Adaptation and Sustainability

Synopsis

The charge for this background report was to draw insight from what is now commonly referred as hazard adaptation within the context of sustainability principles for input into the development of the Nashville 2040 General Plan. This background report outlines a holistic approach to hazard adaptation, including using sustainability tools to better prepare for future risks. Inherent to sustainability is the concept of adding value and resiliency to a community. This requires a continuous improvement process focused on the quality of life in Davidson County that integrates: (1) equity (the shared needs and interests of people), (2) economy (value in jobs, profit making, and broader prosperity) and, (3) the environment (inherent resilience for life provided by the earth and its corresponding natural systems). This report emphasizes using risk management as a primary tool of adaptation due to a variety of threats that may compromise Nashville's future quality of life. In short, this background report outlines a compelling case for the city and its people to hasten prudent steps to adapt to growing hazards through a comprehensive approach using the concepts and practices of sustainability and adaptation to successfully meet future challenges. The summary table (table 1) compares Nashville's current initiatives to state-of-art standards to provide a benchmark of progress achieved and action that needs to be taken.

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Role and Purpose of Background Reports

This background report was developed to provide input to the NashvilleNext planning process. It was researched and authored by community members interested, involved, and knowledgeable on the topic. The authors present best practices, an evaluation of the state of the topic in the Nashville community today, and recommendations for consideration during the planning process.

This report provides a *starting point* for broader community discussion and reflection based on the research and recommendations of the authors. Throughout the planning process, NashvilleNext will use this and other background reports, ongoing research, departmental involvement, community input and engagement to discuss, refine and formulate the policies and recommendations for the general plan.

The information and recommendations provided in this background report are solely those of the authors and contributors and are being provided at the beginning of the NashvilleNext process to start community discussion.

The NashvilleNext Steering Committee thanks and extends its sincere appreciation to the authors of and contributors to this background report for the time and effort to provide this report for community consideration and discussion. The Steering Committee looks forward to the ongoing dialogue on the issues and recommendations that the authors provide.

Any final policies and recommendations endorsed by the NashvilleNext Steering Committee for the consideration of the Metropolitan Planning Commission will be the result of the entire planning process and upcoming community engagement and discussion.

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Introduction

The NashvilleNext planning process initiated several topical background reports to provide insight into the development of NashvilleNext. This particular background report focuses on hazard adaptation with emphasis on flood hazards, climate change hazards and community sustainability opportunities. The background report was asked to address three specific areas:

1. Examination of the national "**state of the art**" actions addressing the topic - presenting the best practices including metrics for measuring success.

2. Examination of Nashville's **current situation** with regard to the topic.

3. Presentation of **desired Nashville responses or actions** including concrete projects/programs, and recommendations for areas needing further study and conversation. It is also important to note what the information in this background report means in the context of NashvilleNext.

The purpose of a general plan is to establish policies that "show the planning commission's recommendations for the physical development of the area" (Department of Economic and Community Development, Local Planning Assistance Office, 2003).

Given the maturation of Nashville's planning functions in recent years, it is anticipated that NashvileNext will play a greater role as the comprehensive coordinating policy document for many of Metropolitan Nashville's public investments and management priorities. Most importantly, a general plan and corresponding sub-area plans provide a reasonable expectation of how and where the private sector should invest. Therefore, NashvilleNext and the information provided by this background report are offered as guides to the community to:

1. Minimize all foreseeable risks;
2. Maximum value, and
3. To establish reasonable expectations for individual and community investments.

Background

What is Adaptation and Sustainability and Why are They Interrelated?

A hazard is something causing unavoidable danger, peril, risk, or difficulty.

Whether the general public agrees or not in human induced climate change, one reality is inescapable. Nashville has experienced direct and indirect, unavoidable, record setting weather-related dangers, perils, risks, and difficulties in recent years.

Some of the more notable challenges of recent years are highlighted as follows.

- **The 2010 Flood resulted in:**
  - $2 billion in estimated damages to private property
  - Rainfall that exceeded 17 inches, highest in 140 years of recorded history
  - 13 inches of rain in 36 hours, more than doubling the previous two-day rainfall record set in 1979
  - 11 deaths
  - 2,773 impacted businesses with 14,499 workers
  - 12,903 Individual Assistance projects, totaling $87 million (City of Nashville, 2010).
  - 768 Public Assistance projects, totaling $53 million (City of Nashville, 2010).

