Appendix F:
Environment

The environmental appendix provides the existing environmental conditions in Downtown Bethesda with regards to Watersheds and Water Quality, Impervious Cover, Stormwater Management, Heat Island Effect, Air Quality and Urban Green. In addition to the existing conditions analysis, the Environmental Appendix supplements the recommendations in the Sector Plan and provides additional analyses, more detailed methodology and presents further findings with regards to sustainability performance areas and metrics, urban ecosystems, biophilia and energy. A Carbon Footprint Analysis is also provided based on the land use recommendations and projections in the Plan.

Sustainability

1.1 Sustainability

1.2 Performance Areas

1.3 Performance Area Metrics

Environment

1.4 Urban Ecosystems

1.5 Biophilia

1.6 Existing Environmental Conditions

1.6.1 Watersheds & Water Quality

1.6.2 Impervious Cover

1.6.3 Stormwater Management

1.6.4 Heat Island Effect

1.6.5 Air Quality

1.6.6 Urban Green

1.6.7 Benefits of Trees

1.6.8 Soil Volume

1.6.9 Green Roofs

Energy

1.7 High Performance Area & Energy

1.8 High Performance Rationale

1.9 Montgomery County's Carbon Reduction Goals

1.10 Energy Reduction Goals

1.11 Green Economics

Carbon Footprint Analysis

1.12 Findings

LEED-ND

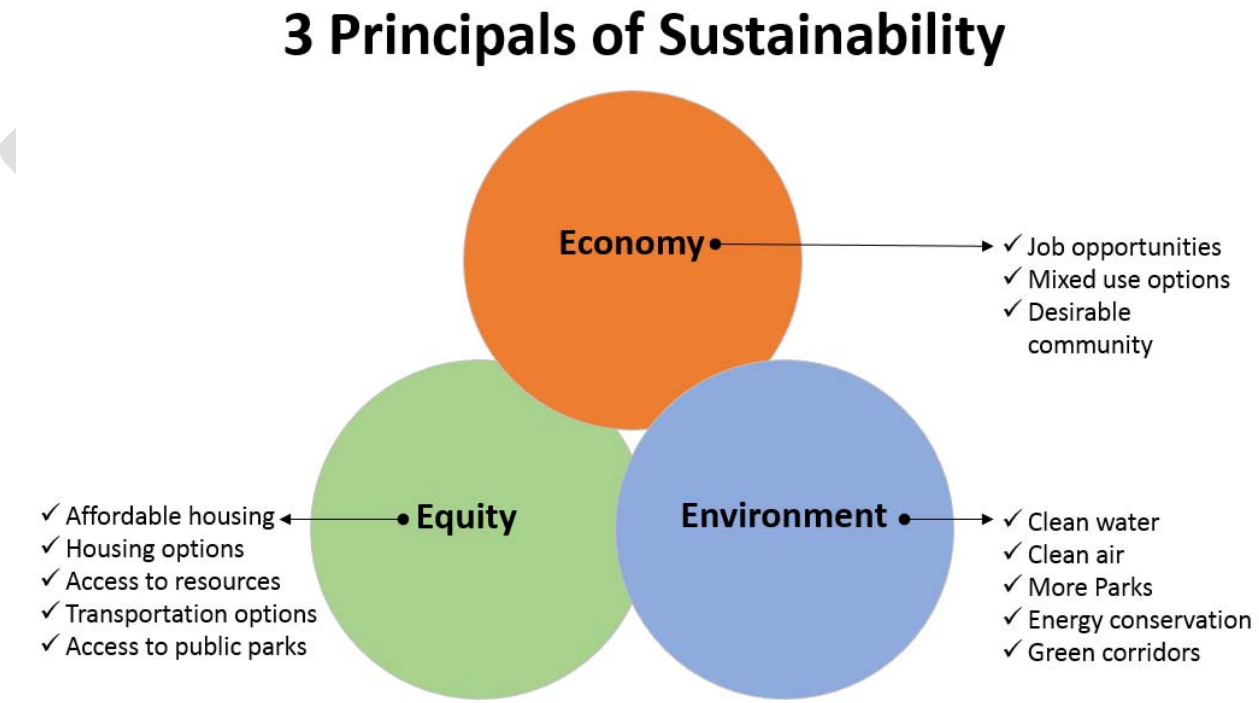
Community Water and Sewer

1.1 SUSTAINABILITY: A Methodology for Good Planning

The central theme of this Sector Plan is sustainability. The tenets of sustainable urbanism include a walkable and transit-served community integrated with high-performance buildings and infrastructure. As the economic heart of Montgomery County, Bethesda is already characterized by excellent walkability, access to transit, mix of uses, community-serving retail and restaurants, and a cultural and economic hub with a significant urban identity. These characteristics are strong foundations towards building a lasting and dynamic 21st Century urban center. By expanding upon these elements Bethesda will be well positioned to become a regional and national leader as a sustainable downtown.

A sustainable community includes three overlapping principles for present and future generations: 1) strong and prosperous economy; 2) social justice and cultural equity; 3) environmental responsibility. To pursue sustainability is to create and maintain the conditions under which each principles works in tandem with another. The objectives and recommendations throughout the Plan intend to improve sustainability by focusing on the most underachieving performance areas or elements of sustainability to ensure long-term economic, equitable, and environmental success.

Bethesda is confronted with a number of challenges: regional competition for growth; affordable housing; traffic congestion; poor air and water quality; high energy demands and carbon emissions; and small, fragmented parcels of open and green space, trees, and vegetation. By addressing these gaps Bethesda be well poised to become a regional and national leader in sustainability.



1.2 Performance Areas

The Sector Plan establishes six interrelated targeted performance areas with associated objectives and recommendations for each performance area. Performance areas are the quantifiable building blocks to which the three principles of sustainability can be defined and measured to ensure success in each category. They are indicators for how a community is "performing" economically, socially, and environmentally. The performance areas are holistic, interlinking categories of planning that aim to improve an already great downtown by filling in the underachieving performance areas resulting in an even greater Bethesda.

The performance areas were developed by evaluating commonalities of new planning methods and measurement models outlined in the following: The American Planning Association Policy Guide on Sustainability; LEED for Neighborhood Development; STAR Community Index; EcoDistricts; Sustainability Sites Initiative; Smart Growth Initiatives; and Architecture 2030. The six performance areas evolved through the analyzes of housing demographics (demand and deficiencies); existing and future transportation infrastructure and needs; existing parks and recreation areas; land-use; existing natural resources; environmental conditions; urban design elements; historical buildings; energy use; and many other planning components.

Six Sustainability Performance Areas (indicators)

1. Access and Mobility
   - Goals:
     - Increase & improve transportation options
     - Reduce vehicle miles travelled
     - Improve pedestrian mobility
     - Improve circulation systems

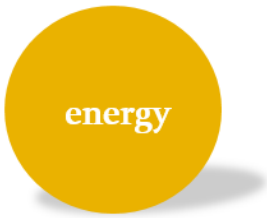
2. Equity
   - Goals:
     - Increase affordable housing options
     - Retain mix of economies and age diversity
     - Ensure environmental justice
     - Provide growth and development opportunities
     - Encourage flexibility in space and programming to adapt to future needs.

3. Community Identity
   - Goals:
     - Improve neighborhood identity and character
     - Support innovation and design excellence
     - Beautify the city through area-wide greening and improved parkland;
     - Improve streetscapes.

4. Health and Habitat
   - Goals:
     - Improve public health
     - Increase public green and habitat connectivity
     - Improve air quality
     - Increase access and quality of parks and open space

5. Water
   - Goals
     - Improve stormwater treatment
     - Water conservation
     - Improved stream quality

6. Energy
   - Goals:
     - Reduce energy consumption
     - Contribute to carbon reduction goals
     - Reduce greenhouse gas



Many of these performance areas are already well integrated into the fabric of Bethesda's existing urban landscape. Bethesda has a thriving identity, mixed use development, diverse transit options, a walkable street grid, and many other features of a well-planned downtown. On the other hand, improvements can be made to all performance areas. Habitat and health can be improved by providing additional parks, tree plantings, and green cover. Water quality can be improved through the installation of stormwater management features, and reduced impervious cover. Equity can improve by increasing affordable housing, access to transit options, age in place potential, and additional parks and resources. Access and mobility can be improved providing transportation options, and improving pedestrian and bicycle mobility.

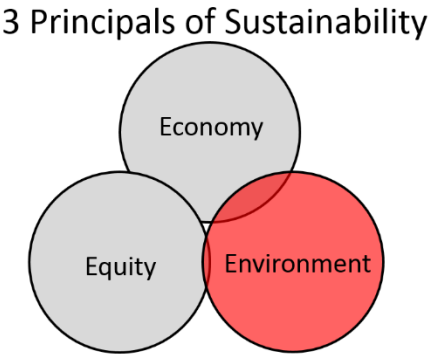
1.3 Performance Area Metrics

The metrics chart below quantifies the measurable performance areas indicating where we are today and where Bethesda can be tomorrow. Some performance areas are easily measured such as the number of new bicycle lanes proposed, while others like health and water quality are difficult to quantify. Many of the recommended changes will take many years to achieve and cannot be accurately determined due to unforeseen factors such as economics and development desire.

Sustainability Performance Area Metrics for Bethesda			
Performance Indicators	**Existing**	**Proposed (at full build-out)**	**Percent Change**
Equity			
Multi-unit rental units	4,669	8,456	81% increase
Market-Rate Rental Affordable Housing Units	1992	7,187	260% increase
Rent Restricted	826	Minimum 826, Maximum 1269	54% increase
Employment/Jobs	37,700	51,900	38% increase
Habitat + Health			
Tree Canopy Cover in HPA	45.35 acres	62 acres (approx.)	37% increase
Tree Canopy Cover outside the HPA	91.77 acres	TBD	TBD
Area of Green Roofs	0.75 acres	30-36 acres (approx.)	48% increase
Health			
Number of Parks	6	13 (for a total of 19 parks)	16% increase
Play Areas (per district)	6	TBD through implementation	Proposed Net increase
Area (Acreage) of Parks	10	13 (for a total of 23 acres)	30% increase
Access + Mobility			
Miles of bike lanes	1.19 miles	5.52 miles	364% increase
Resident vehicle miles traveled (VMT)	4.62 miles	3.71 miles	20% decrease
Employee vehicle miles traveled (VMT)	1.90 miles	1.27 miles	33% decrease
Bike share stations	10	TBD through implementation	Proposed Net increase

Sustainability Performance Area Metrics for Bethesda			
Performance Indicators	**Existing**	**Proposed (at full build-out)**	**Percent Change**
Commuters using different modes of transportation (NADMS)* (percent)	39.6	50	26% Proposed Net increase
Water			
Green roofs	0.75 acres	36 acres	48% increase
Stormwater Management Treatment (Percent of Sector Plan Area)	TBD	All new construction must comply with state and local stormwater management regulations	
Energy			
LEED Certified Buildings	1	TBD	
LEED Silver Buildings	0	TBD	
LEED Gold Buildings	4	TBD	
LEED Platinum Buildings (exceeds ASHRAE by 15%)	1	TBD	

ENVIRONMENT



The 'environment' is only one-third of the sustainability puzzle. A healthy environment makes for a desirable place to live, work, and play which stimulates the other two sustainability principles: equity and economics. Environmental sustainability means maintaining clean air, fresh and clean water, protecting natural resources, reducing consumption of nonrenewable resources, and maintaining or enhancing biodiversity (plants and animals) thereby helping future generations meet their own needs.

