] For example, walking through a park, as opposed to an objectively "built environment" increases attention-maintaining ability.[47] Furthermore, runners self-rate natural

[40] Lloyd, J. (2011). CDC: Antidepressant use skyrockets 400% in past 20 years. USA Today.
[41] CDC. An Estimated 1 in 10 U.S. Adults Report Depression.
[42] Gupta, S. and Cohen, E. (2010). CDC: Nearly 1 in 10 U.S. adults depressed. CNN Health.
[43] The Impact of Community Design and Land-Use Choices on Public Health: A Scientific Research Agenda
[44] World Health Organization. (2011). Investing in Mental Health
[45] University of Essex Green Exercise Research Team
[46] Barton and Pretty, 2010. What is the Best Dose of Nature and Green Exercise for Improving Mental Health? A Multi-Study Analysis.
[47] Frank, P. and Jason, D. (2005). Exercise and well-being: a review of mental and physical health benefits associated with physical activity

park settings higher than urban ones in terms of decreasing anger, anxiety, and depression and increasing restoration and tranquility.[48]

Nature Contact and Mental Health

The simple act of viewing nature has shown to provide psychological restoration, reduce stress,[49,50] and provide calming effects.[51] Maintaining a connection with nature is particularly valuable in reducing stress that accompanies urban living.[52] Frederick Law Olmsted believed that nature relaxes people and relieves the tensions of urban life,[53] scientific studies now are confirming that regular engagement with green spaces is linked with better mental health and well-being.[54]

Constant stimulation in modern, urban life leads to mental fatigue,[55] which causes inattentiveness, distractibility, feelings of being withdrawn, irritability, and impulsive and accident-prone behaviors.[56] These mental fatigue symptoms are exacerbated by a general lack of green space in many urban areas.[57] Contact with nature may help with attention, focus, and mental restoration. Natural environments tend to contain elements that engage involuntary or subconscious attention, whereas many car-dominated urban environments are replete with features requiring directed attention such as motor vehicles, advertisements, and noise alerts, for example horns and sirens. Attention Restoration Therapy is a practice that utilizes natural

[48] Pretty, J., Peacock, J., Sellens, M. and Griffin, M. (2005). The mental and physical health outcomes of green exercise.
[49] Grinde, B. and Patil, G. (2009). Biophilia: Does Visual Contact with Nature Impact on Health and Well-Being?
[50] Ulrich, R. (2002). Health Benefits of Gardens in Hospitals.
[51] The Impact of Community Design and Land-Use Choices on Public Health: A Scientific Research Agenda
[52] Vining, J. (2003). The Connection to Other Animals and Caring for Nature.
[53] Pretty, J., Griffin, M., Peacock, J., Hine, R., Sellens, M., and South, N. (2005). Countryside for Health and Well-Being: The Physical and Mental Health Benefits of Green Exercise. Report for the Countryside Recreation Network.
[54] Maller, C., Townsend, M., St Leger, L., Henderson-Wilson, C., Pryor, A., Prosser, L. and Moore, M. (2009). Healthy Parks, Healthy People: The Health Benefitsof Contact with Nature in a Park Context.
[55] Lehrer, J. (2009). How the city hurts your brain... And what you can do about it. The Boston Globe.
[56] The relationship of urban design to human health and condition
[57] Gardner, A. (2009). Being near Nature improves physical, mental health. USA Today.

environments to engage involuntary attention by providing a wide range of engaging stimuli to allow directed-attention mechanisms to rest and be restored.[58]

A number of studies illustrate that walking through nature improves attention, cognitive function, and task performance, whereas walking through a dense urban setting does not.[59,60] In one study in 2008, walking in a natural setting led to statistically significant greater cognitive improvements and self-reported refreshment than exposure to downtown settings.[61] Several other studies confirm this as they illustrate that natural scenes increase recall rate significantly more than built scenes.[62,63] In a Swedish study, elderly residents in an assisted housing facility were asked to spend one hour relaxing outdoors and one hour in their favorite room indoors. Being indoors led to no increase in concentration, whereas being outdoors led to significant cognitive improvement.[64] Cognitive function and task performance appear to be improved by having contact with nature and exercising in natural environments.

Many people, especially city-dwellers, work indoors with limited exposure to nature and sunlight. Indoor environments can contribute to the development of both seasonal and general depression symptoms such as sadness, anxiety, irritability, and withdrawal from social activity.[65] Having access to outdoors and daylight is particularly important in an urban environment because exposure to sunlight allows for the body to synthesize vitamin D, which is needed for

[58] Berman, M., Jonides, J. and Kaplan, S. (2008). The Cognitive Benefits of Interacting With Nature
[59] The mental and physical health outcomes of green exercise
[60] Peacock. J., Hine, R., Willis, G., Griffin, M. and Pretty, J. (2005). The Physical and Mental Health Benefits of Environmental Improvements at Two Sites in London and Welshpool
[61] Ibid.
[62] Berto, R., Baroni, M., Zainaghi, A. and Bettella, S. (2010). An exploratory study of the effect of high and low fascination environments on attentional fatigue
[63] Mental Health & Function. Green Cities: Good Health. Urban Forestry/Urban Greening Research, at the University of Washington.
[64] Kuo, F. (2010). Parks and Other Green Environments: Essential Components of a Healthy Human Habitat
[65] Kuo, F. and Taylor, A. (2004) A Potential Natural Treatment for Attention-Deficit/Hyperactivity Disorder: Evidence From a National Study.

bone health and immune function – vitamin D deficiency is associated with headaches, type I diabetes, chronic fatigue and hypertension.[66,67]

Researchers have found that people, especially young children, respond positively to natural settings that have open space and water features.[68] As one author states, "exposure to nature is a basic human, primary need for health and well-being, not a cultural amenity or preference."[69,70,71] Biophilia, the innate connection between humans and other living systems, can explain the particular human affinity for water, as it is a vital aspect of natural settings.[72] Water is described as the unifying element in nature, and the presence of water in the built environment significantly enhances the biophilic qualities of the area.[73] From an evolution perspective, people tend to react more positively to areas containing water,[74,75] which is one reason why river parkways are particularly effective natural settings in producing mental health benefits. People who view water in nature tend to exhibit greater mental health improvements in the form of anxiety and pain relief than people who have other views or no nature view.[76] Studies show that views of water and the sound of water alleviates stress most effectively.[77,78,79] The sound of trickling water and water waves invokes a sense of tranquility and relaxation contributing to improved health in patients recovering from a health condition. Moreover, elderly people diagnosed with hypertension experienced decreased levels of blood pressure when listening to the sound of ocean waves.

[66] Healthy nature healthy people: 'contact with nature' as an upstream health promotion intervention for populations
[67] Children With Attention Deficits Concentrate Better After Walk in the Park
[68] Ulrich, R. Chapter 3: Biophilia, Biophabia, and Natural landscapes. Kellert, S. and Wilson, E. Eds. The Biophilia Hypothesis. (1993).
[69] Heerwagen, J. Biophilia, Health, and Well-being.
[70] Heerwagen, J. and Hase, B. (2008). Building Biophilia: Connecting People to Nature in Building Design.
[71] Kellert, Heerwagen, and Mador. (2008). Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life.
[72] Kellert, S. and Wilson, E. (1993). The Biophilia Hypothesis.
[73] Ibid.
[74] Kellert, S. and Wilson, E. (1993). The Biophilia Hypothesis.
[75] Ulrich, R. Chapter 3: Biophilia, Biophabia, and Natural landscapes. Kellert, S. and Wilson, E. Eds. The Biophilia Hypothesis. (1993).
[76] Health-related Physical Fitness in Childhood: Status and Recommendations
[77] A School-Based Exercise Intervention Elicits Substantial Bone Health Benefits: A 2-Year Randomized Controlled Trial in Girls
[78] Ulrich, R. Effects of Healthcare Environmental Design on Medical Outcomes.
[79] Heerwagen, J. Biophilia, Health, and Well-being.

Contact with nature has a positive role in psychological health and capacity. Mood can affect the immune system [80], and measures that improve emotional well-being benefit physical health.[81] Trees, greenery, fresh air, and water produce a sense of tranquility. More greenery, access to nearby natural areas, and green exercise, positively correlate with less stress, less sadness, more satisfaction with life,[82] and overall better mental health.[83,84] Recently, more support for the theory of the sounds of water for improving health[85] has emerged. In the future, research is needed to focus on the mental health benefits of exercising around areas of water. All medical treatments for mental disorders have side effects, and some serious and some surprisingly paradoxical. Walking on safe green trails along watersides is a safe mental health intervention that is inadequately available.

Children's Health

Construction of river parkways and open spaces for children to play and exercise offers health benefits as well. The United Nations recognizes a child's right to play as a fundamental human right,[86,87,88] and according to the California Children's Outdoor Bill of Rights, every child should have the opportunity to play and learn outdoors.[89]

[80] Maller, C., Townsend, M., St Leger, L., Henderson-Wilson, C., Pryor, A., Prosser, L. and Moore, M. (2009). Healthy Parks, Healthy People: The Health Benefits of Contact with Nature in a Park Context.
[81] Kellert, S. and Wilson, E. (1993). The Biophilia Hypothesis.
[82] World Health Organization. (2011). Investing in Mental Health
[83] Kuo, F. (2010). Parks and Other Green Environments: Essential Components of a Healthy Human Habitat
[84] Barton, S. (2008). Human Benefits of Green Spaces.
[85] Liddell, A. (2009). Water Fountains for Health and Wellness?
[86] UN General Assembly Resolution 1386 (XIV of X). 1959. Declaration of the Rights of the Child.
[87] Right to Play.
[88] FACT SHEET: A summary of the rights under the Convention on the Rights of the Child
[89] Children's Outdoor Bill of Rights. California Department of Parks and Recreation.

Every child should have the opportunity to:

Play in a safe place
Explore nature
Learn to swim
Go fishing
Follow a trail
Camp under the stars
Ride a bike
Go boating
Connect with the past
Plant a seed

The U.S. Department of Health and Human Services states that the lack of green space is one of the most important causes of childhood obesity, and the need for green places to protect children's health is becoming more recognized and apparent.[90,91,92] Lack of green space correlates with a decrease in exercise, and the risks associated with inactivity last beyond childhood and into adulthood. Childhood obesity has more than doubled in children and tripled in adolescents in the past 30 years, and 17% of children and adolescents aged 2-19 years are obese (Fig. 2).[93,94] In California approximately 27% of children are overweight and less than a quarter can pass the FITNESSGRAM, the state's required physical fitness exam which is on the child's report card.[95] Overweight and physically unfit children have a higher risk of lung diseases, diabetes, asthma, emotional distress, and cancers and are 80% more likely to be severely obese as adults.[96]

[90] Mayors' Guide to Fighting Childhood Obesity. The United States Conference of Mayors
[91] Preventing childhood obesity: the need to create healthy places. (2007). A Cities and Communities Health Report.
[92] Space-oriented Children's Policy: Creating Child-friendly Communities to Improve Children's Well-being.
[93] Ogden, C. and Carroll, M. (2010). Prevalence of Obesity Among Children and Adolescents: United States, Trends 1963–1965 Through 2007–2008.
[94] Trust for America's Health and Robert Wood Johnson Foundation. (2013). F as in Fat: How Obesity Threatens America's Future.
[95] Obesity in Children and Teens. 2011. American Academy of Child and Adolescent Psychiatry.
[96] US Dept. of HHS, Assistant Secretary for Planning and Evaluation, Childhood Obesity.