- **Extreme Heat:**
  - The hottest day on record in Nashville in 141 years of record keeping (109 degrees, June 29, 2012)
  - Hot weather induced "demand of 31,099 megawatts for 8.7 million residents [just shy of a 33,482 megawatt record set in Aug. 16, 2007 -- before the economic downturn" (Sohn, 2012)].

- **Projected Changes in Tennessee's Prized-Landscape** (Sustainable Tennessee, 2012):
  - Climate change will initiate general changes such creating a warmer climate in Middle Tennessee more like that of Northern Alabama.
  - Changes in climate will bring about new introduction of diseases, changes in basic nutrient cycles and crop pollination. (Pg. 31-32).
  - Increases in average temperatures will create a result where a "forest once rich in species diversity may become dominated by only four

May 2010 Flood Devastation

Extreme Heat

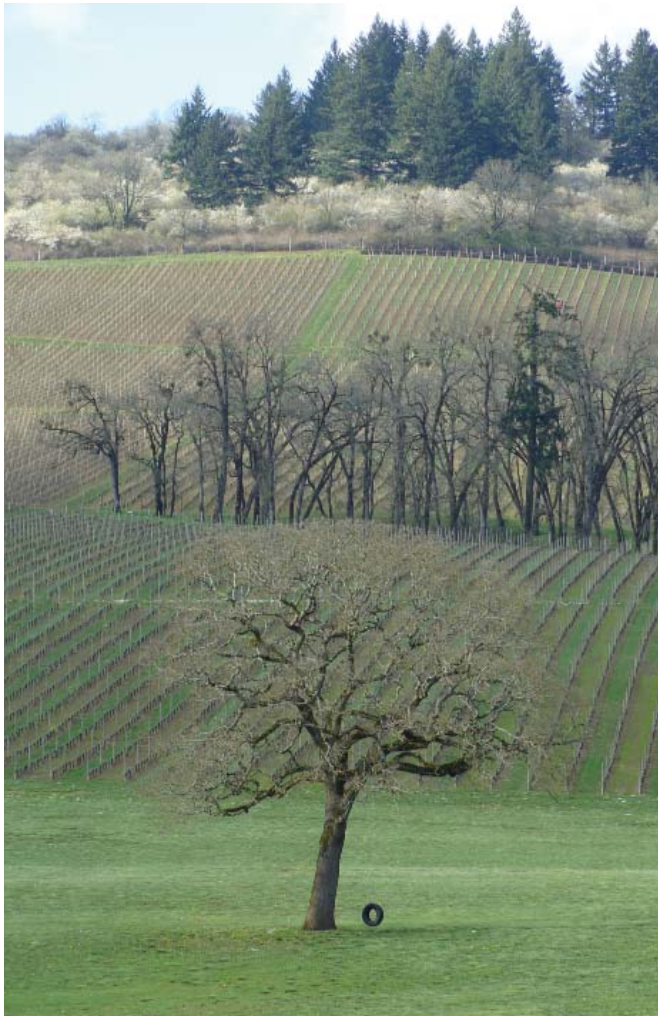
species (loblolly pine and three [species of] oaks)" due to increases in average temperature (pg. 33).
- Temperature increases will decrease stream flows and increase water temperature altering recreational waters (pg. 35-36).

Preparedness and response to floods and other hazards requires a multi-faceted approach. Adaptation and Sustainability is one component in mitigating the harmful effects of flooding. Flooding and flood preparedness is also discussed within the Environmental Resources background report and the Public Safety background report.

Adaptation simply means to take prudent steps to form or to modify to fit a changed environment

Adaptation, in the context of NashvilleNext's process of comprehensive community planning, can be implemented more effectively through a common policy vision. In this manner, the NashvilleNext planning effort becomes a tool of adaptation that forms or modifies the community so that it can adapt successfully to real and potential hazards.

Adaptation is simply a realistic and prudent approach that requires some reactive response(s) to known or realized experiences and ideally many proactive responses prioritized based on risk assessment. Proactive responses will help to attenuate or lessen the impact of growing threats that appear to be increasing in their intensity, impact and cost. Adaptation therefore means being prepared to prevent or minimize where possible and to absorb threats effectively by adding resiliency to the community.