This section will address the existing environmental elements within Bethesda and outline the Sector Plan's recommendations for how conditions can be improved.

Bethesda's natural resources have experienced impacts from development. Ecosystems have been altered, forests have been removed, streams have been channeled, air quality is reduced, urban heat island effect is significant, and energy demand is high. Restoring trees, reducing impervious cover, and providing stormwater management will help mitigate for these losses and improve the quality of life for its citizens. A baseline environmental analysis was performed looking at the existing impervious cover, tree canopy cover, habitat, water quality & stormwater management, energy use, and regional air quality. A limited carbon emission analysis was completed indicating the projected levels after the Sector Plan recommendations are implemented to determine if the carbon goals set by the County will be met.

1.4 URBAN ECOSYSTEM

The overarching goal of the Sector Plan's recommendations is to improve the urban ecosystem in the performance areas of: water, energy, habitat & health, and community identity. An urban ecosystem is described as the relationship between humans, the built environment, and the natural environment. They are dynamic and interdependent systems that affect the health and well-being of a community now and in the future. Improving the natural environment and reducing the demand for energy will directly improve the urban ecosystem benefiting humans and wildlife. There are many approaches to improving the urban ecosystem. When implemented comprehensively and on a site by site basis, these performance based services can be quantified and measured for a healthier, greener, and more prosperous community.

1.5 BIOPHILIA: CONNECTING TO THE NATURAL ENVIRONMENT

Humans evolved outdoors, engrossed in nature, exposed to sunlight, fresh air, and water. This cultivated an intrinsic interdependence between humans and other living systems called *biophilia*. Biophilia is human's innate biological connection with nature. It helps explain why animal companionship and strolling through a park have restorative, healing effects; and why the sound and sight of water calm fear and anxiety. Biophilia may also help explain why some urban areas, parks, centers, and buildings are preferred over others. For decades, research scientists and design practitioners have been working to define aspects of nature that most impact our satisfaction with the built environment. The overall environmental recommendations intend to increase exposure to nature thereby increasing biophilia and the performance area services of Bethesda.

Unlike earlier times, our urban, suburban, and auto-centric lifestyle has resulted in a disconnection with nature. Recently, sociologist and scientists linked societies that don't get out in nature with acute medical symptoms. In 2005, Richard Louv[1] refers to human beings, especially children, who don't spend enough time outdoors often develop a wide range of behavioral and physical problems such as: attention disorders; hyperactivity; depression; obesity; myopia; aggression; and more.

New approaches to urban planning and design include the integration of nature throughout the urban landscape with the aspiration of cultivating biophilia. This approach seeks to reconnect people to nature and natural systems, and can be done even in dense urban environments. It attempts to make natural resources visible and experiential. The landscape, the architecture, the streets can all influence the biophilia of a community and make daily life more intrinsic, healthy, and rejuvenating. Including nature as a physical and direct experience that includes plant life, water, breezes, scents, sights, and sounds increase the experience of place creating meaningful, direct associations. Buildings, although indirect, can evoke nature. Buildings with natural lighting, materials and elements from nature, spatial hierarchies, artwork, and biomimicry shapes influence our experience and presence in them. Although more empirical evidence is needed, we intuitively know that a connection to nature is important. Favorite human memories often include those sights and places where nature is imparted.

Strategies such as tree-lined streets and corridors, green plazas, green roofs, parks, stormwater management, even urban farms all entice people to interact and be in nature and are woven throughout the recommendations and are incentives of the Sector Plan. Integrating nature and natural elements into building and site design not only benefit people (biophilia), but it also improves ecological sustainability and the quality of the targeted performance areas. For example, planting new trees increases the quantity of air filtration, provides more habitat, cools streets, creates an attractive landscape, and reduces stormwater runoff. Stormwater management features can provide valuable habitat in the form of plant and tree species in addition to improving water quality. Green roofs can reduce heating and cooling costs reducing energy demands while reducing heat island effect and providing habitat, nectar, and brooding opportunities. In combination, these features enhance community identity, improve place-making, and improve mental and physical health.

1.6 EXISTING ENVIRONMENTAL CONDITIONS

The existing conditions of Bethesda's natural resources were analyzed to develop strategies to mitigate and restore impacts to grow a healthier and greener downtown by boosting the performance areas and biophilia. Over time, these approaches will lessen greenhouse gas outputs and reduce fuel consumption; lower energy demand and operational costs; manage stormwater and mimic nature improving stream and water quality; cool streets, improve habitat; and significantly improve quality of life.

1.6.1 Watersheds and Water Quality

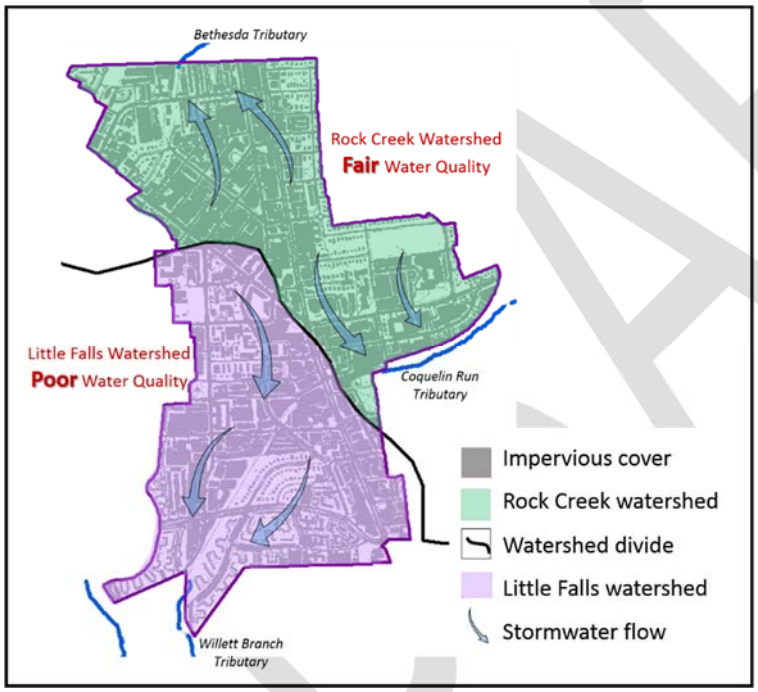
A watershed is the extent of land where surface water from rain, melting snow, or ice converges to a single point, merging with other waters such as a lake, stream, river, or ocean. A subwatershed refers to a smaller drainage area within the larger watershed.

[1] Louv, Richard. *Last Child In The Woods: Saving Our Children From Nature-deficit Disorder*. Chapel Hill, NC: Algonquin Books of Chapel Hill, 2005. Print.

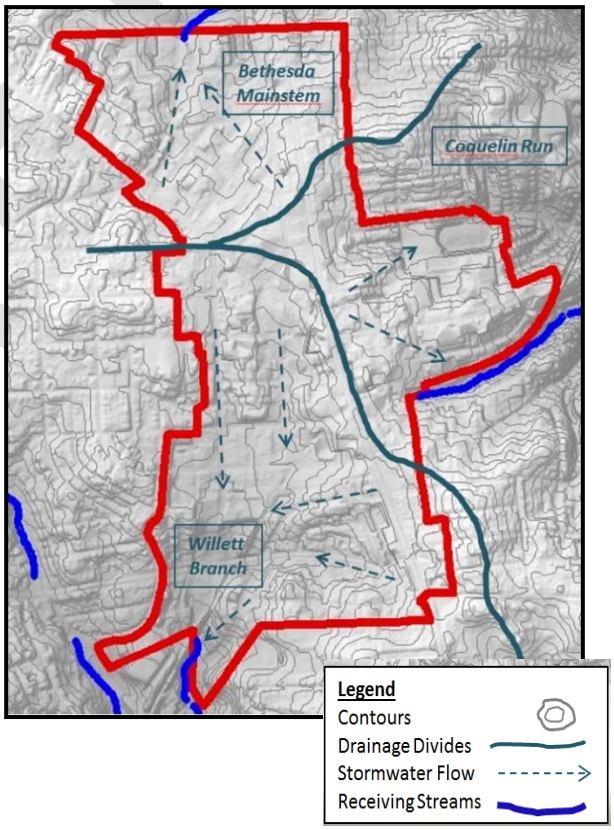
Bethesda, located inside of Interstate 495 (Capital Beltway) just northwest of Washington, DC has two watersheds: Little Falls watershed drains to the southwest draining into Willett Branch before entering the Potomac River; Rock Creek watershed is divided into two subwatersheds; Bethesda Mainstem drains to the north, and Coquelin Run drains to the south. Each of the watersheds flows into the District of Colombia.

In Montgomery County, the health of our streams are assessed by the Department of Environmental Protection using a Stream Conditions Index that measures the aquatic biological community (fish and bugs) of streams. The monitoring results are then used to determine if a stream is in poor, fair, good, or excellent condition. If conditions are poor, sensitive fish and bugs can't survive those conditions. In Bethesda, the Little Falls watershed was rated as "poor" with a low fish and bug counts. Rock Creek was rated fair. The poor and fair water quality directly corresponds to the amount of impervious cover in each watershed.

Watersheds

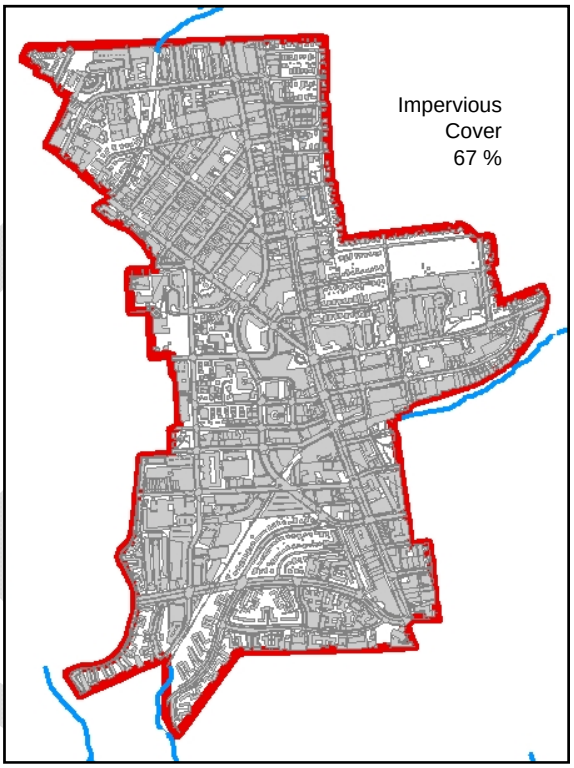


SubWatersheds



1.6.2 Impervious Cover

Impervious cover refers to anything that prevents water from soaking into the ground. Examples include building footprints and paved surfaces for driveways, sidewalks, streets and parking lots. Impervious surfaces curtail groundwater recharge, soil saturation, sediment and pollutant filtration, and the slow release of water from saturated soils to streams, wetlands, or other water bodies. When a surface is impervious, stormwater sweeps across it taking pollutants such as sediments, oils, de-icing salts, sand, pet waste, and lawn fertilizers. These pollutants are discharged into storm drain inlets which eventually discharge at outfall points along streams causing increased stream surges, stream bank erosion, algae blooms, reduced aquatic life, and reduced water quality.