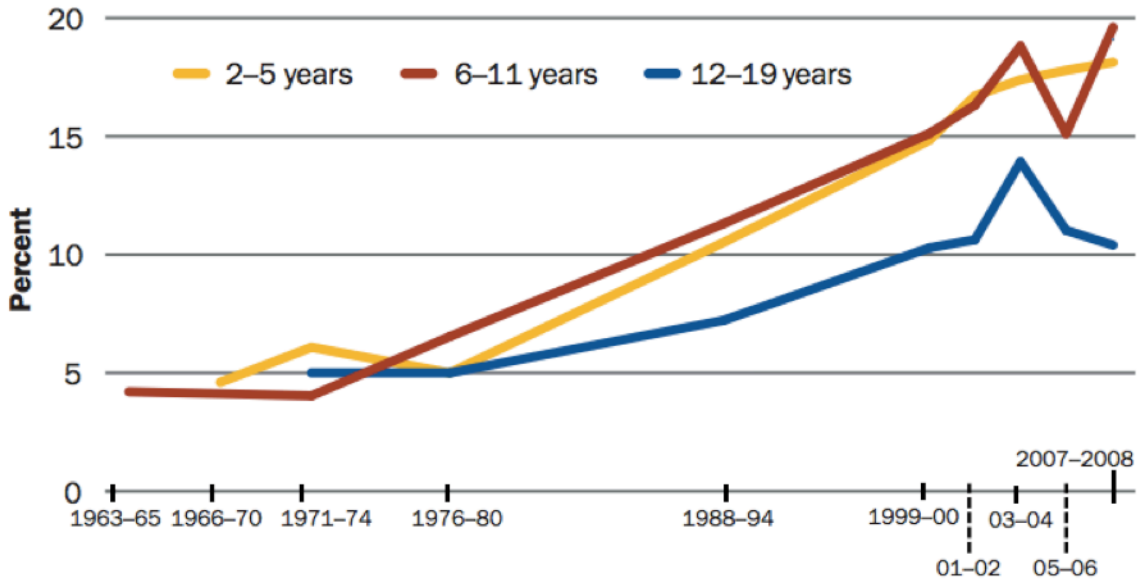


Figure 2. Trends in obesity among U.S. children and adolescents.

Parks and open spaces provide opportunities for children to play and exercise. Studies have shown that children and youth that live near green areas and have access to play outdoors have a lower BMI compared to children without such access.[97] In one study, 60% of children and adolescents showed significant collocation between physical activity and favorable health outcomes, including bone health, strength, and flexibility.[98]

Children's Mental and Social Well-Being

Children have an affinity and need for contact with natural settings.[99,100] Ninety six percent of urban children, when asked to draw their favorite place, drew somewhere outdoors. It is

[97] Health Benefits to Children from Contact with the Outdoors and Nature. 2012. Children and Nature Network.
[98] Sallis, J., Prochaska, J. and Wendell, T. (2000). A review of correlates of physical activity of children and adolescents.
[99] Pretty, J., Griffin, M., Peacock, J., Hine, R., Sellens, M., and South, N. (2005). Countryside for Health and Well-Being: The Physical and Mental Health Benefits of Green Exercise. Report for the Countryside Recreation Network.
[100] White, R. Benefits for Children of Play and Nature.

reasonable to expect that "green natural settings preferred by children would also have a beneficial effect on children's well-being."[101] As with adults, stress has negative effects on the well-being and development of children, and contact with nature helps to buffer the effects of stress or adversity in children.[102] Overall health, which is enhanced by social support, is also linked to children playing outdoors, as studies have shown that children who play outdoors tend to have more friends than those who are restricted to indoor play.[103] Having the opportunity to play in nature on a regular basis helps children develop better interpersonal relationships and have a more positive attitude in school.[104] Allowing childhood contact with nature is a preventive intervention that helps reduce depression and feelings of hopelessness. This, in turn, if contact is encouraged on a sustained basis, reduces aggressive and delinquent juvenile behavior, as well as alcohol, tobacco and drug use.[105]

Children's Attention Capacity and Nature

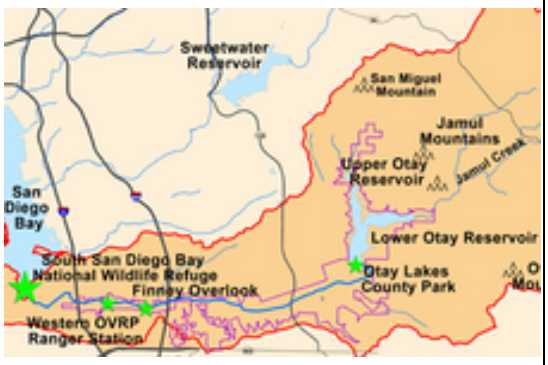
The CDC reports that the most common childhood neurobehavioral disorder, attention deficit/hyperactivity disorder (ADHD), if left untreated can impede a child's performance in school and ability to form social relationships.[106,107] Clinical treatments for ADHD offer relief from symptoms, but can have side effects such as decreased appetite, weight loss, sleeping problems, and irritability.[108] However, there is research that natural outdoor experiences help ameliorate these symptoms without the use of medication.[109] Other studies have shown that

[101] Maller, C., Townsend, M., St Leger , L., Henderson-Wilson, C., Pryor, A., Prosser, L. and Moore, M. (2008). Healthy parks, healthy people: The health benelts of contact with nature in a park context.
[102] Wells, N. and Evans, G. (2003). Nearby Nature: A Buffer of Life Stress among Rural Children
[103] Pretty, J., Peacock, J., Sellens, M. and Griffin, M. (2005). The mental and physical health outcomes of green exercise.
[104] White, R. Benefits for Children of Play and Nature.
[105] Ibid.
[106] A Potential Natural Treatment for Attention-Deficit/Hyperactivity Disorder: Evidence From a National Study.
[107] ADAA. Anxiety Disorders in Children.
[108] Mayo Clinic. Attention-deficit/hyperactivity disorder (ADHD) in children
[109] A Potential Natural Treatment for Attention-Deficit/Hyperactivity Disorder: Evidence From a National Study.

regular contact with outdoor areas -- including taking a walk by a body of water -- reduces the symptoms of ADHD in children.[110] Children's functioning improves after activities in green settings, and the "greener" a children's play area is, the less severe his or her attention deficit symptoms.[111] Contact with nature can also affect and increase attention capacity,[112] increase the ability to think clearly, and enhance intelligence and creativity.[113,114]

Spotlight: Otay River Parkway

The Otay River Parkway in San Diego, California provides educational and recreational opportunities to children through organizations such as WiLDCOAST who develop and maintain outreach programs to local residents. Recognizing that a large population of youth lives in close proximity to the Otay River, WiLDCOAST supports river and nature based educational programs to the area's undeserved population by fostering and enhancing opportunities for children to explore and learn about the natural habitat.



Through field trips to the Otay River Parkway, children are able to engage in activities that expose them to the native wildlife and plants of the area and recognize the environmental and human health benefits the river parkway supplies.

Photo Credits: http://www.wildcoast.net/programs/2

[110] Lawrence et al. 2004. Executive function and ADHD: A comparison of children's performance during neuropsychological testing and real-world activities.
[111] Coping with add The Surprising Connection to Green Play Setting
[112] Exposure to restorative environments helps restore attention capacity
[113] Louv, R. 2011. The Nature Principle: Human Restoration and the End of Nature-Deficit Disorder.
[114] Nature Nurtures: Investigating the Potential of School Grounds. 2000.

Children's Cognition and Nature

Greening outdoor play areas for young children improves academic performance[115] and stimulates creativity due to close contact with nature.[116] Children function better cognitively and emotionally in green environments, and have more creative play in green areas. [117] In a 2001 study, children with views and contact with nature scored higher on tests of concentration and self-discipline, and higher results correlated with greener areas.[118,119,120] Nature plays an important role in childhood development,[121] as it helps develop perceptual and expressive skills, language and cognitive abilities, creativity and imagination, and independence.[122,123] In one study, children who were allowed to play with a wider variety and number of objects scored higher on alternate-use tests than children who were not allowed to do the same.[124] In a constructed playground, children used 42% of the total play content versus 68% of content in a natural setting.[125] This is significant because dramatic play, using more materials and long bouts of imaginary play, are behaviors known to have high social and cognitive benefits.

[115] Godbey, G. (2009). Outdoor Recreation, Health, and Wellness: Understanding and Enhancing the Relationship.
[116] Mental Health & Function. Green Cities: Good Health. Urban Forestry/Urban Greening Research, at the University of Washington.
[117] Silverstone, M. (2011). Tree hugging improves your health
[118] The Value of Public Space.
[119] White, R. Benefits for Children of Play and Nature.
[120] Taylor, A., Kuo, F. and Sullivan, W. (2001). Views of Nature and Self-Discipline From Inner City Children.
[121] Louv, R. (2006). Last Child in the Woods: Saving out Children from Nature-Deficit Disorder.
[122] Ibid.
[123] Strife, S. and Downey, L. (2009). Childhood development and access to nature.
[124] Dansky J.L. and Silverman, I.W. (1973). Effect of play on associative fluency in preschool-aged children.
[125] Children and Nature Network

A summary of the benefits of regular play in nature for children:

- Children who play regularly in natural environments show more advanced motor fitness, including coordination, balance and agility, and they are sick less often (Grahn et al. 1997; Fjortoft & Sageie 2001).

- Exposure to natural environments improves children's cognitive development by improving their awareness, reasoning and observational skills (Pyle 2002).

- Nature buffers the impact of life's stresses on children and helps them deal with adversity. The greater the amount of nature exposure, the greater the benefits (Wells & Evans 2003).

- Natural environments stimulate social interaction between children (Moore 1986, Bixler et al. 2002) and children who play in nature have more positive feelings each other (Moore 1996).

- Play in outdoor environments stimulates all aspects of children's development more readily than indoor environments (Moore & Wong 1997).

Summary adapted from: http://www.whitehutchinson.com/children/articles/benefits.shtml
Photo Credit: http://progressiveearlychildhoodeducation.blogspot.com/2011/08/playing-in-nature-benefits-childrens.html

Sense of Community and Health

A healthy community as defined by the California Center for Healthy Cities and Communities "promotes a positive physical, social, and economic environment that supports the well-being of its members."[126] The physical structure of the city can be a catalyst for a sense of community and empowerment, which can lead to healthier individuals and improved local economy. Understanding the local culture and social aspects of the physical environment are important in constructing an area that will be beneficial and useful for the community. For example, many urban neighborhoods lack adequate access to trails and water features. The areas around a river that are prospectively available for conversion into a parkway are frequently rundown,

[126] Center for Civic Partnerships. California Healthy Cities and Communities.

abandoned land previously used for industrial purposes, and in lower socioeconomic areas of a city that are often lacking green space or areas safe for outdoor activity.

In order to revitalize cities, improve urban aesthetics, strengthen place identity, and increase environmental health and awareness, the practice of daylighting streams has been utilized around the world.[127,128] Historically, many streams and rivers were channelized or diverted into pipes and other drainage systems,[129] and daylighting involves redirecting streams above ground and, often times, restoring the surrounding habitat. Benefits of daylighting include improved ecological conditions and more effective flood control by increasing permeable land, increased perceived safety as the areas becomes more maintained and used, and community cohesion.[130] Furthermore, daylighting tends to be more cost-effective than designing and replacing old pipes.[131] There have been several recent examples of this practice, and they have generally served to increase green space in urban environments, improve the habitat for endangered species, and provide better natural drainage, water filtering, and infiltration. For instance, Pipers Creek in Seattle, Washington was able to bring back its salmon population by maintaining the stream and using natural forms of drainage and stormwater collection. While the goal of daylighting is usually to restore a stream to a more natural state, many cities are also utilizing them in their economic revitalization and physical activity plans.