A Clear and Present Challenge

Climate Change

Globally, carbon dioxide is the planet's most common warming gas. When carbon is stored underground in the form of coal, petroleum and natural gas, its ability to interact with the atmosphere is limited. When fossil fuels are burned, what was largely underground is now transferred to the atmosphere where little existed before and in a form that can more quickly chemically react. Simple chemistry dictates that new and bigger inputs of carbon or any chemical will mix with other gases in the atmosphere. This will result in unpredictable and uncontrolled chemical reactions with unpredictable results and very likely unwanted risks.

As evidence that risks are increasing, Nashville's average temperature has warmed by approximately 2 degrees Fahrenheit since 1950. This is further substantiated by measures taken by President George H.W. Bush's Administration and its Department of Agriculture, to revise the maps delineating the warmest plant hardiness zones, northward. In addition, 9 of the last 10 years between 2002 and 2011 were among the 10 warmest years in the temperature records dating back to 1880. Thus, by an average change of only 2 degrees, the frequency and intensity of extreme weather events has drastically increased (Sustainable Tennessee, 2012).

Analysis of multiple climate model simulations indicate that projected increases in average temperatures for Metro Nashville area are likely to warm by approximately 3-5 degrees by mid-century and 5-9 degrees by century's end (Sustainable Tennessee, 2012). Some experts project that global temperatures are already poised to increase by additional 1.5 - 2 degrees, even if all the emissions of carbon are stopped today (NRC (2011) America's Climate Choices. National Academies Press.)

So, why should people act if the evidence indicates it may be too late? Throughout history, people have acted on clear and present challenges with the faith and hope that the right human action will succeed. This generation now faces its biggest challenge. The only remaining question is: How should people respond?

Sustainability Defined in Terms of Value

Increasingly, one of the most common approaches that communities use today in the context of an effort like NashvilleNext and in hazard adaptation is to adopt the values and principles of sustainability (American Planning Association, 2011). The Federal Emergency Management Agency has also recently described this as a "whole community approach" (Federal Emergency Management Agency, 2012). Sustainability is as an action that " . . . meets the needs of the present without compromising the ability of future generations to meet their needs" (Dressner, 2008, p. 1). Therefore, sustainability is the best foundation for creating hazard adaptation actions. In the City of Chicago's climate adaptation plan, sustainability measures serve in four of the five approaches of which adaptation is listed fifth. Appendix A outlines a more detailed, model effort of hazard adaptation.

The Chicago Climate Action Plan Outlines Five Strategies:

1. Energy Efficient Buildings
2. Clean and Renewable Energy Sources
3. Improved Transportation Options
4. Reduced Waste and Industrial Pollution
5. Adaptation

Upon further review of the Chicago Plan, it clearly focuses on sustainability under the umbrella of adaptation. Sustainability and adaptation therefore are virtually the same or, at the very least, are mutually beneficial processes. In reality, sustainability is a proactive approach based on the opportunity to add value to a community. Adaptation is a reactive response and seeks to avoid or lessen a hazard.

In order to understand effective adaptation, one must understand sustainability. The following therefore summarizes the principles of a hazard adaptation in terms of the five values of sustainability. These values or principles can help to create a better and more effective plan for Nashville's future and a hazard adaptation plan.

1. "Value Added" is Bigger than Any One Discipline

"Value added" is a sustainability concept and a business concept. It is not to be confused with a discipline such as engineering, business management, chemistry, foreign language, or public policy. Adding value informs and directs disciplinary skills toward the purpose of a sustainable, lasting outcome. Instead of applying one's discipline to a challenge, value added processes require multiple disciplines to work together to create a transformed result or trans-disciplinary approach for a higher quality outcome. Multiple skill sets, diverse perspectives, and collaborative teamwork are necessary for comprehensive and sustained solutions to occur. Therefore, a city-wide planning process, involving a wide array of disciplines and input, is inherently a sustainable process. Being value added however, is incomplete without the integration of the following additional aspects.

2. The Job of Hazard Adaptation and Sustainability Never Ends

The journey to perfection is never fully realized. It continually motivates the human species to constantly optimize its performance. NashvilleNext should therefore, be a dynamic plan that optimizes performance through a process of continuous improvement and continuously monitored metrics once the plan is formalized. If there is "no best", as a Toyota engineer once noted, then there is no reason to stop improving.