Research has shown that "when impervious cover reaches 10-25% of the total area, major alterations in stream morphology (shape) occur that significantly reduce habitat quality. At greater than 25% impervious cover, streams suffer from loss of habitat, floodplain connectivity, and bank stability, as well as decreased water quality."[2] Within the Bethesda Downtown Sector Plan, total impervious cover is nearly 67 percent overall. Of that, 38 percent is from roads and parking lots. The remaining 29 percent is from building cover. These numbers are high, particularly since less than 1 percent (approximately) of this impervious cover provides stormwater treatment prior to discharge into receiving streams. This non-point source of pollution is the primary cause of the impaired streams, poor water quality and loss of aquatic life seen in the three tributaries of Bethesda.

1.6.3 Stormwater Management

Protecting and improving the quality and ecological health of Montgomery County's streams is a considerable planning objective. This goal is especially important because Montgomery County is part of the Chesapeake Bay watershed, a national treasure constituting the largest estuary in the United States and one of the largest and most biologically productive estuaries in the world.

On December 29th, 2010, the United States Environmental Protection Agency (EPA) in cooperation with Bay watershed jurisdictions of Maryland, Virginia, Pennsylvania, Delaware, West Virginia, New York, and the District of Columbia (DC), developed a nutrient and sediment pollution diet for the Bay, consistent with Clean Water Act requirements, to guide and assist Chesapeake Bay restoration efforts. This 'diet' is known as the Chesapeake Bay Total Maximum Daily Load (TMDL). After determining the impaired waters, Maryland identified a comprehensive set of pollution control strategies that collectively will achieve the nutrient and sediment reductions needed to meet the State's 2017 and 2025 goals for restoring the Bay and improving local waters.

[2] Center for Watershed Protection, "Impacts of Impervious Cover on Aquatic Systems", Ellicott City, MD, 20003

How does this influence the Bethesda Downtown Sector Plan? There are many techniques to minimize the effects of stormwater runoff. In the past, stormwater management regulations required large areas of land where the runoff was collected in pond-like depressions and released slowly over a period of time. However, in May of 2009 the State amended its stormwater manual requiring the application of Environmental Site Design (ESD) methods to minimize onsite and offsite hydrologic and water quality impacts due to runoff. ESD attempts to incorporate and mimic natural hydrologic processes into the built environment. There are many types of ESD's including permeable pavements, bioretention, structural cells, natural landscaping, green roofs, and tree plantings (see Bethesda's Design Guidelines). By regulation, these measures must be designed and implemented in new developments. ESD's can also be integrated into the existing streetscape or along sidewalks. ESD stormwater management practices have the capability to meet the goals of the Chesapeake Bay Total Maximum Daily Load (TMDL) for pollution reduction. It can significantly improve the quality of stormwater runoff thereby improving the quality of the receiving streams.

ESD's can be vegetated with a complex variety of plants from native grasses to shrubs and trees. They have an enormous potential to fill in green gaps in Bethesda and assists with improved air quality, reduced greenhouse gases and heat island effect, increased health and quality of place, and the aesthetic appeal.

Water quality, one of the performance areas of this Plan will be improved in the three receiving tributaries. It will take many years to achieve but with each new development and streetscape design, the construction of integrated stormwater management treatments will begin to reduce the quantity and improve the quality of stormwater runoff to the receiving streams.

Environmental Site Design are water quality management techniques such as: green roofs, tree plantings, rain gardens, permeable pavement, that mimic natural hydrologic functions. They are proven to help solve stream and water quality problems while improving the health and livability of neighborhoods.

Sector Plan Goals:

- Reduce untreated stormwater runoff to improve stream quality.
- Reduce water consumption through conservation measures.

Sector Plan Recommendations:

- Integrate environmental site design strategies that provide multiple performance area benefits for water quality, habitat, health and aesthetic improvement. Strategies include:
    - Intensive green roofs (6 inches or deeper to maximize water treatment).
    - Stormwater planters.
    - Pervious pavement.
    - Bioswales/biofiltration/bioretention/bioinfiltration.
    - Rainwater harvesting for retention, irrigation, and gray water.
- Incorporate multiple stormwater management facilities or treatment train to maximize benefits. The use of waivers should be limited.
- Integrate stormwater management within the right-of-way where feasible. Stormwater management should not displace the proposed bicycle networks.
- Reduce impervious cover to maximize stormwater infiltration and/or green space.
- Use permeable paving for roads, road shoulders, parking spaces, and parking lanes where feasible.

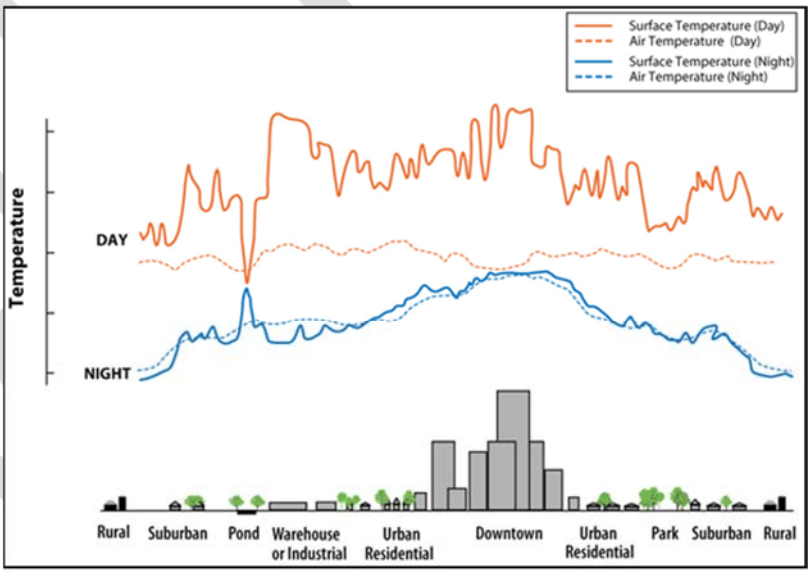
- Utilize environmental site design for parks and open spaces where it can be interpreted for community education.
- When feasible, exceed the County's minimum stormwater treatment requirement.
- Use street trees for stormwater interception, temperature mitigation and air quality improvement.

1.6.4 Heat Island Effect

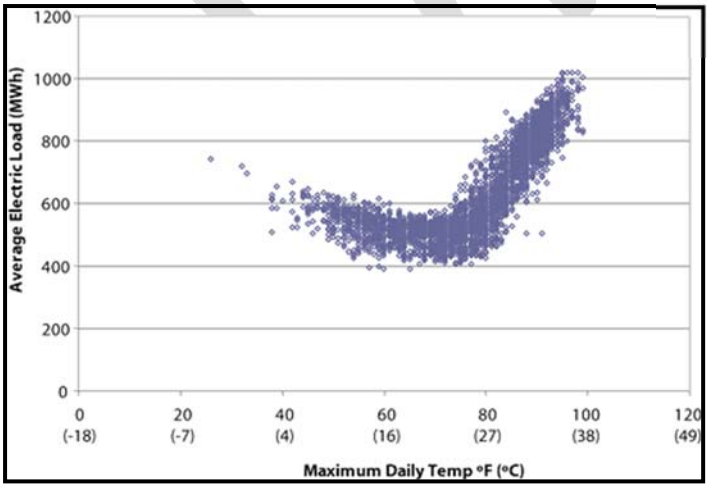
Impervious surfaces collect solar heat in their dense mass. When the heat is released, it raises air temperatures of the surrounding area producing an urban 'heat island'. According to the U.S. Environmental Protection Agency, urban areas can get as much as 22 degrees[3] Fahrenheit higher than their surrounding greener areas.

Higher local temperatures increase the demand for cooling which utilizes greater amounts of energy. In Montgomery County sixty percent of the energy used for heating and cooling buildings is generated from coal and other fossil fuels[4] where the combustion byproduct is carbon dioxide (CO_2), sulfur dioxide (SO2), nitrogen oxide (NOx), particulate matter (PM), carbon monoxide (CO), and mercury (Hg). These pollutants are harmful to human health and also contribute to complex air quality problems such as the formation of ground-level ozone (smog), fine particulate matter, climate change, and acid rain.

Increased Energy Demand when Temperatures are above 80 degrees



Graphic source: http://www.epa.gov/hiri/images/UHI_profile-rev-big.gif



The image to the left demonstrates the increase in energy demand when temperatures rise above 80 degrees.

Image provided by USEPA.

[3] Akbari, H. 2005. Energy Saving Potentials and Air Quality Benefits of Urban Heat Island Mitigation (PDF) (19 pp, 251K). Lawrence Berkeley National Laboratory.

[4] http://www6.montgomerycountymd.gov/dectmpl.asp?url=/content/dep/energy/EnergyWise.asp

Heat island effect and its associated pollution levels can affect human health by contributing to discomfort, respiratory difficulties, exhaustion, heat stroke, and even mortality. Elevated levels of harmful ozone pollution can occur during hot weather due to the chemical reaction between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. It is a major portion of urban smog.

Ozone can:

- Increase demand for medications, visits to doctors, emergency rooms, and hospital admissions
- Make it more difficult to breathe deeply and vigorously.
- Cause shortness of breath and pain when taking a deep breath.
- Inflame and damage the airways.
- Aggravate lung diseases such as asthma, emphysema, and chronic bronchitis.
- Increase the frequency of asthma attacks.
- Make the lungs more susceptible to infection.
- Continue to damage the lungs even when the symptoms have disappeared[5].

1.6.5 Air Quality

The Washington Metropolitan area is currently classified as a nonattainment area for ozone and fine particulate matter[6] as it does not meet the National Ambient Air Quality Standards (NAAQS) set by the Environmental Protection Agency (EPA). A nonattainment area is a locality where air pollution levels persistently exceed National Ambient Air Quality Standards or a locality that contributes to ambient air quality in a nearby area that fails to meet standards. These standards are designed to protect the public from exposure to ground-level ozone. Designating an area as nonattainment is a formal rulemaking process, and EPA normally takes this action only after air quality standards have been exceeded for several consecutive years.

To assist in the reduction of ozone, greenhouse gases, and improve overall air quality, the Sector Plan recommends multiple measures for reducing vehicle miles travelled (Section 2.3 Transportation), the planting of vegetation (Section 2.4 Urban Ecosystem), reducing energy use and demand through the construction of high performing buildings (Section 2.5 High Performance Area).

1.6.6 Urban Green

Urban green space, such as parks, street trees, tree clusters, green roofs, planted areas including stormwater management systems, streams, and community gardens provide critical ecosystem services and the biophilic elements of a community. There is mounting evidence on the psychological, physical, and economic benefits of living and working in areas with urban green (see Biophilia on page 7). Numerous cities are now greening their landscape in an effort to improve the quality of life for its residents, create better communities, and draw new businesses and residents.