Other daylighting projects include the Saw Mill River in New York. The hidden river underneath the city of Yonkers played an integral role for the mills and industries of the town in the early 1600s but was buried in steel and concrete in 1925 to make way for a parking lot for the New

[127] Pinkham, R. (2000). Daylighting: New Life for Buried Streams. Rocky Mountain Institute.
[128] Buchholz, T and Younos, T. (2007). Urban Stream Daylighting Case Study Evaluations.
[129] Ibid.
[130] Stream Daylighting, Rocky Mountain Institute.
[131] Buchholz, T and Younos, T. (2007). Urban Stream Daylighting Case Study Evaluations.

York Department of Motor Vehicles. In 2005, Groundwork Hudson Valley, a group that advocates for ecological health of the Hudson River, enlisted design students from Columbia University to create renditions of a daylighted Saw Mill River. These ideas spurred many other ideas and possibilities for the revitalization of the river and garnered support from many agencies including the U.S. Army Corps of Engineers resulting in a final plan that routes the Saw Mill River through 800 feet of riverscape.[132] Eventually complemented with other amenities to accommodate community activities, the restoration of the river brings back a waterfront that was not previously accessible. The waterway also helps revitalize fish habitat and protect native species. The natural attraction of the river ecosystem and potential development of community amenities is making Yonkers more attractive and is generating more foot traffic and activity.

Figure 3. The Cheong Gye Cheong River in Seoul, South Korea before daylighting (left) and after (right).

The daylighting of streams is a practice seen worldwide. For instance, Vancouver, which had channelized many of its rivers as it developed, has begun both uncovering and reestablishing streams in their historical routes. Vancouver views the ocean that surrounds it as one of its most important assets, and takes its stewardship role to heart. In this role, the city has

[132] Richardson, D. River rising: Water helps revive a washed-up industrial town.

established several integrated drainage and water management programs,[133] part of which is the Still Creek Enhancement, which plans to "return the creek-side habitat to native plantings, remove concrete and naturalize creek banks, and [add] interpretive plaques and boardwalks to provide recreational and educational opportunities."[134]

One other significant example, and one of the largest daylighting projects was the Cheong Gye Cheong River in Seoul in South Korea (Fig. 3). This river had been covered by concrete in the 1950s and 20 years later, a major freeway was built over it. In 2002, Mayor Lee Myung-bak was elected and pledged to restore the river.[135] Over the next three years, the freeway was torn down, and the river revitalized. Since then, the urban heat island effect has been reduced (city areas by the river have an average temperature 5.6 degrees Fahrenheit lower than the surrounding areas), biodiversity has increased, and people around the country have initiated restoration projects on their local streams and rivers.[136]

Poverty, Health, and Park Space

People living in poverty are more likely to be in fair or poor health, and often have higher levels of chronic diseases such as asthma, obesity, diabetes, and cardiovascular disease.[137,138,139,140] The U.S. Behavioral Risk Factor Surveillance System (BRFSS) and the U.S. National Health and National and Nutrition Examination Survey (NHANES) both show that "inner-city residents are

[133] Protecting Our Water. City of Vancouver.
[134] Still Creek Enhancement Plan. City of Vancouver.
[135] Rao, K. Seoul tears down an urban highway and the city can breathe again.
[136] Ibid.
[137] Pushkarev, B. S., & Zupan, J. M. (1982). Where transit works: Urban densities for public transportation. *Urban transportation: Perspectives and prospects*, 341-344.
[138] H. S. Levinson and R. A. Weant, eds. (1982). *Urban Transportation: Perspectives and Prospects*. Westport, CT, Eno Foundation.
[139] Houston, D., J. Wu, P. Ong, and A. Winer. (2006). Down to the meter: Localized vehicle pollution matters.
[140] Eberhardt, M.S. and Pamuk E.R. 2004. The importance of place of residence: examining health in rural and nonrural areas.

more overweight, less physically active, and less healthy overall than the general population."[141] The National Health Interview Survey also shows that in the 1990's, people in city centers (where there is less open, green space) have poor diets with high consumption of fast foods and high-fat foods, and are more likely to be obese than those who live in the suburbs.[142] This phenomenon has been studied, and the main explanation for this difference is levels of physical inactivity, and among those who live in urban areas, inactivity is highest among low-income residents.[143,144]

The correlation between income and children's health is also evident.[145] "Based on parent reports, non-poor children are more likely than poor children to have only a handful of relatively minor health conditions, such as hay fever and sinusitis. Poorer children, by contrast, are more likely to have asthma, frequent headaches, heart conditions, kidney disease, epilepsy, digestive problems, mental retardation, and vision and hearing disorders."[146] Furthermore, those living in low-income neighborhoods may lack access to health services and preventive care.[147] The poorest and most disadvantaged communities can benefit greatly from river parkways that provide space for exercise, recreation, and nature contact.

[141] Ibid.
[142] Schoenborn, C., Adams, P. and Barnes, P. Body Weight Status of Adults: United States, 1997–98. CDC
[143] Parks, S.E., Housemann, R.A., and Brownson, R.C. 2003. Differential correlates of physical activity in urban and rural adults of various socioeconomic backgrounds in the United States.
[144] Lopez, R. and Hynes, P. Obesity, physical activity, and the urban environment: public health research needs
[145] Case, A. and Paxson, C. (2006). Children's Health and Social Mobility. The Future of Children: Princeton and Brookings
[146] Ibid.
[147] Centers for Disease Control and Prevention (CDC), National Center for Health Statistics. (2012). Data on Health Insurance and Access to Care.

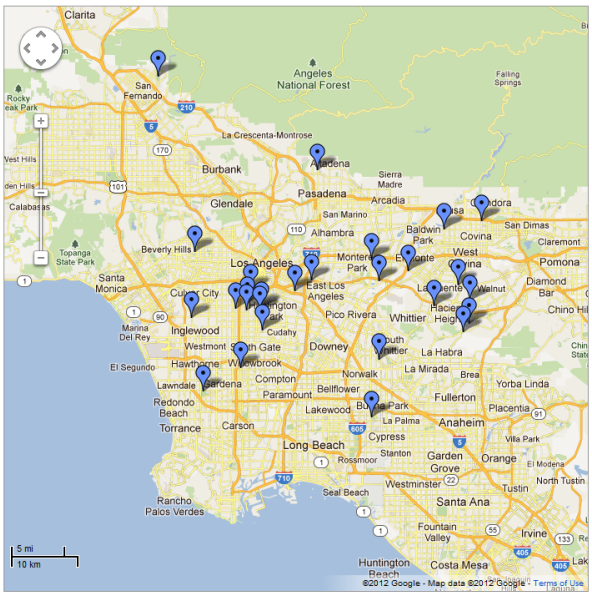
Education and Promenading: Creating a Community Culture Change

Differences in level of physical activity, particularly with leisure walking, are apparent among various class and ethnic groups, which leads to the important question how to involve wider communities and populations with low participation levels. A century ago when parks, such as Central Park in New York, were designed, they were intended as places for promenading and education. Promenading -- walking leisurely especially to meet or be seen by others -- is an effective form of education and social teaching. The concept of promenading can be applied more broadly to physical fitness; examples include parents who run or use fitness zones in front of children to instill the importance of a healthy lifestyle, or use of a local river parkway communicates the importance of physical activity to the community-at-large. Frederick Law Olmsted believed that people needed to learn how to use park spaces, and that watching others use the space was one of the best ways to accomplish this.[148] This principle and practice of promenading and role-modeling remains important in public space today. As demonstrated in Los Angeles and Trust for Public Land's Fitness Zones, promenading is an important component of parks**.** RAND Corporation reported that parks where fitness zones exist have a more active atmosphere than those without, even among those not utilizing the fitness equipment directly.[149,150] The view of what is "healthy" affects parenting as well, and having more spaces for safe childhood activities integrated into a neighborhood can help encourage more healthy behaviors.[151,152,153,154] Increasing the diversity of outdoor settings increases children's level of physical activity, time outdoors, and environmental awareness.

[148] Fairfield, J. (2012). The Public and Its Possibilities: Triumphs and Tragedies in the American City.
[149] The Trust for Public Land. From Fitness Zones to the Medical Mile: How Urban Park Systems Can Best Promote Health and Wellness.
[150] Cohen, D., Marsh, T., Williamson, S. and Golinelli, D. (2012). Impact and Cost-Effectiveness of Family Fitness Zones - A Natural Experiment in Urban Public Parks
[151] The Council of State Governments. Obesity Tool Kit.
[152] Robert Wood Johnson Foundation, Where We Live Matters for Our Health: Neighborhoods and Health
[153] CDC. School Health Guidelines to Promote Healthy Eating and Physical Activity. Morbidity and Mortality Weekly Report (MMWR)

Spotlight: Fitness Zones, Los Angeles

As an approach to the overabundance of areas with little to no access to exercise facilities and opportunities, The Trust for Public Land created Fitness Zones in the Los Angeles area to provide park exercise equipment to stimulate physical activity. Fitness Zones are outdoor gyms appropriate for all levels of fitness and have become a resource to facilitate use of parks and physical activity in densely populated neighborhoods. Since introducing these outdoor exercise equipment areas in 29 parks, there has been an increase in park use and physical activity.



Above is a map of many of the fitness zones installed by The Trust for Public Land.

Photo Credit: http://www.tpl.org/what-we-do/where-we-work/california/los-angeles-county/

Community Pride and Empowerment

Human connection with nature has cultural effects on a community. Interaction with nature has been shown to increase environmental concern, promote stewardship, decrease crime levels, and encourage volunteerism.[155] Those who volunteer for environmental organizations have been shown to have 50% fewer cases of depression as non-volunteers, while other forms of

[154] Increasing Physical activity

[155] U.S. Environmental Protection Agency. Green Communities Assistance Kit: Indicators; California State Parks. 2005. The Health and Social Benefits of Recreation.

volunteering lower the risk by only 10%.[156] Furthermore, the design of the built environment can facilitate interaction within a community and increase social capital (collective benefits of social networks).[157] This is particularly evident in public spaces, such as parks and plazas; increasing social capital corresponds with health improvements.[158] For instance, in Portland, Oregon, a public area was revitalized by painting murals, adding benches, and building planter boxes. Through these relatively simple efforts, social capital was built, and local residents reported feeling a stronger sense of community and improvement in mental health in terms of lessening depression.[159]

Community connection with urban parks can bring neighbors together in a safe, clean area, and can also help improve a community's image and desirability, both for current and future residents. Interaction with these parks also encourages connection with other people and therefore increases community efficacy. Urban river parkways can help a community form stronger ties internally and with the local environment.