3. The Longest Lasting Solutions Function Like Natural Systems

A **system** *is an interconnected set of elements that is coherently organized in a way that achieves something. Systems can be nested within systems. Therefore there can be purposes within purposes."* (Meadows, 2007)

What does this definition mean? Systems and particularly natural systems are inherently very complex and cannot be predictably controlled. Even though changes by humans to natural systems seem easy to make, the response by natural systems to the change cannot be as easily predicted. Because natural systems are so complex, negative consequences often come too late to see the need to reverse the change. Conversely, natural systems can easily manage, replace and replicate themselves and will adapt to new challenges in the absence of human disruption.

Worse yet, human built systems are much more dependent on human intervention from beginning to end. Human built systems are much more linear and more predictable. But, since they are much simpler, single dimension human built systems such as levees or pumping stations cannot self adapt to bigger floods or regenerate or repair themselves when floods or time destroy them. Therefore, human systems come at one price when first installed and then cost much more years later since they eventually require extensive maintenance.

> Therefore, helping natural systems that have performed successfully for all time to continue to perform successfully is a critical function or value. This is important to not only enjoy the benefits of the system but to avoid the high cost of controlling a natural system that will easily outlast the human systems that seek to control it.

The ultimate cost of trying to control natural systems is that it eliminates the very processes that provide resiliency against the types of hazards, risks and threats increasingly experienced by Nashville in recent years.

Today, Nashville is making strides in restoring natural systems that can protect the lives and property of Nashvillians from future extreme weather events. Like many cities, Nashville must address development that occurred over decades when policy and regulation did not protect natural systems such as floodplains and wetlands. However, for several years now, Nashville's development regulations have protected floodplain, wetlands and other natural systems that play a key role during extreme weather events. Meanwhile, the city has taken decisive action – after the 2010 flood and other floods – to purchase properties in the flood way, further protecting critical natural systems.

The following represents a potential sustainable systems approach using nature as the mentor to develop Nashville's 2040 General Plan.

Figure 1: A Summary of All Systems in Broadly Sustainable Communities

"In its broadest sense, the strategy for sustainable development aims to promote *harmony among human brings and between humanity and nature* [emphasis added] . . . the pursuit of sustainable development requires:

- a political system that secures effective citizen participation,
- an economic system that is able to generate surpluses and technical knowledge on a self-reliant and sustained basis,
- a social system that manages tensions arising from disharmonious development,
- a production system that . . . preserve the ecological base for development,
- a technological system that can search continuously for new solutions,
- an international system that fosters sustainable . . . trade and finance, and
- an administrative system that . . . has the capacity for self-correction."