5 http://www.epa.gov/glo/health.html

3: http://www.healthymontgomery.org/modules.php?op=modload&name=NS-Indicator&file=indicator&iid=7599149

6 http://www.montgomerycountymd.gov/dep/air/outdoor-pollutants.html

Ecological Benefits of Urban Green	Social Value of Urban Green
• Provide habitat	• Fosters social contact
• Links corridors and greenways	• Safer neighborhoods
• Prevent soil erosion	• Play and recreation opportunities
• Trees absorb pollutants	• Exposes nature to children & adults
• Reduces urban heat island effect	• Beautifies the hard-scape of buildings
• Lowers surface temperatures	• Attract new residents, families and tourism
• Reduce noise pollution	• Attract businesses and create jobs
• Indicator of ecological health	• Raise property value
• Improves air and water quality	• Strengthens social bonds

A Geographic Information Systems (GIS) analysis was completed by the Maryland-National Capital Park and Planning Commission staff to determine the amount of tree canopy (leaves, branches, and stems of trees that cover the ground when viewed from above) within the Bethesda Downtown Sector Plan boundary. The size of the Sector Plan is 451.51 acres, of which approximately 136 acres or 30 percent is in tree canopy cover. Twenty percent of the total canopy cover is within the residentially zoned areas with only 10 percent canopy cover in the commercially zoned core.

The Plan recommends three methods for increasing green areas and canopy cover in Commercial/Residential zones of Bethesda: expanding existing *parkland*; intensifying *tree canopy cover*; and increasing the number of *green roofs*.

Sector Plan Goals:

Increase overall urban green cover.

- Increase overall tree canopy cover.
- Expand green corridors by linking green streets, greenspace, and green roofs.
- Improve quality of life and quality of place
- Reduce heat island effect.
- Improve air quality and carbon sequestration capacity
- Improve ecological biodiversity

Green Corridors are areas of connecting habitat (tree cover or/and green space) enabling the movement of small animals, especially birds, from tree to tree, until they find a safe habitat to nest in. They provide unbroken habitat, food, shelter, nesting, and breeding areas

Sector Plan Recommendations:

The following recommendations are important to achieving the urban green goals of the Sector Plan:

- Supplement tree planting along streets and public space to achieve a minimum of 50 percent overall canopy cover.
- On private property, provide a minimum of 35 percent green cover, which may include either singularly or a combination of the following: (see page 16 for further detail)

    - Intensive green roof (6 inches or deeper) on 35 percent of rooftop*. (see page 20) detail)
    - Tree canopy cover on 35 percent of landscape.
    - A combination of tree canopy and intensive green roof for a total green cover of 35 percent or greater*.

  * If onsite energy generation requires the use of either the roof or open space, accommodations for these features may alter the 35% minimum green cover requirement.

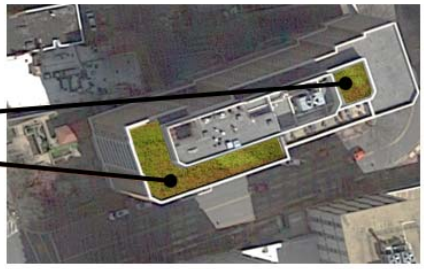
- Install green roofs with at least 6 inches of soil depth allowing for greater stormwater treatment, possible urban agriculture, and the growth of native perennials and grasses to improve habitat, food, shelter and other ecological benefits. (see page 20 for further detail)
- Provide soil volumes for canopy trees of no less than 600 cubic feet. (see pages 19-20 for further detail)
- Use appropriate plant species that will thrive in local site conditions and climate. Species should be a combination of native and locally adaptive species lessoning water demand while providing biological benefits.

The following recommendations should be incorporated into development projects wherever possible:

- Prioritize street tree planting along existing and proposed bicycle networks, expanding linear green corridors.
- Increase overall tree canopy cover and subcanopy cover by encouraging the planting of trees on public and private land, along rights-of-way, within open space and existing neighborhoods.
- Consider daylighting Bethesda Mainstem Tributary if purchased as public green space.
- When practical, incorporate vegetation into stormwater management facilities.
- Bury overhead wires underground to avoid conflict with street trees.
- Achieve an overall canopy cover with species diversity where no single genus comprises more than 20 percent of the total population of trees.
- Apply Sustainable Sites Initiative (SITES) principles on new construction projects.
- Maximize species diversity along the horizontal and vertical planting planes.

OPTIONS FOR 35 PERCENT GREEN COVER as recommended above on page 15

A. 35% green roof

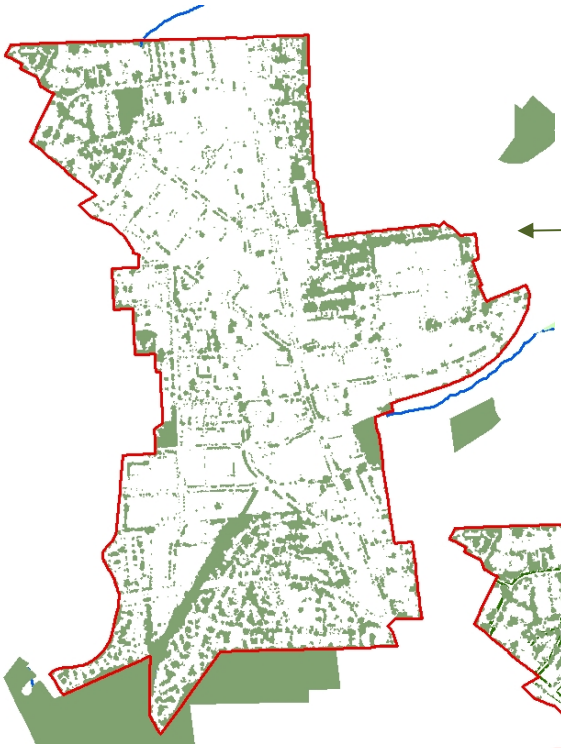


B. 35% canopy (tree) cover

C. 35% total green cover

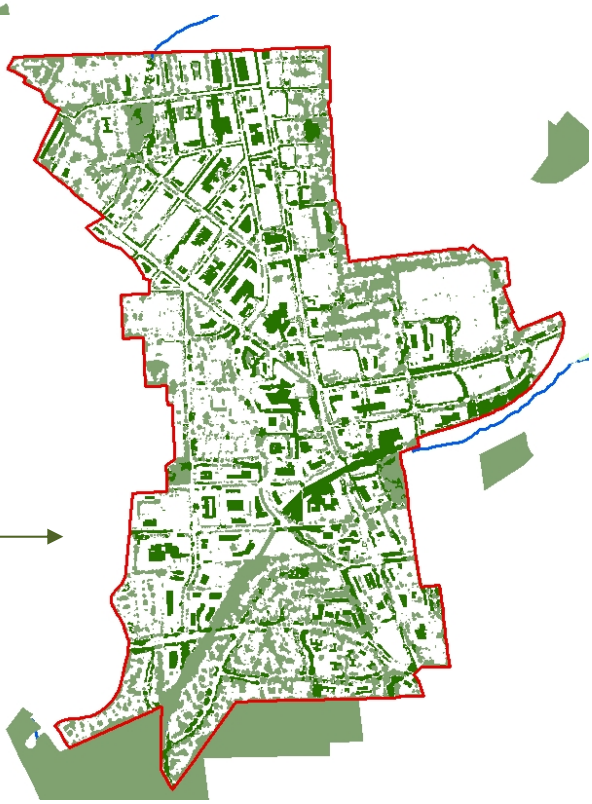
X % green roof + X % canopy cover = 35%

PROPOSED GREEN COVER RECOMMENDATIONS



Bethesda's Existing Tree Canopy Cover: 140Acres (approximately)

Existing Tree Canopy Cover + Proposed Street Tree Planting = 200 Acres (approximately)



Existing Tree Canopy Cover + Proposed Street Tree Planting + Green Cover = 240 Acres (approximately)

1.6.7 Benefits of Trees

Planting trees are a very simple, attainable means of reducing the effects of anthropomorphic impacts on the community. They provide a myriad of benefits that far exceed the cost for design, planting, and maintenance of the trees.

Economic Benefits:

- Large, mature street trees are found to be the most important indicator of attractiveness in a community[7].
- Businesses on tree-scaped streets show 12% higher income streams, which is often the essential competitive edge needed for main street store success[8].
- Shoppers are attracted to and linger longer on tree-lined streets — that means more sales and profits.
- Trees add as much as 20% value to property.
- Strategically placed trees can cut summer air conditioning costs for businesses by as much as 50 percent or more.
- Rental rates of commercial office properties were approximately 7% higher on sites having quality landscape, including trees.
- Office workers with a view of nature are more productive, report fewer illnesses, and have higher job satisfaction.
- Tree planting and green roofs creates local job opportunities.

Traffic Calming:

- The presence of trees reduces the speed of drivers, and reduces the frequency and severity of crashes. Speed differentials are noted from 3 mph to 15 mph.

Air Quality/Pollution Reduction

- Trees help to clean the air by trapping airborne pollutants such as ozone, nitrogen oxides, sulfur dioxides, carbon monoxide, carbon dioxide, and small particulates less than 10 microns in size. A mature tree can absorb 120-240 lbs of particulate pollution each year.
- Trees can filter up to 60% of pollution particulates.
- Green roofs trap greenhouse gasses, airborne particulates, and reduce smog cooling and filtering the commutes air and temperature.
- Each year an average acre of mature trees absorbs up to 26 pounds of carbon dioxide from the air, which is equal to the amount of Co_2 produced by driving a car 26,000 miles.
- Trees release oxygen as a product of photosynthesis. Two medium-sized, healthy trees can supply the oxygen required for a single person for a year.

Water Quality/Erosion

- For every 5% of tree cover added to a community, storm water runoff is reduced by approximately 2%.
- Trees reduce soil erosion when planted along streams and waterways.
- Trees can intercept between 7 percent and 22 percent of storm water runoff from impermeable surfaces.

[7] Georgia Urban Forestry Publication, Shade-*Healthy Trees, Healthy Cities, Healthy People,* 2004
[8] http://www.state.sc.us/forest/urbben.htm

Energy and Waste Savings

- Trees save energy by reducing energy used for cooling in the hotter months. They provide a windbreak during winter. This results in burning less fossil fuels to generate electricity for cooling and heating.

Reduce Crime, Increase Public Safety and Build Community

- A University of Illinois study finds that trees in urban areas are directly correlated with lower levels of fear, fewer incivilities, and less violent and aggressive behavior.[9]

Healing & Health

- A 2008 study by researchers at Columbia University found that more trees in urban neighborhoods correlate with a lower incidence of asthma.
- Hundreds of studies have indicated that trees help lower blood pressure, create a relaxed feeling and increased overall well-being.
- In urban areas with more street trees, people judge walking distances to be less, and are therefore more likely to travel on foot, which has health benefits.
- Trees can make the wait for a bus feel shorter.
- Street trees and sidewalk gardens build neighborhood and civic pride.
- Trees can provide protection against skin cancer by reducing UV-B exposure (the most damaging type of solar radiation) by about half, according to a study by Richard Grant, Purdue University; and Gordon Heisler, USDA Forest Service.
- Exposure to even small amounts of trees and grass aids concentration, leading to greater effectiveness [ibid]
- Reduced air pollution from the presence of trees helps to ameliorate respiratory problems, such as asthma—the leading serious chronic illness among children.
- Urban greening is an easy and effective strategy for beautifying the built environment and increasing the amount of space that can be utilized by citizens and wildlife.