Community Economic Benefit

River parkways in urban areas provide communities not only with opportunities to participate in healthy behaviors, but can also enhance community pride through increased local revenue and economic benefit from tourism and improved property values. Active outdoor recreation, such as bicycling, wildlife viewing, and other trail activities, contributed $730 billion each year to the

[156] Kuo, F.E. (2010). Parks and Other Green Environments: Essential Components of a Healthy Human Habitat.
[157] Dannenberg, A., Frumkin, H., and Jackson, R. (2011). Making Healthy Places: Designing and Building for Health, Well-being, and Sustainability. Island Press: Washington, DC.
[158] Ibid.
[159] Dannenberg, A., Frumkin, H., and Jackson, R. (2011). Making Healthy Places: Designing and Building for Health, Well-being, and Sustainability. Island Press: Washington, DC.

U.S. economy and supports 6.5 million jobs nationally. Wildlife-related recreation remains one of the most popular activities in the U.S. In 2011, more than 90 million U.S. residents participated in some form of wildlife-related recreation and spent $144.7 billion on these activities.[160] According to the U.S. Fish and Wildlife Service, 71.8 million Americans participated in wildlife viewing specifically, with 6.73 million in California (the highest participation of any state), and this activity generated 1,0280,000 jobs and $27.8 billion in income and wages.[161]

The economic benefit of investing in infrastructure to enhance quality of life is further illustrated by a restoration project of a waterfront greenway in Camden, New Jersey, which has stimulated the local economy and has created jobs. Originally planned to connect residents of the community to the waterfront, the 1.4-mile greenway known as the Ulysses S. Wiggins Park has brought in more than 600 residents, 2,000 workers, and two million tourists annually since it has been constructed. Trails can be made popular across the region, and trail tourism is one way of generating local tourism in places that are not typical vacation destinations.[162]

Investment around parks can also help revitalize and economically redevelop a city. In Greenville, South Carolina, the city attributes its economic health to city investment in a park in 2004.[163,164] Though the park cost $13 million to develop, it has brought in over $100 million investments in the surrounding areas.[165] There are numerous economic studies from the 1970s to the present that document higher property values near parks.[166,167,168] Green spaces also

[160] U.S. Fish and Wildlife Service. 2011. National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.
[161] U.S. Fish & Wildlife Service. 2006. Wildlife Watching in the U.S.: The Economic Impacts on National and State Economies in 2006..
[162] California Department of Parks and Recreation. Sustainable Tourism in California State Parks
[163] Espey, Molly and Kwame Owusu-Edusei. 2001. Neighborhood Parks and Residential Property Values in Greenville, South Carolina. Journal of Agriculture and Applied Economics 33(3):487-492.
[164] Rose, J. (2011). How A Park Helped One Town Weather The Recession. NPR.
[165] Ibid.
[166] Crompton, J.(2007). The Impact Of Parks And Open Spaces On Property Values
[167] Jaeger, W. and Plantinga, A. (2007). How Have land-use Regulations Affected Property Values in Oregon?
[168] The Value of Public Space.

increase real estate value. One case study found that the value of properties near Pennypack Park in Philadelphia increased from about $1,000 per acre at 2,500 feet from the park to $11,500 per acre at 40 feet from the park.[169] In addition to the presence of a park, the distribution of park spaces also affects land values. For instance, in Colorado, land value decreased by $4.20 for every foot farther away from the "greenbelt."[170] Data from a 2000 study in Portland, Oregon also indicates that the correlation between property value and proximity to green space is significant. At distances between about 100 feet from the perimeter of the park to about 1,500 feet, the price premium for homes ranged between 1.51% and 4.09%. According to a 2001 study, the sale prices of homes within 1,500 feet of a natural, largely undeveloped space, are estimated at 16.1 percent more than for homes farther than 1,500 feet away from the space.[171] Having urban river parkways is particularly beneficial because it adds park spaces to places in city areas that often have the greatest need for revitalization.

In 2009, the City of Elgin, Illinois was identified as the most overweight city in Illinois with 63% of adults and 16% of children overweight or obese.[172] In an effort to decrease these alarming overweight and obesity rates, leaders of Kane County (where Elgin is located) realized that land-use decisions impact lifestyles and sought to improve daily routines by implementing walkable neighborhoods and open spaces for active living.[173] The Bikeway Master Plan is an example of city planning and design that fosters active living by connecting neighborhoods in the city with bicycle and pedestrian oriented pathways. There are bicycle paths and sidewalks along the banks of the Fox River in Elgin that runs through Festival Park. The paths engage people with

[169] Hammer, Thomas R., Robert E. Coughlin, and Edward T. Horn IV. 1974. "The Effect of a Large Urban Park on Real Estate Value." American Institute of Planning Journal July: 274–77.
[170] Correll, Mark R., Jane H. Lillydahl, and Larry D. Singell. 1978. "The Effects of Greenbelts on Residential Property Values: Some Findings on the Political Economy of Open Space." Land Economics 54(2): 207–17.
[171] Dunse, N., C. Dehring, and M. White. 2007. Urban parks, open space, and residential property value. Findings in Built and Rural Environments (FiBRE), Rural Institution of Chartered Surveyors. United Kingdom.
[172] Dannenberg, A., Frumkin, H., and Jackson, R. (2011). Making Healthy Places: Designing and Building for Health, Well-being, and Sustainability. Island Press: Washington, DC.
[173] Kane County Health Department, Vital Signs: 2009 Report to the Community, Annual Report.

the river and connect them to the amenities near the shore. More public facilities and amenities such as the library and recreation center are placed along the river to attract the community to the river paths. Ed Schock, the mayor of Elgin, states, "People want to be near the water...people see the opportunities that walking and biking paths have to offer...it is no accident that almost every new development in the last ten years has been along the river." By diversifying the strategies for health improvement in the community, the city understands that more parks and recreational open spaces are imperative to sustaining a healthy community.

Colorado's river projects offer examples of how river parkways can transform communities and benefit human health. One such project is the Northside Park in Denver. This park revitalized an area that used to be a sewer plant as part of the South Platte River Corridor initiative. The restoration project has provided wildlife habitat, water quality regulation, storm drainage design, and a vibrant place for exercise and outdoor recreation. Boulder, Colorado understands that their residents are active because of the way the city was developed. The infrastructure of Boulder encourages physical activity by facilitating walking, bicycling, and enjoyment of outdoor scenery. As a result, the city of Boulder has the lowest rate of obesity in the U.S. at 12.1%.[174] The creation of trails and pathways develop a culture of physical activity in the daily lives of people living in Boulder. This is a culture starting as early as 1920 when Frederick Law Olmsted Jr. encouraged citizens to preserve the creeks and waterways of Boulder as a source of connection with nature.[175] The city takes advantage of the surrounding natural features such as the creeks and streams by aligning them with bicycle and pedestrian paths. Boulder also creates a series of bicycle routes that connect places of interest, making it safer and more common for bicycle riding as a primary source of transportation. These strategies demonstrate the

[174] Witters, D. (2012). More Than 15% Obese in Nearly All U.S. Metro Areas
[175] Jackson, R. Designing Healthy Communities

importance of open spaces and natural environments that can improve community health and facilitate a sense of community identity.

Adequate, easy, and equal access to open space is often a major obstacle for members of low income and minority communities. The revitalization of riverfronts with parks offers many community benefits; it provides residents the opportunity to be outdoors and active, facilitates interactions between nature and humans, and allows children the opportunity to play outdoors.[176] Revitalizing these areas also encourages economic development and reduces the need for automobile trips.[177]

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[176] Commission for Architecture and the Built Environment (CABE). The Value of Public Space.
[177] Idib.

Urban River Parkways and Environmental Health

Environmental Health Implications
Urban River Parkways and Water Quality
Urban River Parkways and Air Quality
Urban River Parkways and Heat
Environmental and Human Health Implications

Climate change will have costly and life-threatening impacts on urban areas. Urban density and plans can exacerbate these impacts. Features of urban areas that contribute to environmental problems include the burning of fossil fuels, the loss of trees and vegetation, and widespread impervious (paved) surfaces. In many areas, mitigation and adaptation plans to deal with climate change are being considered and implemented.

Mitigation efforts are those which seek to reduce climate change by reducing deforestation and fossil fuel consumption and greenhouse gas emissions, and include efforts such as making non-motorized transportation more accessible and planting more vegetation and trees. Adaptation measures seek to lessen the severity of the health impact of climate change, such as installing air conditioning, planting drought-resistant vegetation, and increasing water storage. Because climate change is associated with increasing temperatures, changes in severity and frequency of storm events, and general changes in water quantity and quality, river parkways have the potential to be part of both mitigation and adaptation strategies. These strategies can be implemented through both policy and design measures. For example, riparian (riverside)

vegetation can act as a carbon sink to improve air quality, lead to better flood management, storage and filtering of water, preserve biodiversity, and reduce urban heat island effects.

Urban River Parkway Effects on Water Quality

Since the Industrial Revolution, rivers have been utilized for transport, waste removal, and energy production, and the land in adjacent cities and communities has become polluted with contaminants that can leach into groundwater.[178] Urban runoff is a serious concern for water quality as it transports many pollutants to rivers and oceans. Runoff, particularly from stormwater, is the leading cause of pollution along the Southern California coast,[179] and is described by the California State Water Resources Control Board as a "toxic soup" of trash, pesticides, animal waste, motor oil, and other contaminants that lead to unsanitary and unhealthy living environments.[180] These pollutants are harmful to both animal and human health. For instance in Los Angeles, 100 million gallons of contaminated water runs into the oceans each dry day, and according to the Santa Monica Bay Restoration Project, storm water pollution leads to an "increased risk of viral infections, earaches, sinus problems, fever, flu, and skin rashes and viral diseases such as hepatitis for those swimming in the ocean close to storm drain outfalls."[181]

The World Health Organization (WHO) asserts, "access to safe drinking-water is essential to health, a basic human right and a component of effective policy for health protection."[182] The WHO documents that, unsafe water, sanitation, and hygiene were ranked among the leading

[178] U.S. Environmental Protection Agency. Brownfields and Land Revitalization.
[179] Heal the Bay. Urban Runoff.
[180] State Water Resources Control Board. Storm Water Pollution. California Environmental Protection Agency.
[181] Ibid.
[182] World Health Organization. (2006). Guidelines for Drinking-water Quality

global risks for death. Worldwide, poor water quality was estimated to be responsible for 1.9 million deaths and 64.2 million years of life lost in 2004, which accounts for 3.2% of all deaths.[183] If conditions are not changed, an estimated 135 million people will die worldwide from water quality related diseases by 2020.[184] The WHO also estimates that water quality and water borne illnesses cause up to a third of all hospital admissions and 60% of all infant deaths.[185] In the U.S., while there are fewer water quality issues than in developing countries, there are still cases of illness caused by poor water quality.

Spotlight: South Los Angeles Wetlands Park

The South Los Angeles Wetlands Park is a former bus and rail car maintenance yard that has been transformed into a nine-acre park. Aside from providing much needed recreational space, the reconstructed wetlands park increases water quality by treating storm water from storm drains before it is discharged into the Los Angeles River.[1] The wetlands acts as a filter for trash, chemicals, and oils from city streets, as bacteria in the wetlands can naturally clean up the pollutants. The South Los Angeles Wetlands Park can uptake 680,000 gallons of stormwater per day, cleaning water before entering the Los Angeles River and ultimately, the Pacific Ocean.