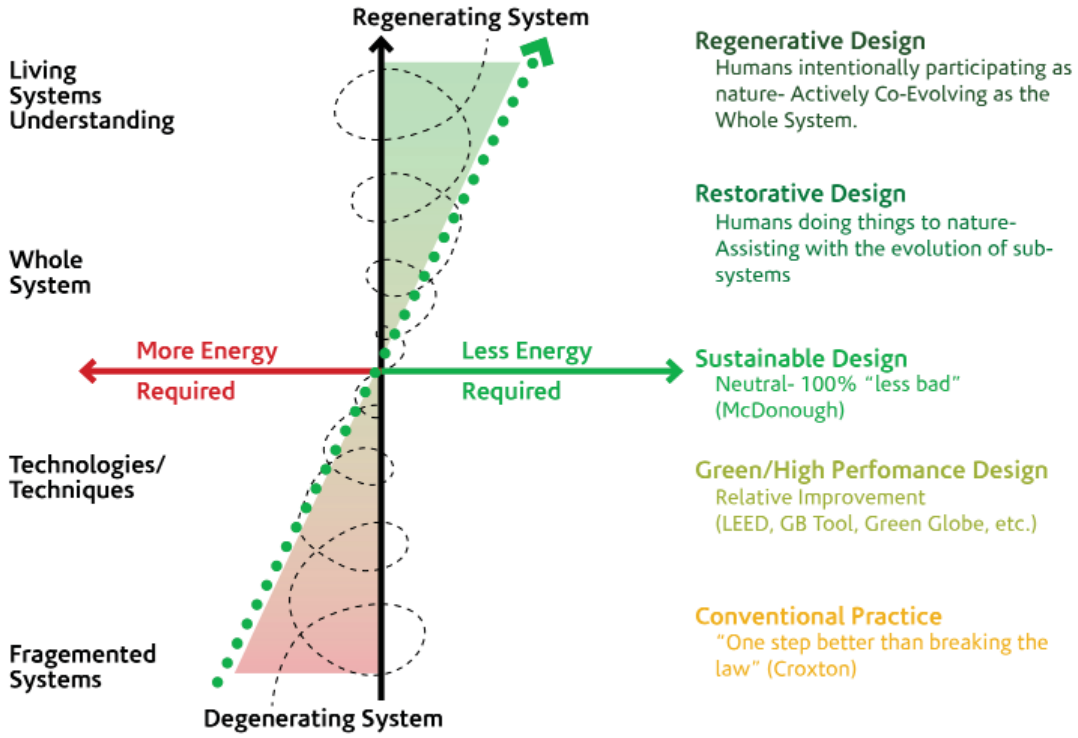


Figure 2: Continuum of Design *Source: United States Green Building Council*

4. Regenerative Systems Eliminate Risk & Work

Nature and natural systems have a longer and more consistent track record of success in survival than human beings. Nature is therefore the best mentor for a community in shaping its adaptive design for more effective survival. Businesses refer to this concept as Copy Exact. When a business process is perfected, the next step is Copy Exact.

Natural systems operate in closed cycles producing no waste (all waste is food in nature). They use abundant and free energy and nutrition. The key therefore to utilizing the success of natural systems is to realize that natural systems operate at a regenerative level.

Restoring natural systems puts into motion natural processes that allow natural functions to flourish. This does not mean, however, a ban on development. It means a development approach that integrates natural design. It works progressively toward a process of continuous improvement that ultimately embraces regenerative design. This is the key to adding resiliency or value to Nashville as highlighted in Figure 2.

5. The Total Cost Dictates Total Value

Harvard University defines life cycle costing as "a method of economic analysis for all costs related to building, operating, and maintaining a project over a defined period of time." Traditional practices such as developing a floodplain can seem cheaper and seem to add community value with short-term jobs and property taxes. Then public assistance pays for flood damages that exceed the value of the previous development, taxes, and jobs. Life cycle cost analysis ensures that the public and the community know what the risks are in ecological, fiscal and social terms, for the whole life of the project, not just the beginning.

Design Characteristics for a Sustainable, Adaptable, Resilient Community

The following is a list of Chicago's adaptation plan priorities (City of Chicago, 2010).

1. Manage Heat
2. Pursue Innovative Cooling
3. Protect Air Quality
4. Manage Storm water
5. Implement Green Urban Design
6. Preserve Our Plants and Trees
7. Engage the Public
8. Engage Businesses
9. Plan for the Future
10. Reduce Waste
11. Improve Transportation Options
12. Clean Renewable Energy
13. Energy Efficient Buildings

As a state-of-the-art approach, the Chicago adaptation plan provides insight into the development of the following characteristics of sustainability and adaptation. Each of the following characteristics has been uniquely customized for application in the Nashville Next planning process. It is also important to note that each plays a very critical role as one complete set of tools. Since there are no silver bullets in the age in which humans now live, today's challenges require a comprehensive approach, quite appropriately suited to a city-wide plan. Further, all planning powers and authorities should be amended and be brought to bear to adopt these practices and compatible with all planning functions and tools. Prior history has shown that many planning and zoning policies can in fact be barriers to such progress if they are not updated.

In recent years, various Metro Nashville departments that work in growth and development have introduced policies, regulations, tools and incentives to encourage sustainable development that will help Nashville prepare for future weather-related hazards. The Codes Department created a "Green Building Permit" that is issued to any building meeting the sustainable design protocol within the zoning code. The "green permit" incentivizes sustainable development through expediting the permitting process for a builiding permit and providing local recognition for excellence in sustainable development. Meanwhile, Metro Water Services recently released the Low Impact Development (LID) Manual, which provides incentives for developers to use green infrastructure to meet stormwater runoff water quality requirements.

The following section highlights key strategies and tools that can be used in building design, site design and in policy discussions to create sustainable, adaptable and resilient communities.