Habitat

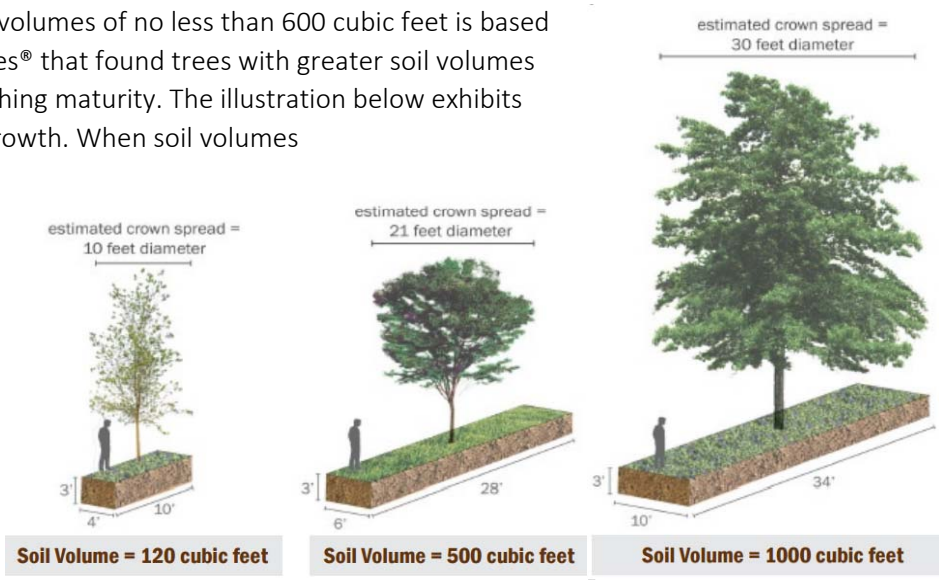
- Street trees provide food, shelter and nesting for birds, insects, and mammals.
- Urban habitats can act as reservoirs for endangered species. (Howenstine, 1993)

1.6.8 Soil Volume

There is competition for space in urban areas. Sidewalks, buildings, roadways, bicycle lanes, stormwater management, trees, and landscaping all require land; all are of importance. Landscape panels and planting beds are an integrated element of a community but often they do not contain enough soil volume to support the growth and long-term health of mature trees. Roots are vital to the survival of trees and need enough soil to support expansion and survival.

[9] Kuo, *F.E. 2001, "Environment and Crime in the Inner City: Does Vegetation Reduce Crime?" Environment and Behavior, Volume 33, Number), pp 343-367.---www.herluiuc.edu*

The recommendation for soil volumes of no less than 600 cubic feet is based on a study done by Casey Trees® that found trees with greater soil volumes have a greater chance of reaching maturity. The illustration below exhibits the best conditions for tree growth. When soil volumes are 500 cubic feet or greater, tree canopies can reach 20 feet or more. The minimum of 600 cubic feet is the base, exceeding 600 cubic feet is highly suggested.



Graphic provided by Casey Trees: "Tree Space Design: Growing the Tree Out of the Box. 2008. Casey Trees

1.6.9 Green Roofs

Rooftops count for much of a city's impervious cover, contribute to heat island effect, create ecological dead zones, and are most often blocked off from human use. The same footprint can instead become an opportunity to cool downtown, provide passive recreation, provide space for renewable technology, deliver stormwater management, and provide habitat for plants, birds, bees, and a host of other essential species. Green roofs can also act as habitat connectors linking trees, parks, and other greenspaces to widen green corridors beyond tree-lined streets and parks.

The recommendation for 35 percent of a roof to be a green roof with a depth of at least 6-inches (extensive roof) allows for new opportunities with immensely positive effects for humans and the environment. Outlined below are many benefits provided by green roofs.

Noise Attenuation

- Green roofs have excellent noise attenuation. An intensive (> 4") roof can reduce sound by 46-50 decibels (Peck et al. 1999).

New Amenity Space

- Green roofs create new open space opportunities in what would otherwise be unusable or uncomfortable space.
- Green roofs advance smart growth principles and positively affect the urban environment by increasing amenity and green space. Green roofs can serve a number of functions and uses, including:
    - Community gardens (e.g. residential and local food production): Using green roofs as the site for an urban agriculture project can create urban businesses, improve access to fresh foods, and reduce a community's urban footprint through the creation of a local food system
    - Commercial space (e.g. display areas and restaurant terraces)
    - Recreational space (e.g. lawn bowling and children's playgrounds)
- Green roofs are able to cool downtowns during hot summer months and reduce Heat Island Effect. Instead of the sun hitting an impervious surface and radiating heat into the surrounding downtown, the vegetation on a green roof absorbs the sunlight and cools the surface and surrounding air.

- With green roofs, water is stored by the substrate soils and utilized by the plants serving as a stormwater management facility. The deeper the soil medium, the greater the amount of stormwater that can be treated. For example, a roof with 5-7.9 inches of soil depth can hold up to 5.9 inches of water.
- Green roofs can moderate the temperature of the water.
- Green roofs can contribute to landfill diversion by: prolonging the life of waterproofing membranes, reducing associated waste; the use of recycled materials in the growing medium; and prolonging the service life of heating, ventilation, and HVAC systems through decreased need for use.
- The risk posed by electromagnetic radiation (from wireless devices and mobile communication) to human health is still a question for debate. Nevertheless, green roofs are capable of reducing electromagnetic radiation penetration by 99.4% (Herman 2003).

Stormwater Management

- Reduce the amount of stormwater runoff and delay the time at which runoff occurs, resulting in decreased stress on sewer systems at peak flow periods.
- Water is stored by the substrate and then taken up by the plants from where it is returned to the atmosphere through transpiration and evaporation.
- In summer, depending on the plants and depth of growing medium, green roofs retain 70-90% of the precipitation that falls on them; in winter they retain between 25-40%.
- Green roofs not only retain rainwater, but also moderate the temperature of the water and act as natural filters for any of the water that happens to run off.
- Green roofs reduce the amount of stormwater runoff and also delay the time at which runoff occurs, resulting in decreased stress on sewer systems at peak flow periods.

Moderate Urban Heat Island Effect (UHI)

- Through the daily dew and evaporation cycle, plants on vertical and horizontal surfaces are able to cool cities during hot summer months and reduce the Urban Heat Island (UHI) effect. The light absorbed by vegetation would otherwise be converted into heat energy.
- Green roofs can also help reduce the distribution of dust and particulate matter throughout the city, as well as the production of smog. This can play a role in reducing greenhouse gas emissions and adapting urban areas to a future climate with warmer summers.

Improved Air Quality

- Plants on green roofs can capture airborne pollutants and atmospheric deposition.
- Plants filter noxious gases
- Green roofs can moderate temperatures and reduce demand on power plants, and potentially decrease the amount of CO2 and other polluting by-products being released into the air.

Owner Benefits

- Additional compliance with MS4 stormwater requirements
- Reduces heating/cooling costs
- Tax incentives
- LEED Credits
- Last 2x longer
- Increased property value
- Great marketing
- May increase sales value

- Lower employee and tenant turnover

Green Roof Examples

Outdoor sitting and observation area

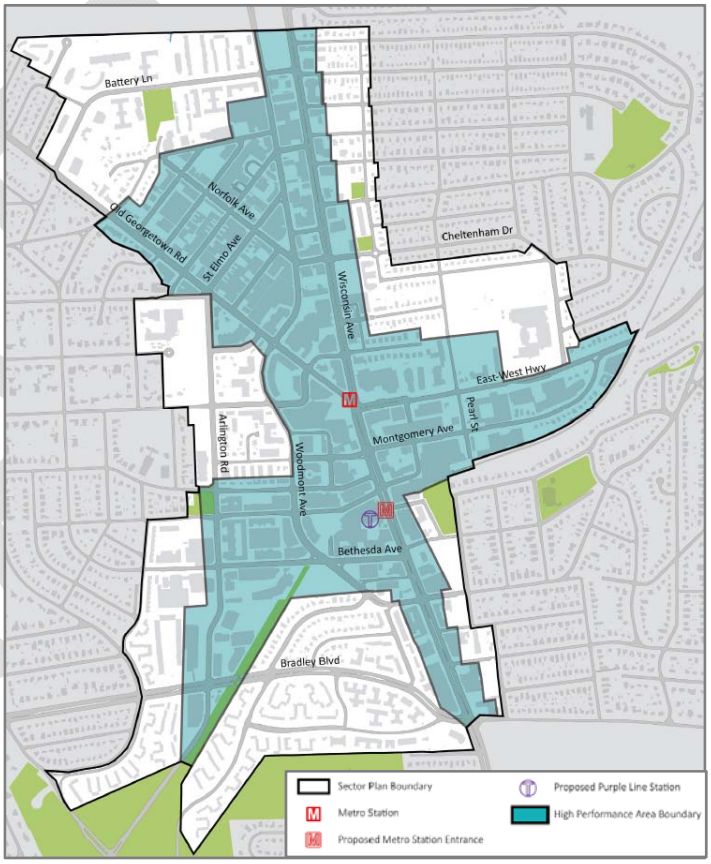
Outdoor gathering and play area

Creative habitat and educational area

ENERGY

1.7 High Performance Area

Buildings contribute 65 percent of the greenhouse gas in Montgomery County. Reducing greenhouse gas is essential in curbing climate change. In an effort to address climate change and make Bethesda more sustainable, the Plan proposes the concept of a High Performance Area (HPA). The High Performance Area (HPA) is a geographic area and instrument to accelerate sustainability in two of Bethesda's most underachieving performance areas: Equity (Section 2.2.3) and Energy (Section 2.5). The concept is to reward developers who exceed county minimum requirements for energy efficient buildings and affordable housing. Through energy efficiencies, renewable energy systems, and even district energy, not only can we lower energy consumption, but also create jobs and economic opportunities in the community. The HPA will also fill in the gaps in the underachieving performance areas of energy and affordable housing but will support innovation, and a 21st Century energy and climate conscious lifestyle. In turn, this will attract new businesses, residents, and renew community pride.



The High Performance Area will also help meet the County's climate objectives for reducing carbon emissions, greenhouse gases[10], energy demand, and make transit-oriented development even smarter by providing greater density with the lowest ecological impact. By addressing the performance area of energy, the Sector Plan advances comprehensive and holistic sustainable planning in the County's densest urban community.

The development of the High Performance Area is also in response to community feedback, the County's greenhouse gas reduction initiative, widespread new sustainable planning initiatives, and growing market demand for sustainable development and living that includes healthy places to live, work and play. Undertaking green development projects demonstrates a commitment to quality, permanence, and stewardship that improves an owner's or a developer's reputation in the community and in the industry as a whole. Those involved with sustainability are viewed as innovators, exemplars, and leaders in their

[10] Montgomery County Climate Protection Plan, 2009

fields and good people to do business with in the future. In his Site Planning and Design Handbook, Thomas Russ writes that "buildings once reflected an elegance of design, a thoughtful construction based on awareness of the environment. Buildings in this tradition were active working machines."[11] Green development is "active" building that it reminds us of our connection to a world larger than ourselves, a world to be inherited by our children. Our responsibility today is to create and maintain sound environmental, social, and fiscal legacies. The practice of sustainable, green development is the crucial pillar of that responsibility.