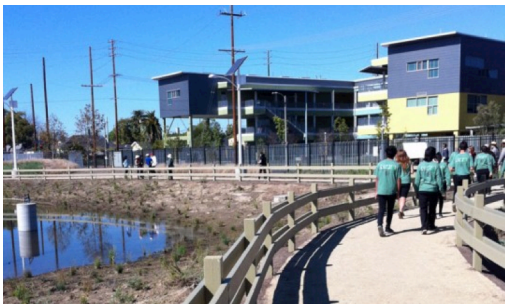

Photo Credits: http://inhabitat.com/nine-acre-l-a-parking-lot-transformed-into-a-pollution-reducing-wetland/ and http://laist.com/2009/06/12/ballona_wetlands_breaks_ground.php

[183] Good, L.B. Interview with Khan, O.A. 2009. Water Safety: Reducing the Infectious Disease Burden Due to Unsafe Water, Sanitation, and Hygiene
[184] Gleick, P. (2002). Dirty Water: Estimated Deaths from Water-Related Diseases 2000-2020
[185] WWF. Water Pollution Factsheet

Several important interventions can be undertaken to improve water quality including slowing/reducing the volume of runoff and creating mechanisms to remove pollutants. Adding permeable surfaces that allow water infiltration into the earth reduces the amount of urban runoff. Having permeable surfaces near rivers is particularly important as it helps reduce runoff from flowing and depositing contaminants directly into larger water sources such as the ocean. Additionally, permeable surfaces improve water quality by soil-filtering and degrading toxicants that otherwise would be discharged into river systems.[186] To remove the pollutant load of runoff, infiltration into the soil and maintaining healthy habitats and plant life in urban areas is essential.

In addition to water quality issues, water quantity issues -- from flooding to droughts -- are becoming increasingly concerning. Flooding can overwhelm water capture and diversion capacity if permeable surfaces are not in place, and in most urban areas the majority of the land cover is impermeable. Flooding causes about half of all worldwide deaths related to natural disasters, and is the leading cause of natural disaster deaths in the U.S.,[187] with particular risk associated with flash flooding. Moreover, flooding has human health costs in addition to drowning, including increases in infectious diseases, allergies, and dermatitis as well as damage to property and infrastructure.[188] With climate change increasing the frequency and severity of weather events, having land that lacks the capacity to store or absorb water increases these risks.[189,190] Urban river parkways have characteristics that enable them to capture storm water and protect against flash floods. They also improve water management including rain water capture, which are necessary in highly populated areas. They also create a buffer and

[186] U.S. Environmental Protection Agency. Stormwater Management Best Practices.
[187] Ohl, C.A. (2000). Flooding and human health.
[188] Green, C.H. and Penning-Rowsell, E.C. (2007). Flooding and the quantification of 'intangibles.'
[189] Pye, V.I. and Patrick, R. (1983). Groundwater contamination in the United States.
[190] National Research Council. Ground water recharge using waters of impaired quality

permeation field between water courses and buildings.

Drinking water is obtained from either surface water (streams and lakes) or groundwater. Groundwater is collected through wells that extract water from underground aquifers. It is important to "recharge" aquifers to ensure future water supplies. Impermeable surfaces covering urban areas cause water to run off instead of infiltrating the soil and recharging underground water storage areas, resulting in greater reliance on artificial groundwater recharge. Groundwater recharge must be carefully controlled and regulated to avoid exposing people to bacterial infections, parasites, or disinfection by-products.[191] Permeable surfaces, readily provided by urban river parkways, allow water to permeate through the ground and replenish underground aquifers.

Transporting water from other regions is an important source for water in the arid Southwest U.S. including cities like Los Angeles, which receives on average less than 20 inches of rain per year.[192] Transport of water is costly, both economically and environmentally. Drought can cause a shortage of clean water and concentrates contaminants in surface waters.[193] In Southern California, a vast majority of the water supply is imported from the Colorado River and from Northern and Eastern California and. Groundwater sources provide only an average of 11% of the water supply for the Los Angeles region, and a mere 1% is recycled water.[194] Importing water is energy intensive and expensive. In 2010, the operating costs of the Colorado River Aqueduct (one of the three major water aqueducts) was $49 million, and due to energy costs

[191] Bouwer, H. (2000). Integrated water management: emerging issues and challenges.
[192] Groundwater Basin Reports. Los Angeles County Coastal Plain Basins - Santa Monica Basin
[193] CDC. Health Effects. Climate and Health Program.
[194] Los Angeles Department of Water and Power.

and greenhouse gas offsetting costs, the energy costs are estimated to increase 80% by 2020.[195] The California State Water Project is the largest consumer of energy in California, using approximately 2-3% of all of California's electricity in order to transport water from the San Francisco Bay-Delta to Southern California[196], alternative measures to conserve, recycle, and capture rainwater and stormwater and to recharge groundwater are essential to sustaining water quality and quantity.

Santa Monica, California is an example of city efforts to reduce reliance on imported water by increasing groundwater recharge. One initiative established in 2003 is the garden/garden project, and was designed to encourage residents and landscape designers to use sustainable garden practices. These practices include using low-volume drip irrigation, weather-sensitive irrigation controllers, and dry creek bed and infiltration pits that capture stormwater runoff and recharge groundwater.[197] Furthermore, the use of California native plants provide habitat and food vital to native birds and insects while requiring less water, pesticides, and fertilizers for sustenance. By both producing more permeable land and by using less water and fertilizer intensive vegetation, water is conserved, used for recharge, and stormwater runoff discharged in nearby waters and streams is reduced.

[195] Boxall, B. (2011). Water's energy -- and expense. Los Angeles Times.
[196] Energy Down the Drain, NRDC
[197] garden/garden: A Comparison in Santa Monica. The Sustainable Sites initiate

Urban River Parkway Effects on Air Quality

Air pollution from stationery sources has been greatly reduced thanks to the U.S. Clean Air Act and California initiatives.[198,199] Today in the U.S., the most air polluted cities are those with heavy levels of vehicular air pollution (mobile sources), especially in hot sunny areas with leeward mountains, such as Los Angeles, Fresno, and Riverside, California.[200,201] These effects are most marked in waterside areas near international ports, such as the Ports of Los Angeles and Long Beach, where air pollution from ships, cranes, trucks (especially old diesel trucks), locomotives, and other vehicles concentrate. Oftentimes, these are older areas of a city with low cost housing and a large percentage of the population including poor and minority people who already face economic and health challenges.[202,203]

The health effects from air pollution are well documented. The main pollutants produced by mobile sources (vehicle exhaust) are nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOCs), black carbon (BC), fine particulate matter (PM), ozone (O_3), diesel exhaust, and sulfur oxides (SOx).[204] According to the World Health Organization (WHO), 4.6 million people die annually due to air pollution.[205,206] Ozone inhalation leads to lung damage and increases the severity of asthma and other respiratory diseases,[207] and particulate pollution leads to similar health problems.[208] The California Air Resources Board (CARB) reports that particulate matter is a main contributor to deaths from air quality, with an estimated 9,000

[198] Office of the Attorney General. Environment & Public Health. State of California Department of Justice.
[199] US EPA. Clean Air Act
[200] Kennan, C. (2012). Top 10 Most Polluted US Cities.
[201] Goodwin, J. (2011). Report: California Cities Have Worst Air Pollution in U.S.
[202] Bonorris, S. Ed. (2010). Environmental Justice for All: A Fifty State Survey of Legislation, Policies and Cases University of California, Hastings.
[203] Skelton, R. and Miller, V. (2006). The Environmental Justice Movement. Natural Resource Defense Council.
[204] SCAG 2012 RTP/SCS Performance Metrics & Health
[205] Miller, T. Non-Communicable Disease Primer: Where Does the World Stand? PBS Newshour.
[206] Air Pollution. Science Daily.
[207] Health Effects of Ozone in the General Population. US Environmental Protection Agency.
[208] State of the Air 2012: Particle Pollution. The American Lung Association.

premature deaths in California each year.[209] Approximately 24.6 million people in the U.S. have asthma[210] and 11,000 people suffer from asthma-related deaths each year.[211] The areas with the worst air quality, such as the Los Angeles Basin and the San Joaquin Valley in California, consequently suffer from greater public health problems[212] such as a 5% increase in childhood asthma each year since 1980.[213] The American Lung Association reports that fine particles, sulfur dioxide and ozone have been linked to increases in medication use and hospital visits.[214] With climate warming, asthma and allergies will increase due to ground level ozone, increased pollen production, and the lengthening of allergy seasons. For example, ragweed is a common source of allergies and the plant produces more pollen as climate change stimulates an earlier onset of Spring.[215,216,217] The Natural Resources Defense Council (NRDC) estimates that 110 million Americans in 2007 lived in areas where ragweed and high ozone levels both exist – in addition, aggravated allergies and asthma will disproportionately affect urban residents and symptoms are most severe in children because they breathe more air relative to their body weight.[218]

Ground-level ozone, produced by the chemical reaction of NOx, CO, and VOCs in sunlight, is a reactive chemical that reacts with lung tissue to cause inflammation and other respiratory symptoms. According to the Environmental Protection Agency (EPA), at least one third of the American population lives in areas where the EPA ozone standard of 0.12 ppm is exceeded. Moreover, the state of California has even stricter standards where the one hour standard for

[209] California Air Resources Board. News Release. Fine particle air pollution responsible for 9,000 premature deaths in California each year.
[210] Akinbami, L, Moorman, J. and Liu, X. (2011). Asthma Prevalence, Health Care Use, and Mortality: United States, 2005–2009. National Health Statistics Report.
[211] Benjamin, Georges C. *At the Intersection of Public Health and Transportation: Promoting Healthy Transportation Policy*
[212] American Lung Association State of the Air
[213] Benjamin, Georges C. *At the Intersection of Public Health and Transportation: Promoting Healthy Transportation Policy*
[214] Key Facts About….Air Pollution. American Lung Association.
[215] Global Warming: Impacts to Public Health and Air Quality. American Lung Association in California.
[216] Pervin, T., Gerdtham, U. and Lyttkens, C. (2008). Societal costs of air pollution-related health hazards: A review of methods and results.
[217] Health Effects. CDC. Climate and Health Program.
[218] Schwartz J. (2004). Air Pollution and Children's Health. *Pediatrics* 113(4):1037-1043

ozone is not to exceed levels of 0.09 ppm.[219] However in Los Angeles, the EPA limit of 0.12 ppm on ozone is exceeded half of the days of the year.[220] Emergency room data demonstrates a correlation between increasing asthma attacks and days on which ozone levels exceed the standard, particularly for children and the elderly.[221]

In the summer, when air conditioner and electricity use normally peaks, the burning of fossil fuels for energy production generates excessive amounts of particulate matter pollution. CARB estimates that energy usage for the state will increase 25-50% in the next century. Vehicle exhaust and wildfires due to increased temperatures or drought also increase levels of particulate matter.

Urban river parkways serve as a carbon sink (a climate change mitigation effort) and remove some of particulate matter from air by increasing vegetation land cover.[222,223] Plants limit greenhouse gases in the atmosphere through carbon sequestration. Trees and soil sequester carbon dioxide and clean the air, and having more vegetation -- and a wider variety -- in an otherwise urban area helps improve air quality. [224,225,226,227]

[219] Ozone and Ambient Air Quality Standards. California Environmental Protection Agency: Air Resources Board.
[220] Donaldson, K.,, Brown, D., Brown, G., Davis, J., Maclaren, W. and Slight, J. The Role of Inflammation in Ozone-Induced Lung Injury. US Environmental Protection Agency.
[221] White et al. (1994). Exacerbations of childhood asthma and ozone pollution in Atlanta.
[222] Groth, P., Miller, R., Nadkarni, N., Riley, M. and Shoup, L. (2008). Quantifying the Greenhouse Gas Benefits of Urban Parks. ICF International for The Trust for Public Land.
[223] Fujii, E., Lawton, J., Cahill, T., Barnes, D., Hayes, C. and Spada, N. Breathe California of Sacramento Emigrant Trails Health Effects Task Force: Removal Rates of Particulate Matter onto Vegetation as a Function of Particle Size. BREATHE California.
[224] Stavins, R. and Richards, K. (2005). The cost of US Forest-based.
[225] Groth, P., Miller, R., Nadkarni, N., Riley, M. and Shoup, L. (2008). Quantifying the Greenhouse Gas Benefits of Urban Parks. ICF International for The Trust for Public Land.
[226] Alexander, S. et al. Opportunities and Challenges for Ecological Restoration within REDD+
[227] Gorte, R. (2009). Carbon Sequestration in Forests. Congressional Research Service.