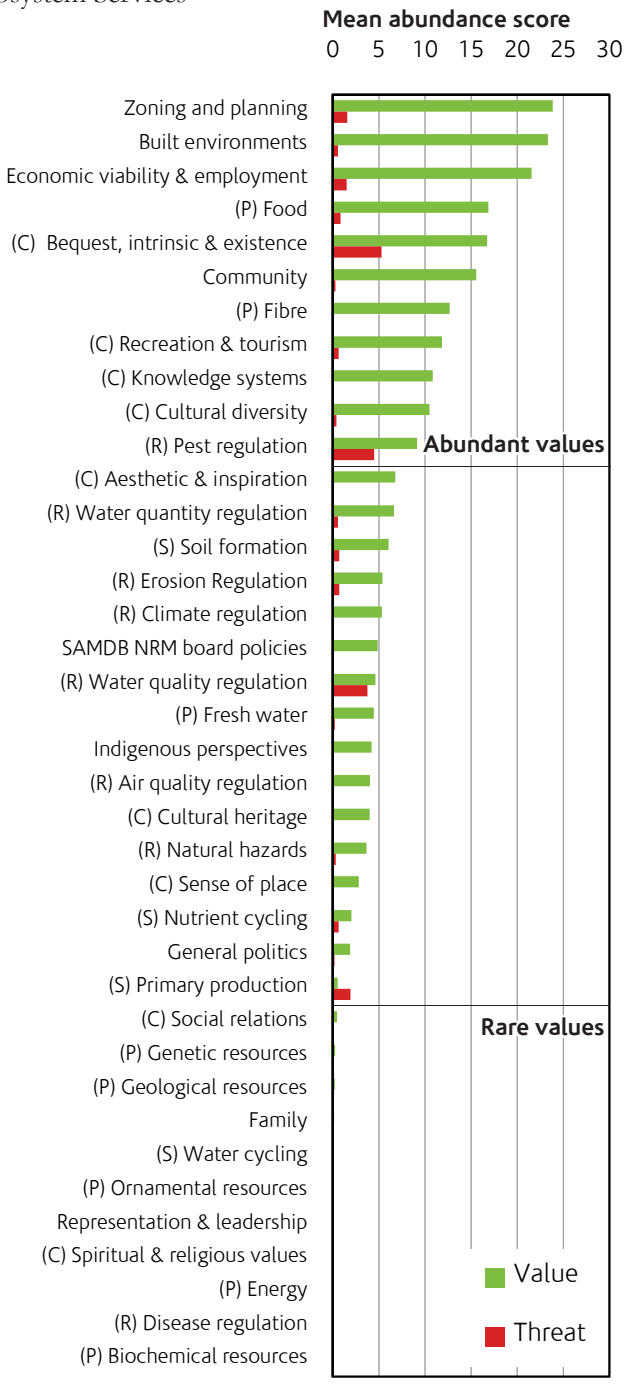
1. Rural Natural Infrastructure

The use of "natural infrastructure" is the most important tool in designing sustainable, adaptable communities. Natural infrastructure is a systems tool that relies upon many of the other design characteristics discussed later in this report.

Natural infrastructure is made up of landforms, geology, plants, animals and other local natural and wild features. Wetlands, floodplains, riparian areas, upland forests, soils, karst geology, streams, rivers, diverse wildlife populations and other natural systems are the more commonly recognized subsystems of natural

infrastructure. Most natural infrastructure unfortunately has been traditionally viewed as developable assets that did not merit or provide the same social or economic value as traditional infrastructure as illustrated in Figure 3.

Figure 3: Abundance and Rarity of Social Values for Ecosystem Services



Increasing numbers of studies document that natural infrastructure "can deliver specific services more cost effectively than built infrastructure" (Bostick, 2012). As science continues to document and quantify the functions of natural infrastructure, these benefits have become increasingly measurable. Some can be related in terms of avoided costs, avoided replacement costs or in terms of the cost of the same service if it were provided in built infrastructure.

For example:

- The loss of free ecological services such as natural filtration for clean water requires more costly chemical and mechanical treatment inputs to create safe drinking water.
- The loss of floodplains to development that previously stored flood water for free requires society to create expensive lake and levee structures that cannot be built large enough to withstand climate change events.
- The loss of water supply during drought occurs because it is no longer infiltrated and stored underground due to growing impervious surfaces creates higher costs for storing water above ground in detention basins.
- Previously native, aesthetic landscapes are no longer attractive for human enjoyment and now cost society more money in terms of fertilizer, trimming, mowing and replanting after extreme weather events, or because non-native plants were used that need many more inputs when placed in Nashville's climate.