Sector Plan Recommendation

The High Performance Area aims to raise the level of sustainability by incentivizing the construction of buildings that exceed the minimum energy performance requirements.

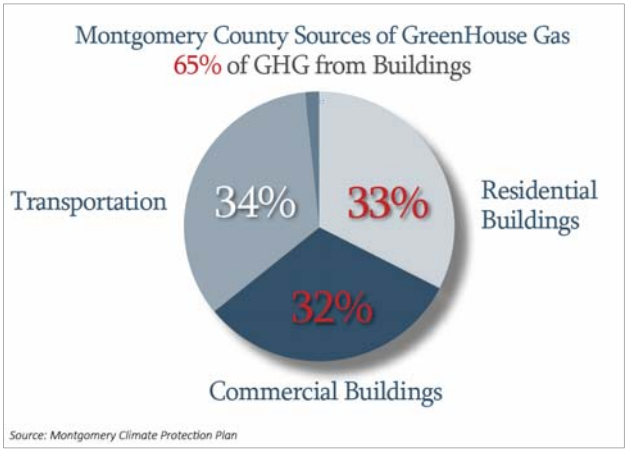
- An optional method building over 4 stories must exceed the current existing ASHRAE 90.1* requirement by at least 15 percent.
- Should the County approve the International Green Construction Code (IgCC), building energy performance must rank two points lower (more efficient) than the Zero Energy Performance Index (zEPI) score listed in the most recent International Green Building Code (IGCC) as locally amended.

*Note: The percent reductions for buildings below ASHRAE and the IGCC was developed with the assistance of the Institute for Market Transformation; Montgomery County USGBC chapter; the New Buildings Institute, Montgomery County Department of Energy; Metropolitan Council of Government; and the American Council for an Energy-Efficient Economy.

This 'stretch code' rewards developers who build for the benefit of the community and its residents elevating public relations and public good, lowering operating costs, saving energy, and attracting tenants.

1.8 High Performance Area Rationale

In Montgomery County, four sectors contribute to greenhouse gas emissions (GHG): *transportation* (34 percent), commercial building (32 percent), residential *buildings* (33 percent) and *solid waste management* (1 percent). Reducing GHG in the county requires an aggressive program to decrease the energy demands in each sector source. To address buildings, Montgomery County now requires all buildings 10,000 square feet or larger to meet Leadership in Energy and Environmental Design (LEED) Silver certification. LEED is an exceptional model for environmentally responsible construction, however it does not ensure high efficiencies in energy performance and often LEED Certified, Silver, and even Gold buildings have hefty energy demands that contributing to greenhouse gas emissions, and the loss of non-renewable resources.



[11] Russ, Thomas, Site Planning and Design Handbook, 2009, Second Edition, Chapter 3

While the County is making headway towards the purchasing of clean energy, 47 percent of the energy used in Montgomery County buildings are heated and cooled using coal and other fossil fuels[12]. The byproduct of coal combustion is carbon dioxide (CO2), the leading source of climate change. Reducing demands for coal and other nonrenewable resources will directly reduce greenhouse gases.

Increasing building efficiencies is part of the equation to address climate change and energy demands. Presently, all buildings except for low-rise residential buildings must meet minimum requirements for energy efficient designs called American Society of Heating, Refrigerating, and Air-Conditioning Engineers, or ASHRAE Standard (90.1). This is a national standard that continues to evolve and move towards greater energy efficiencies every few years (2004, 2007, 2010, and 2013). Although strict in application, technology is advancing quicker than the standards. In an effort to curb energy demand further, Montgomery County is on the verge of approving the International Green Construction Code, or IgCC. This is the first model code to include sustainability measures for the entire construction project and its site — from design through construction, certificate of occupancy and beyond. The new code is expected to make buildings more efficient, reduce waste, and have a positive impact on health, safety and community welfare. If approved, this is a progressive County effort. Nevertheless, existing technology, economic returns and regional competition allow for even greater building efficiencies. Providing incentives to developers that exceed minimum standards continues to advance technology while keeping Bethesda cutting edge.

1.9 Montgomery County's Carbon Reduction Goals

Curtailing greenhouse gas is not easy. It takes multiple agency initiatives, legislation, and intention as well as a combined effort of all sectors of government to participate in this difficult endeavor. Montgomery County Government has adopted many new programs and passed legislation with the intention of curbing greenhouse gas and climate change. The County's Climate Protection Plan[13] (CPP) (2009) requires the county to stop increasing Countywide GHG emissions by 2010 and achieve a 10% reduction every 5 years through 2050. However, in March of 2015, the Montgomery County Department of Environmental Protection published their annual report on CPP and determined that "the County is not on track to meet the goals established in the CPP". This is not surprising as population growth and energy demand for technology and resources continues to rise. No one agency or entity can tackle greenhouse gas reduction and climate change. The M-NCPPC ("Commission") can strengthen their role in assisting in this effort. It can expand beyond its present capacity as directed in County Bill (34-07) which requires the Commission to make recommendations for carbon emissions reductions in master plans. It also has the directive to further consider and curb energy as directed in the Approved and Adopted General Plan Refinement of the Goals and Objectives for Montgomery County (1993) which identifies the Commission as an agency to "Promote the efficient use of energy and plan for the County's long-term energy needs". It also states that the Commission must "Consider energy conservation practices during master plan, subdivision, site

[12] http://www.rockvillemd.gov/DocumentCenter/View/204

[13] https://www.montgomerycountymd.gov/DEP/Resources/Files/ReportsandPublications/Sustainability/Working%20Group/Climate-Protection-Plan-Sustainable-Working-Group-09.pdf

plan, and the mandatory referral review". These are prominent and supportive charges for Bethesda's High Performance Area.

High Performance Area Implementation

The High Performance Area will be implemented through the public benefits package in the Commercial/ Residential and Employment Zones for optional method of development. Early in the development review process, at the time of the Sketch or Preliminary Site Plan, if the developer desires maximum density, the commitment to reaching the goals of the High Performance Area will be met.

1.10 Energy Reduction Goals

- Improve building energy efficiency and reduce energy demand.
- Reduce vehicle miles traveled.

Sector Plan Recommendations:

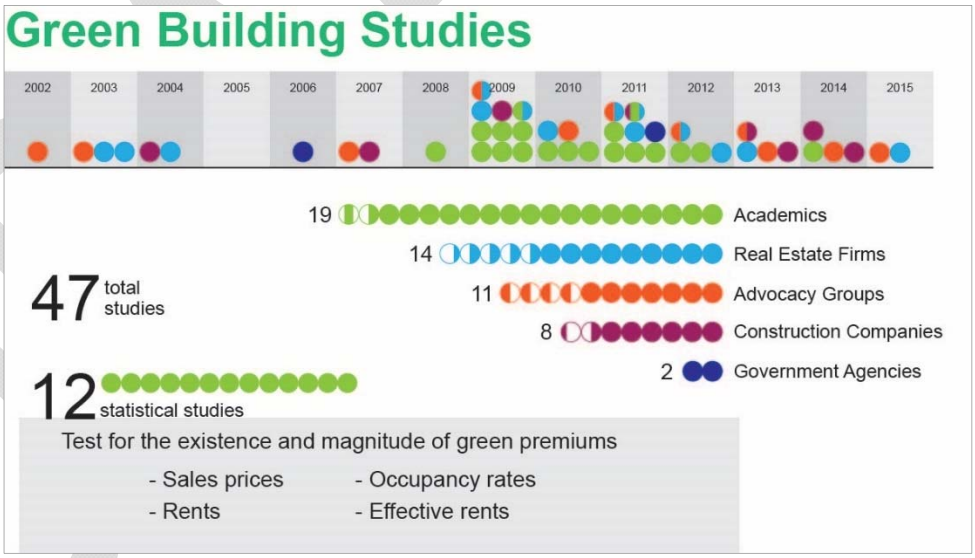
- In the High Performance Area, buildings must meet the public benefits category for CR Energy Conservation and Generation 59-C-15.856 (b). An optional method building over 4 stories must exceed the current existing ASHRAE 90.1 requirement by at least 15 percent. Should the County approve the International Green Construction Code (IgCC), building energy performance must rank two points lower (more efficient) than the adopted standard in order to achieve the maximum allowable density for the zoned property.
- Utilize "whole building design" approach to new construction, considering the interactions of all building components, building envelope and systems to create a more comfortable building that saves energy and reduces environmental impacts.
- Reduce heating, cooling and lighting loads through climate-responsive design and conservation practices.
    - Design building massing that maximizes natural ventilation, air flow and access to natural lighting.
    - Use high-performance building envelopes; select walls, roofs and other assemblies based on long-term insulation, air barrier performance and durability requirements.
    - Install light-emitting diodes (LED) lighting throughout buildings.
    - Use Energy Star-approved and/or Federal Energy Management Program (FEMP) designated energy-efficient products that meet or exceed U.S. Department of Energy Standards.
- Maximize use of alternative energy systems to supply a portion or all of a building's energy demand. Some alternative energy systems may include:
    - Solar power.
    - Geothermal.
    - Co-generation.
    - Biomass and biogas strategies.

    - Purchase electricity generated from renewable sources or low polluting sources.
- Maximize solar orientation and design techniques that take advantage of passive solar heating, cooling and lighting.
- Design buildings with operable windows for cross-ventilation.
- Utilize green roofs to reduce heating and cooling demand.
- Utilize low albedo surfaces to diffuse reflectivity, reducing heat island effect.
- Consider zero energy concepts.
- Exceed County requirements for minimum LEED certification or its equivalent standards.
- Utilize district energy (central heating/cooling) if two or more buildings are being constructed adjacent to each other.

1.11 Green Economics

As part of the research to investigate the economic costs and benefits of green buildings, over 40 different studies were reviewed. These studies were conducted by a number of different entities, including construction companies, real estate firms, non-profits, academics and government agencies. The sources for the studies reviewed as part of this research are shown below.

The focus of the research was on 12 statistical studies that investigate the effect that green building certification has on *sales prices, rents, occupancy rates, and effective rents*. When green certification has a positive effect on these measures, we call the added value resulting from green certification a *green premium*.



The conclusion from these 12 statistical studies is that green premiums do exist for sales prices, rents, occupancy rates, and effective rents, and therefore that green buildings generate higher revenue than their uncertified counterparts.

Sales Prices

Nine different economics papers, published between 2009 and 2012, tested for the existence of a green premium on property sales prices. Two papers tested for this premium using samples of single-family homes, while seven used data from commercial office properties. Sample sizes range, but the best studies of commercial office properties looked at 6,000-7,000 properties. All studies decisively concluded

that a green premium exists for property sales prices. Findings for the magnitude of this green premium vary, and are shown in table below.