Reducing Air Pollution Health Costs

The U.S. spends roughly $50 to $80 billion per year[228] on the clinical treatment of diseases associated with air pollution. Furthermore, CARB estimates $170 billion in health impacts from premature deaths, hospital admissions related to respiratory and cardiovascular disease, asthma and other lower respiratory symptoms, cases of acute bronchitis, and 1.9 million workdays lost because of elevated ozone and particulate levels.[229] Poor air quality also led to an annual total of 14 million missed school days by American children. Considering the approximate cost of public elementary school per student was $10,441 in 2008[230] and that the average number of school days is 180,[231] one day of public school costs the U.S. roughly $58 per child. Taking into account the 14 million missed school days of American children, the educational costs related to poor air quality alone, is approximately $812 million dollars in one academic school year.

Road traffic congestion reduction strategies such as those implemented during the 1996 Summer Olympic Games in Atlanta, GA, significantly improved air quality and reduced rates of asthma. During the 1996 Olympic Games, peak ozone levels decreased 27.9% and acute asthma care decreased 41.6%[232]. Similar to those used in the 1984 Summer Olympics in Los Angeles, the city of Atlanta reduced traffic congestion by limiting travel via private automobile travel and promoting alternative services such public transportation and park-and-ride services. As a result, lower ambient ozone levels and particulate matter were measured. CDC research found reduced rates of acute cardiovascular and emergency room visits from children with asthma in Atlanta clearly showing how reductions in driving and automotive pollution can lessen health

[228] The Hidden Health Costs of Transportation. American Public Health Association.
[229] Global Warming: Impacts to Public Health and Air Quality. American Lung Association in California.
[230] Fast Facts. Institute of Education Sciences. National Center for Education Statistics.
[231] Average length of school year and average length of school day, by selected characteristics: United States, 2001-02
[232] Peel, JL, et al. (2010). Impact of Improved Air Quality During the 1996 Summer Olympic Games in Atlanta on Multiple Cardiovascular and Respiratory Outcomes. *Health Effects Institute*. Research Report 148. Boston, MA.

care costs.[26]

Urban River Parkways and Heat

Urban areas are distinct from other land areas – they have more buildings, paved surfaces, motor vehicles, and air pollution and fewer water features, trees, and other vegetation. Urban areas can be 6-8°F warmer than rural areas, a phenomenon known as the urban heat island effect (Fig. 4).[233] These temperature differences are greatest at night, as the evaporation that would usually occur in cooler evenings is limited both due to the lack of vegetation and the slow release of heat from dark surfaces (such as street pavement and rooftops) that occurs.[234] Dark surfaces have a low albedo (reflectivity) and thus absorb heat more readily compared to other surfaces such as grass.[235] There is also a concentration of heat sources such as boilers and power plants, vehicles and furnaces, even cooking stoves and computer "server farms." As temperatures rise, more and more water evaporates from water bodies, such as rivers, and a positive feedback system is generated that further increases urban temperatures.[236] Urbanization in general reduces green space and affects stream or river temperatures, and air pollution tend to trap heat.[237,238] The lack of vegetation and other factors that naturally cool the environment results in hotter weather and lack of places for people to cool down, such as shaded park areas.

[233] Dannenberg, A., Frumkin, H., and Jackson, R. (2011). Making Healthy Places: Designing and Building for Health, Well-being, and Sustainability. Island Press: Washington, DC.
[234] London's Urban Heat Island: A Summary for Decision Makers. (2006). Mayor of London.
[235] Tom Markvart and Luis Castałżer (2003). *Practical Handbook of Photovoltaics: Fundamentals and Applications.*
[236] Reducing Urban Heat Islands: Compendium of Strategies Urban Heat Island Basics. US Environmental Protection Agency.
[237] Low Impact Development (LID) A Literature Review. US Environmental Protection Agency: Office of Water, Washington D.C..
[238] Nelson, et al. (2009). Forecasting the combined effects of urbanization and climate change on stream ecosystems: from impacts to management solutions.

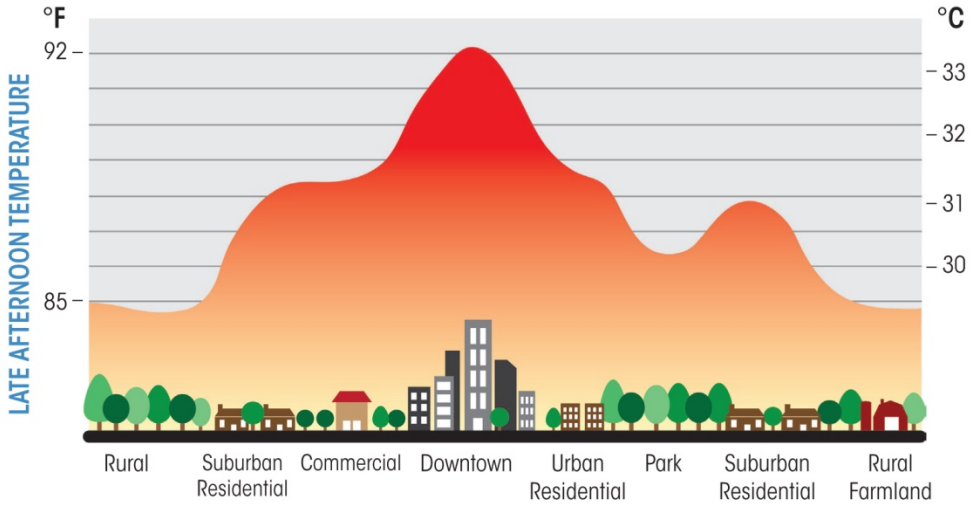

Figure 4. The urban heat island effect.

The urban heat island effect is a contributing factor to extreme heat events that are increasing in frequency in the U.S. Within climate change conversations, there are several points that experts are "particularly confident" about including an increasing frequency of severe heat waves. In a report by the Intergovernmental Panel on Climate Change (IPCC), over the past 100 years, global temperatures have risen by 1.3°F, and are expected to rise between 2-11.5°F by the year 2100.[239] Due to increasing temperatures and severity of heat waves, the mortality rate related to heat stroke is increasing and the CDC reports that excess heat related deaths could rise from the current estimate of 700 per year to up to 5,000 per year in 2050.[240] Health factors associated with increased heat exposure include dehydration and heat exhaustion, two health concerns that potentially cause heat stroke. Extreme temperatures can also exacerbate existing cardiovascular and respiratory diseases. In addition, heat increases levels of ground-level ozone, which harms lungs both directly, by making asthma and other pulmonary disease impacts more severe, and indirectly, by increasing the need for fossil fuel consumption by running air

[239] Global Warming: Impacts to Public Health and Air Quality. American Lung Association in California.
[240] Heat Waves. CDC. Climate and Health Program

conditioners.[241] Extreme heat events account for more climate-related fatalities than any other extreme weather event.

Urban river parkways help to reduce heat effects by providing more unpaved areas and more vegetation. The greenways and multi-use trails that comprise the corridors of river parkways create additional permeable landscapes essential for water absorption and reduction of heat from paved surfaces. Trees in particular produce shade that reduces the urban heat island effect,[242] vegetation facilitates evapotranspiration, and more water reflects heat (increases albedo) to counteract absorption by other urban surfaces. Rivers and healthy ecosystems surrounding them are effective ways of mitigating the rising temperatures in urban areas,[243] thereby reducing the risk of heat stress and other heat-related health conditions.

Restoring a healthy river ecosystem in a city can offer benefits in that it "preserves ecosystems and biodiversity, provides clean air and water, maintains ecosystem function, and fosters human involvement in the natural environment."[244] The revitalization of riverfronts by the inclusion of parks and greenways rejuvenates natural habitats, restoring associated ecological services and improving the environment for people who live in the vicinity. River parkways have benefits for air quality, water quality, urban heat, and biodiversity.

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[241] Health Effects. CDC. Climate and Health Program.
[242] Ibid.
[243] Reducing Urban Heat Islands: Compendium of Strategies Urban Heat Island Basics. US Environmental Protection Agency.
[244] Benefits of Protected Areas. Environment Canada.

Influences on River Parkway Use

Influences on River Parkway Use
Health Promotion Initiatives
Designs That Promote Physical Activity
Features and Presence of Water
Perceived Safety, Design, and Maintenance

While urban river parkways can foster and enhance the health of a community, merely constructing pathways and open spaces does not guarantee their use. Rather, it is the combination of infrastructure and design and the change in culture by way of community engagement and movement that lead to the use of river parkways. A layout that reflects physical activity and health will in turn reinforce a culture attracting people that value fitness. For example, motivating people to be physically active in an environment with many barriers and no access to open spaces or trails is not likely to be effective, and simply building a park or sidewalk is often insufficient to get people to use them. A comprehensive approach offers ways to motivate people to take advantage of the opportunities. The culture shift is as important as the physical change and it can be very long lasting.[245]

[245] Moerlein, K. and Carothers, C. (2012). Total Environment of Change: Impacts of Climate Change and Social Transitions on Subsistence Fisheries in Northwest Alaska

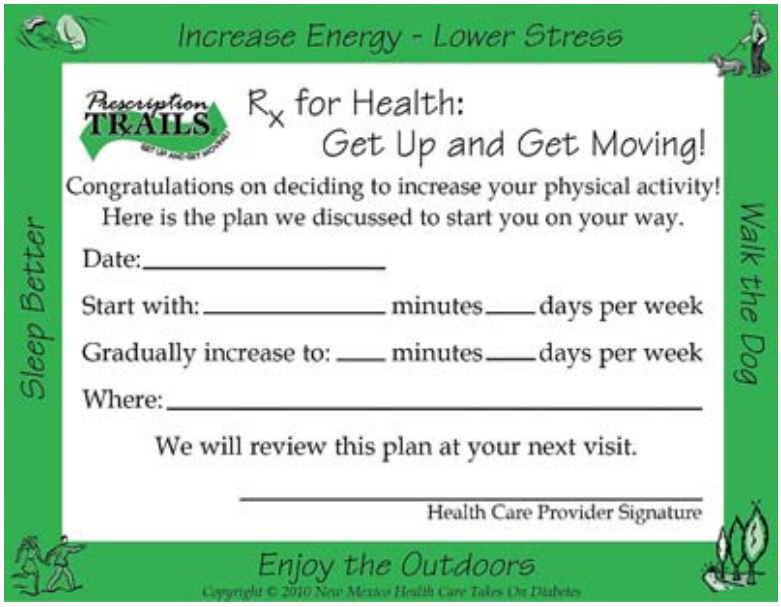
Health Promotion Initiatives

All members of society can benefit from urban river parkways, whether it is benefits to physical, mental, environmental, or community health. But to promote healthy populations is to include health considerations when developing projects, programs, and policies. Health Impact Assessment (HIA) is a related tool that can help improve public health by considering the potential positive and negative health impacts of a project.[246] The National Park Service, partnerships such as the Federal Urban Waters Partnership, and the State of California have implemented aspects of HIA to help protect population health. The National Park Service's Healthy Parks Healthy People United States program promotes health and well-being by reconnecting people to public lands and parks.[247] By collaborating with multidisciplinary organizations including those involved with health care, science, business, and advocacy, the National Park Service has established partnerships to promote parks and open spaces as integral contributors to healthy lifestyles.