The Nashville 2010 flood further emphasized the need for natural infrastructure. Figure 4 illustrates that most of the water storage available below surface occurs in the driest and widest portion of the unsaturated zone of hillsides, typically occupied by forests. Floodplains have little water storage below the surface due to the close proximity of the water table and necessarily are critical instead for above surface storage. Wetlands, riparian buffers, and floodplains (not just flood ways) are also the last line of

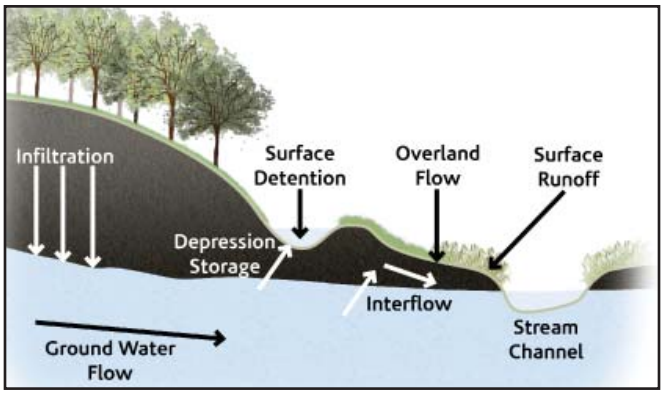


Figure 4: The Greatest Volume of Infiltrated Underground Storage of Flood Waters Occurs in Uplands (Top Left), Not Floodplains (Bottom Right)
(U.S. Geological Survey, 2012), (Brian, 2010)

defense from storm event hazards. After the flood, the Corps of Engineers and Metro Government has taken steps to incorporate natural infrastructure and these actions are ongoing.

It is also important to understand the unique characteristics of Nashville's natural infrastructure. The Corps of Engineers has determined that up to half of all rainfall in Middle Tennessee is evaporated off the surfaces of plant leaves and bark and/or transpired or released as a gas from within the leaves themselves after being absorbed by tree roots (Hair, 2011). Karst topography in the Nashville region means that below ground infiltration must be balanced by above ground evapotranspiration using vegetation (i.e., trees but also vegetation underneath the tree canopy) to prevent the accelerated growth of sinkholes. If too much infiltration occurs, increased head pressure by water entry and acidified water will accelerate erosion of limestone. Further studies illustrate that riparian tree species indigenous to the floodplain must be restored since their uptake of water (i.e., volume removed from the floodplain and groundwater table) greatly exceeds that of upland forests (Nebit, n.d.).

One other signal of urgency for a radical departure from traditional impervious surfaces to spongy surfaces is the reality of how effective forests are at managing water. Even if every roof, parking surface, yard and gutter could store runoff, it would still approximate only 60-70 percent of the water runoff removal of native forests. This explains why many communities are so deliberate and are so aggressive about preserving and restoring native landscapes and making every roof space green or parking space porous. The basic arithmetic of water therefore dictates that natural infrastructure is critical to a truly resilient community.

In short, Nashville will continue to lose resiliency in disasters and pay more for previously free public services IF it does not preserve, restore, and allow natural systems to continually regenerate in the manner

that is more abundant and higher quality than human infrastructure can do alone. Metro Nashville Government's buy out of foldaway property after the flood of 2010 is just one step that the city has taken to continue to restore natural infrastructure to protect the city from weather-related hazardous events. The Water Services Department, in conjunction with area non-profits, works to keep existing waterways free of debris that could exacerbate flooding. Meanwhile, the Parks Department strategically locates greenways on or near floodplain, providing an amenity to the community that provides visual reminder of the importance of protecting Nashville's waterways and floodplains.

2. Urban Natural Infrastructure

Hazard adaptation challenges create the need to proactively invest and implement sustainable urban infrastructure. The need for landscape maintenance emerges when previously natural landscapes are developed or "improved". Natural landscapes are best sustained or restored with local genetics and indigenous species so they can become regenerative systems again. Often their characteristics of color, shape and form that also change with the seasons are completely unique to Nashville and increase interest in the Nashville experience.