SALES PRICE FINDINGS					
SINGLE-FAMILY RESIDENTIAL		**AUTHORS**	**SAMPLE SIZE**	**R-SQUARED**	**FINDING**
2012	The Value of Green Labels in the California Housing Market	Nils Kok and Matthew E. Kahn	1,609,879	0.864	**9.00%**
2012	The Value of "Green": Evidence from the First Mandatory Green Building Program	Ramya Rajajagadeesan Aroul and J. Andrew Hansz	14,055	0.780	**2.25%**
				AVERAGE OF SINGLE-FAMILY RESIDENTIAL FINDINGS =	**5.63%**
COMMERCIAL OFFICE					
2011	The Economics of Green Building	Piet Eichholtz, Nils Kok and John Quigley	5,993	0.616	**13.00%**
2011	Green Noise or Green Value?	Franz Fuerst and Pat McAllister	6,156	0.420	**30.00%**
2010	Sustainability and the Dynamics of Green Building	Piet Eichholtz, Nils Kok and John Quigley	5,993	0.616	**13.30%**
2009	Income, Value and Returns in Socially Responsible Office Properties	Gary Pivo and Jeffrey D. Fisher	7,647	0.594	**8.50%**
2009	Doing Well by Doing Good	Piet Eichholtz, Nils Kok and John Quigley	1,816	0.340	**16.50%**
2009	Does Green Pay Off?	Norm Miller, Jay Spivey and Andy Florance	927	0.468	**7.85%**
2009	New Evidence on the Green Building Rent and Price Premium	Franz Fuerst and Pat McAllister	6,158	0.420	**36.00%**
				AVERAGE OF COMMERCIAL OFFICE FINDINGS =	**17.88%**
				AVERAGE OF ALL FINDINGS =	**15.16%**

The two papers looking at green premiums in the single-family housing market provide robust and conclusive evidence that green premiums exist for single-family homes. Seven studies investigating the green premium on commercial office space found premiums ranging from 7.85% to 36%. The most significant findings for the magnitude of this green sales price premium were 8.5%, 13%, and 13.3%.

Rent Premiums

The research included 8 different papers studying the existence and value of green rent premiums. Seven of these papers studied green rent premiums for commercial office space. The remaining study looked at the green rent premiums for multifamily residential properties. All studies found a green rent premium to exist with findings ranging from 1.8% to 12.11%.

The studies of commercial office properties provide significant and substantial evidence for the existence of green rent premiums. The average of all findings indicates a roughly 5% green rent premium, although the two most significant results are on the lower end of the spectrum with estimates of 1.8% and 2.6%. These numbers may seem low, but rent premiums, unlike sales premiums, compound over time, providing additional revenue every time rent is paid. As a result, even a 2% rent premium significantly increases a rental property's profitability now and into the future.

RENT PREMIUM NUMBERS					
MULTIFAMILY RESIDENTIAL		AUTHORS	SAMPLE SIZE	R-SQUARED	FINDING
2014	Certification Matters: Is Green Talk Cheap Talk?	Shaun A. Bond and Avis Devine	1,544	0.840	**7.60%**
COMMERCIAL OFFICE					
2011	Green Noise or Green Value?	Franz Fuerst and Pat McAllister	18,519	0.620	**5.00%**
2011	The Economics of Green Building	Piet Eichholtz, Nils Kok and John Quigley	20,801	0.816	**2.60%**
2010	Sustainability and the Dynamics of Green Building	Piet Eichholtz, Nils Kok and John Quigley	20,801	0.817	**1.80%**
2010	Green Design and the Market for Commercial Office Space	Jonathan A. Wiley, Justin D. Benefield and Ken H. Johnson	7,308	0.600	**12.11%**
2009	Doing Well by Doing Good	Piet Eichholtz, Nils Kok and John Quigley	8,182	0.680	**3.00%**
2009	Income, Value and Returns in Socially Responsible Office Properties	Gary Pivo and Jeffrey D. Fisher	7,627	?	**5.20%**
2009	New Evidence on the Green Building Rent and Price Premium	Franz Fuerst and Pat McAllister	6,158	0.610	**6.00%**
				AVERAGE OF COMMERCIAL OFFICE FINDINGS =	**5.10%**
				AVERAGE OF ALL FINDINGS =	**5.41%**

Occupancy Premium and Effective Rent Premium

Sales price and rent premiums are the most thoroughly and statistically investigated benefits of green buildings. However, in addition to prices and rents, occupancy rate can be a useful and meaningful metric for evaluating the profitability of a building, by measuring the percentage of units that are occupied and therefore paying rent. This research includes six papers: three papers that studied occupancy rates in isolation; and three papers that studied the combined effect on occupancy rates and rents.

Another three papers looked at the effect of green certification on occupancy rates. The findings of these papers are shown in table below. Scholarly articles on this topic is less robust than estimates of sales price and rent premiums. However, there is still significant evidence that an occupancy premium does exist, and the findings of these three studies give a sense of roughly what magnitude that premium might have.

OCCUPANCY PREMIUM NUMBERS					
COMMERCIAL OFFICE		**AUTHORS**	**SAMPLE SIZE**	**R-SQUARED**	**FINDING**
2010	Green Design and the Market for Commercial Office Space	Jonathan A. Wiley, Justin D. Benefield and Ken H. Johnson	7,308	0.460	**13.83%**
2009	Income, Value and Returns in Socially Responsible Office Properties	Gary Pivo and Jeffrey D. Fisher	1,199	?	**1.30%**
2009	An Investigation of the Effect of Eco-Labeling on Office Occupancy Rates	Franz Fuerst and Pat McAllister	24,283	0.280	**5.29%**
				AVERAGE OF ALL FINDINGS =	**6.81%**

Effective rent is an aggregate of rent and occupancy rate. More specifically, effective rent is rent multiplied by occupancy rate. This serves as a useful measure, as rather than quantifying rent premiums and occupancy rate premiums individually, the effective rent premium measures the combined effect of the two. Thus, the effective rent premium is our most accurate and comprehensive measure of the additional rental revenue generated by properties that have been green-certified. Only one group of

authors tested for an effective rent premium: Piet Eichholtz, Nils Kok and John Quigley. They found a significant green premium, and estimates of the magnitude range from 4.7% to 7.6%.

EFFECTIVE RENT PREMIUM NUMBERS					
COMMERCIAL OFFICE		AUTHORS	SAMPLE SIZE	R-SQUARED	FINDING
2011	The Economics of Green Building	Piet Eichholtz, Nils Kok and John Quigley	20,801	0.709	**7.60%**
2010	Sustainability and the Dynamics of Green Building	Piet Eichholtz, Nils Kok and John Quigley	20,801	0.710	**4.70%**
2009	Doing Well by Doing Good	Piet Eichholtz, Nils Kok and John Quigley	5,993	0.410	**6.40%**
				AVERAGE OF ALL FINDINGS =	**6.23%**

Construction Costs

As discussed above, there are significant market advantages associated with green properties, namely their ability to generate higher levels of revenue through higher rents, sales prices, and occupancy. But there is also an additional cost associated with constructing a green building, and until relatively recently, this upfront cost appeared to outweigh the benefits of green buildings in most cases. Recent research provides evidence that this upfront additional cost of building green is often exaggerated. Many different entities, from real estate firms to construction companies to non-profits, have done their own studies on the additional construction cost of building green supporting the claim that green building is less than two percent more expensive than non-green building.

Studies of the additional cost of building green are less data-driven than those looking at green premiums, due mostly to the lack of public data on things like construction costs. Instead, these studies rely on industry professionals with green building experience, relatively small samples of green construction projects, and survey responses from the building community. Regression analysis was not conducted for the datasets available, and therefore we cannot speak conclusively about the statistical significance of any of these findings. Nonetheless, a number of different scholars have independently determined that the additional cost of green construction is no more than 5%, and a majority of scholars agree that green construction, when done right, can cost less than 2% extra. In fact, the study with the largest sample size, conducted by Davis Langdon Construction, found that there was no difference between construction costs for green buildings and construction costs for non-green buildings. All of these studies looked at the additional cost of building a LEED-certified building, and there were no studies that looked at the costs of Energy Star buildings.

Perhaps more important than the precise value of the green construction premium is its value relative to the expectations of the construction industry. The research on green construction premiums is decisive in asserting that the additional cost of building green is "not as high as is perceived by the development industry."[14] In fact, the same study suggests that additional costs can be avoided altogether when green strategies are considered early in the design process.

Energy Savings

The last and perhaps most vital benefit of green buildings are energy and financial savings created through enhanced energy efficiency. These energy savings help owners and developers quickly recoup

[14] "The Business Case for Green Building" by the World Green Building Council

their initial investments in building green, and often make occupying green buildings more affordable thanks to lower energy bills. Five different studies of energy savings in green buildings found energy savings ranging from 12.9% to 35%. There is also anecdotal evidence of companies and organizations profiting in the long term by increasing their energy efficiency, with an exemplary local example being the Tower Companies. This evidence is backed by one survey that found that 70% of building professionals cite lower operating costs as the greatest benefit of green building.[15]

Payback Periods

Using research on green premiums, green construction costs, and energy savings, a statistical model was created to calculate how long it takes for the initial investment in building green to be paid off by the benefits of green premiums and energy savings.

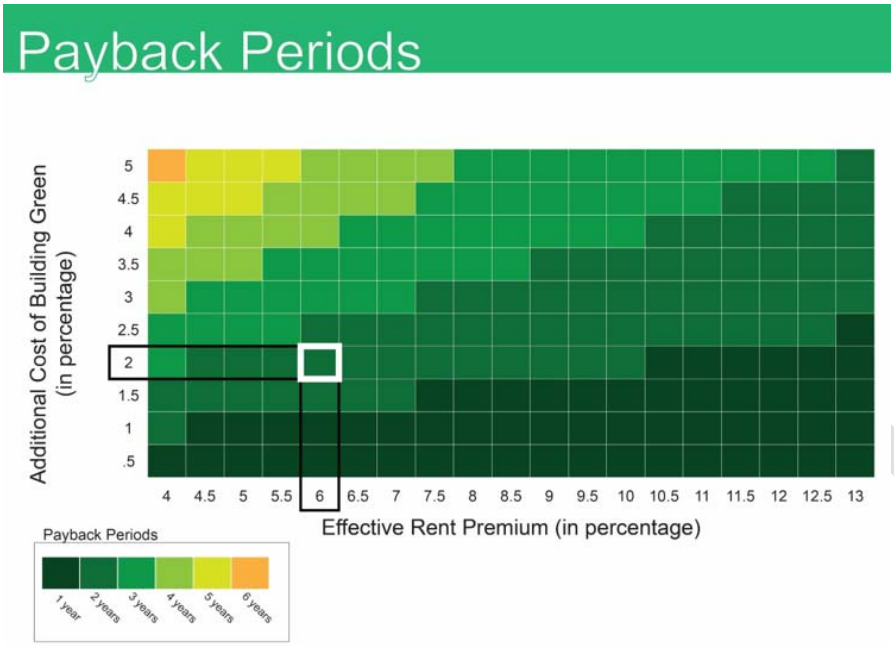
These calculations necessarily included a number of assumptions. Most of these assumptions were held constant, while two, construction premium and effective rent premium, served as independent variables and changed in order to simulate different scenarios.