[246] National Research Council. (2011). *Improving Health in the United States - The Role of Health Impact Assessment*. Washington, DC: The National Academies Press.
[247] National Park Service. (2011). Healthy Parks Healthy People U.S. Strategic Action Plan

Spotlight: Park Prescriptions

One such partnership involves health and medical providers utilizing "park prescriptions" as referrals for patients to engage in outdoor recreation. The National Environmental Education Foundation's Children and Nature Initiative encourages the use of prescription pads where physicians refer patients to reconnect with nature by walking, riding a bicycle, or wildlife-watching. To complement this, the California State Parks and SeeChange Health Insurance incentivizes member by reimbursing entrance fees to State Parks, making it easy and virtually free to visit them.



In what began as a simple prescription of patient exercise, the physicians at the Heart Clinic Arkansas prescribed the development of a path. As a result of the heart clinic's involvement, the Medical Mile is now a main attraction of the Little Rock's Arkansas River Trail providing opportunities for walking, running, skating, and bicycling. These initiatives develop stronger connections between the health care system and public land and although evaluation of the effectiveness of such initiatives is still in its nascent stages, there is no doubt that they will burgeon as successful tools to create a culture where river parkways and the elements they comprise become synonymous with health.

Photo Credit: Albuquerque Prescription Trails Pilot Program," *Network & Provider News*, Lovelace Health Plan, Summer 2008.

The Urban Waters Federal Partnership is a pilot program in partnership with 11 agencies including the EPA, Department of Interior, United States Department of Agriculture, and others. The partnership has made it a priority to engage communities, particularly those facing

economic burden and lack of access to open space, in revitalizing efforts along waterways.[248] The Los Angeles River is one of seven rivers selected in this partnership to reconnect communities with their waterways. In collaboration with many city and non-profit organization programs, the LA River partnership seeks to reestablish the 51-mile river as an integrative and connected corridor of parks and bikeways. Currently, the LA River has 26 miles of bike paths along its banks with gaps between some sections of paths. The recently launched Greenway 2020 campaign aims to fully connect all 51 miles of the river's bike paths by year 2020, a goal that will make the LA River one of the longest continuous urban parkways in the country.[249] Other projects include points of access between the LA River and adjacent neighborhoods, and acquiring a former rail yard to create the largest park along the river.

Moreover, California state expenditures have been allocated for programs that protect and conserve the environment and devote open spaces for recreational opportunities to the public. One example is the Proposition 84 River Parkways Grant Program which provides funding to local agencies and organizations that have current projects that provide recreation opportunities along rivers and streams, riparian habitat restoration, flood management, and conversion of existing rivers (while the original Prop 84 funding has been spent, the program can be funded through a variety of sources).[250] Appropriation of state funding allows organizations such as The San Joaquin River Parkway and Conservation Trust (SJRPCT) to establish river parkway projects and programs that Fresno, California area residents can enjoy. SJRPCT seeks to develop and manage the Trust's land and trail programs and to improve public access to the parkway. Programs such as "Respite by the River," scheduled nature walks, and projects to expand the Lewis S. Eaton Trail from 5 miles to 22 miles are just some of the initiatives to

[248] Urban Waters Federal Partnership. US Environmental Protection Agency.
[249] LA River Revitalization Corporation. Greenway 2020.
[250] California Natural Resources Agency: Grant Programs – Proposition 84.

encourage walking, bicycling, fishing, and connection with nature. Such federal and state programs recognize the important health benefits of river parkways and have acquired land adjacent to rivers to promote activity in green spaces and revitalize communities.[251]

Designs That Promote Physical Activity

Park design – the features and physical layout of the space – influences the level and type of park usage. There are a number of features that make an area attractive and usable for physical activity, and they range from the type of walking surfaces to the presence of trees on a street. In one study that compared 33 parks across four neighborhoods in Ontario, Canada, parks with a larger variety of features were found to be more likely to be used for physical activity. Furthermore, out of the amenities and facilities studied, trails were found to have the strongest relationship with park use for physical activity.[252] Other common park features reported to facilitate physical activity included adjacent sidewalks, trashcans, benches, multiple entrances, clear signage, landscaping, bicycle racks, parking, and historical or educational features. Larger parks tended to have more natural features. While features like trees, water, and wildlife influence visiting and physical activity in parks, the complex interactions between features can provide additional benefits.[253,254,255] Urban river parkways have the potential to incorporate many of the features that facilitate physical activity.

Several tools, audits, and studies are used to determine the elements for usability, such as the walk-ability or bike-ability, of a space. The Robert Wood Johnson Foundation has a database on

[251] Ibid.
[252] Kaczynsky, A.T., Potwarka, L.R. and Saelens, B.E. (2008). Association of park size, distance, and features with physical activity in neighborhood parks.
[253] Contribution of Public Parks to Physical Activity
[254] Bauman, A. and Bull, F. (2007). Environmental Correlates of Physical Activity And Walking in Adults and Children: A Review of Reviews. National Institute of Health and Clinical Excellence.
[255] Parks, Playgrounds and Active Living. Active Living Research: Robert Wood Johnson Foundation.

active living including park use (located at http://www.activelivingresearch.org), and many studies about the built environment confirm the same finding: proximity, amenities and destination connectivity, aesthetics, maintenance, and safety are essential characteristics of park design for encouraging park use.[256] As William Whyte and researchers since his film[257] have found, spaces to sit, trees, sun, and connection to surrounding streets are some of the characteristics of successful - and used - public spaces. Furthermore, including multiple users, utilizing local features, and reflecting local culture are important to creating great public spaces.[258]

Proximity

Residents living closer to recreational areas including trails and parks are more likely to utilize them. In one study, 43% of park users lived within one quarter of a mile of the park while only 13% of users lived more than one mile from the park. [259,260,261] Another study showed that California teenagers who lived within a park service area (within one quarter mile of a small park or one half mile of a large park) were more likely to have recently visited a park and more likely to engage in at least 60 minutes of physical activity five or more days per week.[262] In addition, older women living within walking distance (20 minutes) of destinations such as trails and parks were more likely to walk increased amounts per day than women who did not live in such a neighborhood. Outdoor activities are made possible when good access to walkable green

[256] McCormack, et al. (2010). Characteristics of urban parks associated with park use and physical activity: a review of qualitative research.
[257] William H. Whyte: The Social Life of Small Urban Spaces - The Street Corner
[258] Characteristics and Guidelines of Great Public Spaces. Great Places in America: Public Spaces. American Planning Association.
[259] Cohen, D., Sehgal, A., Williamson, S., Sturm, R., McKenzie, T., Lara, R. and Lurie, N. (2006). Park Use and Physical Activity in a Sample of Public Parks in the City of Los Angeles. RAND Corporation.
[260] Zhang, X., Lu, H. and Holt, J.B. (2011). Model spatial accessibility to parks: a national study.
[261] Preventing childhood obesity: the need to create healthy places. (2007). A Cities and Communities Health Report.
[262] Babey S.H., Wolstein J., Krumholz S., Robertson B., Diamant A.L. (2013). Physical Activity, Park Access and Park Use Among California Adolescents. UCLA Center for Health Policy Research.

spaces are provided, allowing for health improvement.[263] Being closer to residential areas increases the likelihood of urban trails and green spaces being used, and increases the probability the green space is used for physical recreation.[264]

Destinations

Destinations linked to urban river parkway, greenways, and open spaces foster activity.[265] Neighborhoods that have useful destinations such as grocery and hardware stores, schools, and workplaces provide specific purposes for walking and bicycling, and increase the levels of these activities. Parkways and multi-use trails provide an approach that simultaneously improves health and creates safe connections to essential destinations for day-to-day activities.

Connectivity

Another goal of urban river parkways is safe connectivity. As an alternative to roadways and motor vehicles, river parkways provide natural or constructed corridors that enhance walking, jogging, and bicycling. As an effort to increase connectivity and safe systems for pedestrians, bicyclists, and equestrians, the L.A. River Revitalization Corporation is planning to build the La Kretz Crossing to connect Atwater Village and Griffith Park (Fig. 5).

[263] Lawrence, RJ. (1996). Wanted: Designs for health in the urban environment. *World Health Forum 17*(4), 363-366.
[264] Desphande, AD, et al. (2005). Environmental correlates of physical activity among individuals with diabetes in the rural Midwest. *Diabetes Care 28*(5), 1012-1018.
[265] Kaczynski, AT and Henderson, KA. (2007). Environmental Correlates of Physical Activity: A Review of Evidence about Parks and Recreation. *Leisure Sciences 29*(4), 315-354.

Figure 5: Future La Kretz Crossing over the Los Angeles River.[266]

Urban river parkways can facilitate connections between bikeways and major destinations to allow for safer and more efficient commutes, promote alternative transportation modes, reduce traffic on roadways, and facilitate physical activity.

Features and Presence of Water

River parkway features such as trails, vegetation, water, and other features are known to facilitate park usage. However, current urban trail and park literature lacks research that models trail and pathway traffic as a function of a specific physical characteristic, such as the presence of water. To begin to find the impact of the presence of a water body and its impact on usage, a simplified look at trail usage and its relation to water presence was undertaken for this paper. In order to determine the impact of water on river parkway use, specific trails were selected using www.trails.com and "popular" trails as a proxy for highest use. Trails.com ranks

[266] Proposed L.A. River bridge is supported by the ideals and wealth of a developer turned philanthropist. (2012). The Eastsider.

the popularity of over 49,000 trails within a particular U.S. region and for specific activities by collecting and analyzing over 10 million votes from site visitors and members. The top ten trails in northern and southern California were selected in each of the following activities: walking, running, and bicycling. Each trail was estimated as "near" or "not near" a water body (a reservoir or ocean) or waterway (a creek or river).

The analysis showed that about 60% of popular trails were near a water body or water feature. Furthermore, an overwhelming percentage of trails utilized local natural spaces for physical activity, versus the very few that were urban or downtown areas. These results support the assumption that people prefer to use local, natural spaces for physical activity, and that water features may be a useful determinant for trail use. This brief analysis of water features and trail use is oversimplified. In order to better assess the impact of water features on trail usage, particularly for urban river trails, a more comprehensive study is needed and should include more rivers and detailed user data (instead of using a proxy such as popularity, since www.trails.com data is comprised of a self-selecting voter pool). Consideration should also be given to other factors such as topography and proximity to the water body.

Perceived Safety, Design, and Maintenance

While design factors such as ease of access, proximity, convenience and multi-function of urban river parkways play an important role in prompting use, real and perceived safety is also associated with increased levels of physical activity.[267,268] Planning for assurance of safety is essential to encourage the use of outdoor environments for health benefits. The association

[267] Prochaska, J.D. (2009). The association of perceived environment with meeting physical activity recommendations across rural-urban settings in Central Texas.
[268] Cohen et al. (2011). Parks and physical activity: Why are some parks used more than others?

between perceived safety and physical activity levels has been studied thoroughly, and several design methods can prevent crime, violence, and injury.

Safety: Crime and Violence

Crime and violence are important factors to consider when designing open spaces. Elements of safety need to be addressed to maximize the advantages of river parkways using Crime Prevention Through Environmental Design (CPTED). CPTED prevents crime by implementing four specific guidelines to heighten perceived likelihood of detection and decrease intent of crime: natural surveillance, natural access control, natural territorial reinforcement, and maintenance.[269] Natural surveillance can be attained through adequate lighting and landscape; crimes are less likely to occur in areas where there are "lines of sight," or where people and activities can be readily observed. Natural access to parkways can help reduce intent of crime by using walkways, fences, lighting and signage to properly direct the flow of people in and out of public spaces. Natural territorial reinforcement is a strategy to distinguish public areas from private ones and reinforce proprietorship, such as using clear signage. Lastly, maintenance is a strategy to increase perceived safety based on the "broken window theory." This theory suggests that if one nuisance (such as a broken window) is allowed to persist, then it will facilitate more nuisances and eventually cause the degradation of the entire neighborhood. Ultimately neglected and poorly maintained properties can become centers of criminal activity.[270] Maintenance not only affects the level of perceived safety but is also aesthetic

[269] CPTED Security. Crime Prevention Through Environmental Design.
[270] Idib.

enjoyment.[271] Proper lighting, signage, land designations, and upkeep of parkways can collectively improve perceived safety and help to lessen intent of crime.

Community policing is another primary component of ensuring safety of parkways and trails. As new and improved trails make travel easier from one place to another, local law enforcement and citizens can enhance perception of safety by implementing neighborhood watch programs and increasing foot and bicycle patrols. The inclusion of CPTED and community policing encourages use of river parkways by strengthening perceived safety and deterring crime and violence.

Safety: Injury Prevention

Injuries are a major cause of death, disability and suffering; they occur for identifiable reasons and are often preventable.[272] The CDC reports that in 2010 "170,000 deaths and 30 million initial visits to emergency departments are attributable to injury."[273] Injuries can be avoided by making changes to the built environment. Planning and implementing safe design is less costly than retrofitting projects after their construction,[274] and there are many design elements that can be incorporated into river parkways to provide a safe environment for recreation, social interaction, and exercise. For example, having green, public areas for commuting reduces the risk of pedestrian injuries, particularly those due to unmaintained sidewalks and/or motor vehicle crashes.

[271] Health Impact Assessment and Brownfields.
[272] Injury and Violence Prevention and Control. CDC.
[273] Dannenberg, A., Frumkin, H., and Jackson, R. (2011). Making Healthy Places: Designing and Building for Health, Well-being, and Sustainability. Island Press: Washington, DC.
[274] Ibid.

Increased driving as noted with urban sprawl has led to increased exposure and risk of injury [275] and vehicle accidents are the leading cause of death for Americans between the ages of 1 and 34.[276] Furthermore, vehicle collisions with pedestrians have a much higher pedestrian fatality rate at higher vehicle speeds (Fig. 6).[277]

Vehicle Speed (mph)	Pedestrian Fatality Rate
20	5%
30	45%
40	85%

Figure 6: As vehicle speeds increase, the pedestrian fatality rate increases dramatically.[278]

Long distances between day-to-day destinations – including green, open spaces and areas to exercise – equates to longer travel times and thus a greater exposure to injury. There is also a lack of "safe systems" for transportation.[279,280] Safe systems separate vehicles from pedestrian and bicycle paths, a feature that urban parkways can provide**.** River parkway trails can increase safety for bicyclists and pedestrians by separating the trails from vehicular traffic thereby reducing opportunities for walkers and bicyclists to be involved in accidents with automobiles. Separating bicycle and pedestrian paths can add another sense of safety and comfort while riding or walking. For example, Boulder, CO has implemented aspects of on-street

[276] Ibid.
[277] UK Department of Transportation. (1987). *Killing Speed and Saving Lives.*
[278] Ibid
[279] Dannenberg, A., Frumkin, H., and Jackson, R. (2011). Making Healthy Places: Designing and Building for Health, Well-being, and Sustainability. Island Press: Washington, DC.
[280] What the doctors prescribe. (2011). New Urban Network. Better Cities & Towns.

(lane within the road) and off-street (multiuse path off the road) bicycle lanes to accommodate different types of users.[281]

Vegetation control is also related to both perceived safety and aesthetics.[282] Vegetation alongside river parkways can provide a pleasant aesthetic, but also needs to be controlled to keep sight lines and signs clear for vehicles, bicyclists, pedestrians and drivers. In particular, vegetation needs to be controlled for safe operation of motor vehicles.[283] Furthermore, well-marked and clear pathways, as well as a setting with distinct elements – which are inherent in urban parkways and their clearly defined "zones" (water, pathway, vegetation), encourage orientation, provide emotional security, and help reduce stress.[284]

In general, the use of urban river parkways can be strongly related to perceived safety and the likelihood of crime. Frequency of park use will decrease when there is more crime and violence, or when poor maintenance will lead to unsafe conditions. Future research is needed on how to reinforce comfort, possibly by attracting families with young children and by making connections within the community, as well as design aspects such as the separation of bicycle and pedestrian pathways. It is important to consider incorporating methods of protection and security in the design of parkways to prevent crime and alleviate worries of dangerous places.

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[281] Dannenberg, A., Frumkin, H., and Jackson, R. (2011). Making Healthy Places: Designing and Building for Health, Well-being, and Sustainability. Island Press: Washington, DC.
[282] Schroeder, H. (1982). Preferred Features of Urban Parks and Forests.
[283] Vermont Local Roads Newsletter, March 2009.
[284] Burns, C. and Kahn, A. Site Matters: Design Concepts, Histories, and Strategies.

Recommendations

Level of Action	*Actions*
Individuals	● Practice healthy behaviors ○ Make exercise a habit - make it fun and social ○ Make playing in green space part of daily routines for children ● Increase awareness of healthful built environments ○ Explore and use local parks and trails
Localities	● Establish parkways, including trails, along rivers and creeks ● Make river parkways a priority when planning for future growth ● Provide local funding and secure state and federal grants to help establish, maintain, and improve local river parkways ● Incorporate river parkways and river restoration whenever feasible in design of flood control and stormwater projects, and consider river parkways as a water quality strategy ● Educate communities about the preventive health benefits that result from physical exercise and outdoor activity ● Establish community programs and activities to sustain a culture of healthy behaviors ● Promote community programs that connect people with their local environments ● Use specific funds to connect to destinations (transit nodes, schools, workplaces, services (e.g. health care), retail, and parks) ● Ensure that open spaces are designed to provide easily accessible and safe areas for green exercise ○ Develop multi-use trails and parks surrounding rivers to achieve the recommended levels of physical activity and time outdoors

Level of Action	*Actions*
Localities (cont'd)	○ Increase safety and reduce anxiety by promoting community policing and utilizing the principles of Crime Prevention Through Environmental Design (CPTED) when designing river parkways ○ Ensure safe use for both pedestrians and bicyclists by providing effective infrastructure and maintenance ○ Utilize clear and attractive signage to indicate the presence of parkways ○ Assure bike and car parking ● Market river parkways as a destination or attraction to increase tourism and community pride ● Use resources available to construct and maintain river parkways for both human and environmental health ○ Use permeable surfaces where possible ● Enhance partnerships across sectors in managing health policy and land use ● View health interventions as an "investment portfolio" with health prevention programs, such as prescription of river parkway use, as a main component of effective and cost-efficient policy ○ Integrate Health Impact Assessments (HIAs) into local decision-making
Regions	● SB 375 (California Law): add locality's actions into area government plans
State and Federal Governments	● Provide grants, technical assistance, and other support to local governments and organizations that are establishing, improving, and operating river parkways ● Integrate river parkways and trails in federal and federally-funded flood control projects, other water-related projects, and fish and

Level of Action	***Actions***
	wildlife restoration projects ● Incorporate river parkways and trails in national and state park projects ● Direct federal and state transportation funding to support establishing, enhancing, and maintaining river parkway trails, scenic and recreational corridors along rivers, and other related facilities ● Provide funding to state and local conservation corps to incorporate at-risk youth in implementation of projects and prioritize underserved communities for river parkway funding and assistance
Organizations	● Health Organizations: public health agencies, pediatrics, etc. ○ Embrace actions that utilize the local environment as preventative health care measures ● Environmental Organizations ○ Involve public in stewardship, consciousness/awareness ○ Facilitate the public's embrace and caring for environment ● Community Organizations ○ Endowed ownership to maintain and monitor parks and trails ○ Add environmental and health education in schools

Conclusion

Urban river parkways can significantly advance public health and wellness by providing attractive places for residents to recreate and embrace more active lifestyles. Trails and pathways along rivers facilitate active recreation and commuting by walking, bicycling, or local transit. Accordingly, river parkways counter sedentary behaviors and factors linked to obesity, diabetes, loss of muscle mass, and other life-threatening chronic diseases. Furthermore, green exercise helps combat mental illnesses such as depression and anxiety in adults and promotes imagination, focused-thinking, and creativity in children. River parkways encourage communities to reconnect with nature while also improving the local environment to combat health issues related to the urban heat island effect and air and water pollution.

Infrastructure investments in urban river parkways have huge returns in the form of health care savings, increases in property values, attraction of outdoor recreation and tourism, and direct cost savings for citizens through low-cost recreation and active transportation opportunity.

Urban river parkways are elements of the built environment that allow community members to find peace, tranquility, and relaxation in a society where leisure time is often difficult to achieve. The habitat surrounding trails and green spaces around waterfronts create a sense of connection with nature otherwise hidden in the urban setting. The rays of the sun, native biota and fauna, and calmness of a river's flow all contribute to a pleasant atmosphere where people are more prone to participate in activities that enhance overall well-being.

However, the existence of river parkways alone does not directly constitute healthy communities; the design of parkways needs to be addressed to ensure use and safety. Without incorporating aesthetic, multi-use, and safety features, people will not be motivated to use the facilities provided. Well maintained landscape, adequate lighting, and safe routes are essential for communities to fully benefit from the healthy activities made possible by river parkways. The synergy between physical activity, exposure to the natural environment, and effective infrastructure design make urban river parkways an invaluable source of mental and physical health benefits.

Recommendations for future action include individual, local, regional, and organizational level activity. Individuals can practice and model healthy behaviors increase awareness of healthful built environments. On a locality level, community programming should be explored, particularly those programs that connect people with each other and the local environment while sustaining a culture of physical activity. Localities should also work to ensure that open spaces are protected and remain accessible and safe areas for green exercise. This can be accomplished in part by establishing strategic partnerships and by integrating Health Impact Assessments into local decision-making. On a regional level as well, locality actions should be incorporated into area government plans, as California's SB 375 encourages. Organizations, particularly those focused on health, environment, and community, should work in partnership with localities to establish local natural areas as places of community pride and use. Furthermore, future studies should be conducted to strengthen the understanding of the level correlation between specific features and trail use, as well as to provide more data about the importance of nature and physical activity on mental health.

Urban River Parkways: An Essential Tool for Public Health

Urban river parkways are an enjoyable and effective public health strategy that provides a solution to the most urgent urban health issues, and ultimately serve to enhance the quality of modern urban life.