Green Assumptions	**Value**
Construction Premium* (Y-axis)	Average: 2% Range: 0.5% - 5.0%
Effective Rent Premium* (X-axis)	Average: 6% Range: 4.0% - 13%
Energy Savings	15%
Building Parameters	
Construction Cost per sq. ft.	$165
Operating Cost Assumptions	
Cleaning per sq. ft.	$1.47
Repairs/Maintenance per sq. ft.	$2.09
Utilities per sq. ft.	$2.70
Roads/Grounds per sq. ft.	$0.29
Security per sq. ft.	$1.26
Administration per sq. ft.	$1.45
Fixed per sq. ft.	$4.20
Market Assumptions	
Rent per sq. ft.	$35.00
Occupancy Rate	88.1%
Discount Rate	5%

*Independent variable

[15] "World Green Building Trends 2016" by Dodge Data & Analytics

The chart below shows how long the green construction investment takes to be paid back for different combinations of construction premiums and rent premiums.



Summary

There is statistical evidence supporting the notion that green buildings generate higher revenue than non-green buildings in a number of ways. Findings indicate they generate higher rents, sales prices, occupancy rates, and effective rents above non-green buildings. The findings demonstrate that green premiums do exist for these metrics, which speaks to the marketing power of green certification.

Second, the upfront cost of building a green building is often presumed too prohibitive with distant and low financial benefits. However, the findings indicate that green buildings may be constructed at 2% additional construction cost or less, and sometimes, if considered at the onset, there may be no additional costs. The numbers also indicate that payback begins on average, within the second year and continues for the life of the building.

Lastly, the energy savings created by more efficient green buildings lead to lower utility bills, lower operating costs, and better profit margins for green developers and tenants.

Overall, this research supports the claim that green buildings are good business investments, and that the additional profitability of green buildings outweighs the additional upfront cost of constructing them.

CARBON FOOTPRINT ANALYSIS RESULTS

1.12 Findings:

Embodied emissions contributions to total greenhouse gas emissions will increase in part due to the demolition of existing structures rather than utilizing existing buildings. Embodied carbon emissions of a building are the carbon dioxide produced during the manufacture of materials, their transport and assembly on site. The proposed zoning will increase the building size and height and therefore demolition of older buildings with new construction is anticipated. This contributes to greater consolidation and urban density reducing sprawl and vehicle miles travelled. At the same time, a great deal of energy is needed for new construction material from around the globe contributing significantly to the total carbon footprint of buildings.

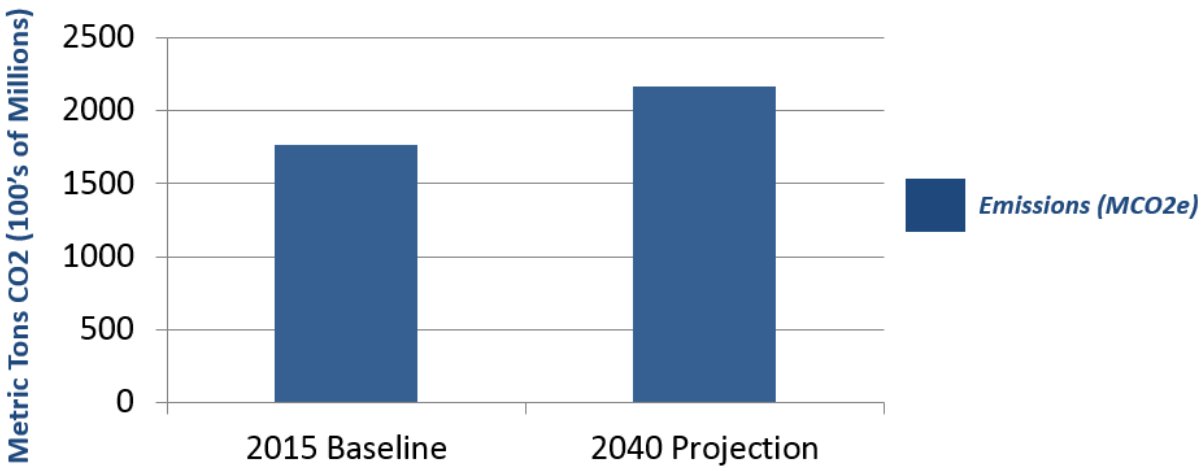
The projected population is expected to increase by 11,300 people, 5,300 households, and 14,200 jobs. Overall, the population is projected to double in size, yet total carbon emissions will only increase by approximately 23 percent (see chart following page "Projected Total Increase in Carbon Emissions"). This number does not factor in improvements in technology, building efficiencies, and the High Performance Area due to the uncertainty of the application and outcome, which assumes even greater carbon emission reduction possibilities. As data for building energy consumption, vehicle fuel efficiency, vehicle miles travelled, and other input parameters change, it may be possible to re-run the model used for this determination to see how design and technology improvements affect projected outcomes and reduce carbon emissions further.

Per capita, it is likely that emissions for vehicle miles travelled will significantly decrease. Projections indicate a 36 percent drop per capita which may improve local air quality, heat island effect, and health (see chart on following page "Projected Total Decrease in Vehicle Miles Travelled per Capita"). However, these benefits may be negated due to increases in population if energy demands from buildings and energy sources do not become more efficient and cleaner as indicated in the results above for overall total carbon reduction emissions. To comprehensively reduce carbon locally, buildings plus reduced vehicle miles travelled must continue to improve in energy efficiencies.

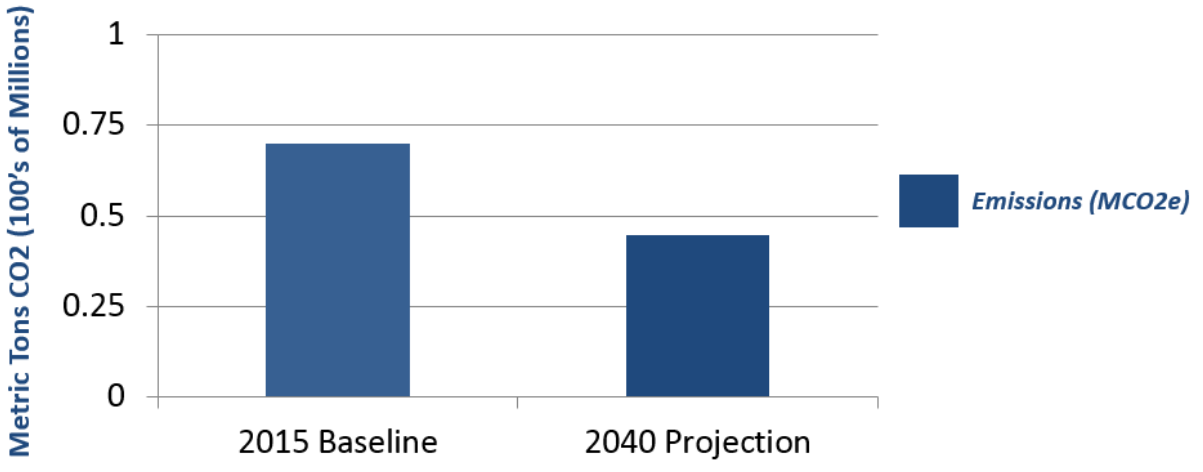
The results using the King County, WA carbon modeling methodology are shown below.

Year	Emissions	Metric Tons per Person/Travelled
	*MTCO2e**	*MTCO2e**
2005 (Baseline)	17,635,856	0.69
2040 (Projection)	21,687,635	0.45

Bethesda
Projected Total Increase in Carbon Emissions



Bethesda
Projected Total Decrease in Vehicle Miles Travelled per Capita



Methodology:

Montgomery County Bill number 34-07 requires the Planning Department to model the carbon footprint associated with its master plans, and to make recommendations for the reduction of carbon emissions. MNCPPC currently uses a greenhouse gas model developed by King County, Washington. The inputs are derived from national averages, and wherever possible we have substituted Montgomery County data obtained by the Planning Department's Research and Technology and the Transportation Division. The results are reported in terms of the equivalent effect of a given volume of carbon dioxide ("carbon dioxide equivalents").

To project total emissions for Bethesda, the spreadsheet model considered embodied energy emissions, building energy emissions, and transportation emissions. The model documentation defines embodied emissions as "emissions that are created through the extraction, processing, transportation, construction and disposal of building materials as well as emissions created through landscape disturbance (by both soil disturbance and changes in above ground biomass). Building energy emissions are created in the normal operation of a building including lighting, heating cooling and ventilation, operation of computers and appliances, etc. Transportation emissions are released by the operation of cars, trucks, buses, motorcycles, etc.

Inputs for Bethesda include the numbers and types of housing units and the square footage of different categories of retail, commercial, and public buildings. The model is run once using 2015 data to establish baseline results. The model is run again using housing units, and commercial and retail space projected to develop under the sector plan (2040) to estimate future greenhouse gas emissions. The model estimates emissions over the life of the development, and results are given in metric tons of CO2 equivalents. The actual outcome of the model is likely to be higher than the reality due to continuous changes in technology, energy efficiencies, and alternative energy sources.

To project total emissions for an area, the spreadsheet model considers embodied energy emissions, building energy emissions, and transportation emissions. The model documentation defines embodied emissions as "emissions that are created through the extraction, processing, transportation, construction and disposal of building materials as well as emissions created through landscape disturbance (by both soil disturbance and changes in above ground biomass). Building energy emissions are created in the normal operation of a building including lighting, heating cooling and ventilation, operation of computers and appliances, etc. Transportation emissions are released by the operation of cars, trucks, buses, motorcycles, etc.

This is different from the County Emissions Inventory prepared by the Montgomery County Department of Environmental Protection, which estimates annual emissions. The model only deals with emissions; no calculations are included to estimate potential carbon offsets from best management practices. The estimates also assume "business as usual" when projecting emissions.

LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN FOR NEIGHBORHOOD DEVELOPMENT (LEED-ND)

Recognizing that buildings are just one component of sustainability, the United States Green Building Council developed a rigorous audit and rating system to measure the overall sustainability of a community called LEED for Neighborhood Development (LEED ND). The rating system holistically quantifies all the elements that make a neighborhood sustainable. The most sustainable neighborhoods

exhibit high levels of walkability, a sense of place, social cohesion and stability amid changing economic and sociopolitical conditions, and address climate change, energy efficiencies, public health, affordable housing and transportation.

The U.S. Green Building Council (USGBC) conducted its first assessment for a master plan on the Draft Bethesda Downtown Plan using the LEED-ND rating system. The results of the scorecard analysis and final report identified where the Plan does and does not align with LEED ND v2009 criteria. The assessment identified very few barriers to sustainability as the Plan makes explicit references to a majority of LEED ND prerequisites. This credible third-party feedback also provided valuable insight into the gaps where elements of sustainability could be bolstered. Many suggestions were not germane to a master plan and fall within other review agencies. Other recommendations will be incorporated into the Plans Design Guidelines. This valuable assessment paves the way for future development projects in Downtown Bethesda to more readily achieve LEED-ND certification.

COMMUNITY WATER AND SEWER

This area is currently served with public water and sewer. No significant upgrades are needed to serve growth in the sector plan area. However, specific capacity evaluations will be performed by WSSC's Planning Group and Development Services Group when detailed information is provided as various parcels and properties are submitted for development review in the sector plan area. The extent of any impact to water and/or sewer system capacity, whether of a localized nature or requiring a capital improvement programmed (CIP) project, will be determined by WSSC. Any new development generating 100,000 or more gallons of sewer per day (approximately 700 units or 3500 employees) would be required to participate in system upgrades. Developments of this size are not expected in Bethesda.

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