Increasingly, built environments are being designed to mimic low maintenance natural environments. These built environments integrate native landforms, native plants and natural functions (e.g., storm water infiltration and flood storage); are cheaper to install than expensive concrete pipes and asphalt; and are less expensive to maintain (See Figure 5). They also prove to be more resilient and adaptable to pests, storm events and more intense hazards. Table 1 shows that Nashville is poised to benefit enormously from this practice. Metro Nashville Government promotes the use of Urban Natural Infrastructure in private sector development, through the use of Green Building Permits (discussed above) and in its own buildings and infrastructure. Since 2007, all Metro buildings over 5,000 square feet and $2 million in construction costs must be Leadership in Energy and Environmental Design (LEED) certified. LEED awards "points" in its certification process for site design elements that would fall under urban natural infrastructure. Finally, Metro Nashville has also led the region in creating "green streets" – street design that incorporates urban natural infrastructure. Both Deaderick Street and the new 28th Avenue/31st Avenue connector included green street elements.

Figure 5: Cost comparison showing natural drainage less than traditional *(Seattle Public Works, n.d.).*

Street type	**Local street** SEA Street	**Local Street** Traditional	**Collector street** Cascade	**Collector Street** Traditional	**Broadview Green Grid** (15 block area)
Community benefits	• one sidewalk per block • new street paving • traffic calming • high neighborhood aesthetic	• two sidewalks per block • new street paving • no traffic calming • no neighborhood aesthetic	• no street improvement • moderate neighborhood aesthetic	• no street improvement • no neighborhood aesthetic	• both "SEA street" and "Cascade" types • one sidewalk per block • new paving • high neighborhood aesthetic
Ecological benefits	• high protection for aquatic biota • mimics natural process • bio-rediate pollutants	• high protection from flooding • some water quality	• high water quality protection • some flood protection	• high protection from flooding • some water quality	• high water quality & aquatic biota protection • some flood protection • excellent monitoring opportunity
impervious area (%)	35%	35%	35%	35%	35%
Cost per block (330 linear feet)	$325,000	$425,000	$285,000	$520,400	Average per block: $280,000

3. Native Landscapes

Native and indigenous plants represent a subset of larger natural systems in Nashville. Native landscapes are discussed in greater detail here to emphasize how critical they are to the resiliency of the community. Native plants possess coping mechanisms shaped by time that are unique to Nashville's climate, soils, pests, diseases, predators and other hazards and threats. The City of Chicago and the State of Minnesota have recognized that plants native to North American is not enough. Genetic quality formed locally and replicated by local and regional certified seed and plant sources are best at adding resiliency and eliminating investment risk. The role plants play in removing water by evapotranspiration further substantiates the need for local plant genetics. The infiltration of water through deep root systems (Figure 6) further substantiates the need for native plants and genetics.

In addition to incorporating native and indigenous plants at public buildings and campuses, Metro Nashville is also committed to protecting and adding to the city's tree canopy. In 2010, Nashville completed its first assessment of the city's tree canopy, which included both an understanding of where trees exist and recommendations on where trees could be planted. This was followed, in 2012, by Mayor Dean's creation of the Metro Landscape Coordination program, which is managed by a new city horticulturist. One of the first tasks for the Metro Landscape Coordination program is an inventory of trees in downtown, to be completed in 2013.

4. Sustainable Building Design

According to the United States Green Building Council and the United States Department of Energy, buildings consume 39 percent of the energy and 74 percent of the electricity used in the United States each year (US Department of Energy, 2012). It is no surprise that communities that are most effective in achieving energy independence simply reduce waste of energy in four ways.

- **Building Efficiency:** Utilizing sustainable principles to create efficient building systems that utilize natural heating/cooling methods.
- **Building Comfort:** Creating comfortable environments for users through efficient building design.
- **Sustainability:** Utilizing renewable building materials and systems that promote efficient human behaviors.
- **Energy Efficiency:** Allowing only energy efficient devices, reducing energy demand.

Sustainable design is central to the American way of life and pivotal to the success of free markets in competition for consumer interest. Today, Nashville and the region are largely reliant on non-renewable fossil fuels with little significant competition.

Metro Nashville is not only encouraging sustainable building design in its own buildings (see above, the discussion of Metro's commitment to LEED), but is also encouraging energy efficiency in the private sector through the Mayor's Green Workplace Challenge program. The Mayor's Green Workplace Challenge program encourages building owners and property managers to reduce energy use, water consumption and waste.

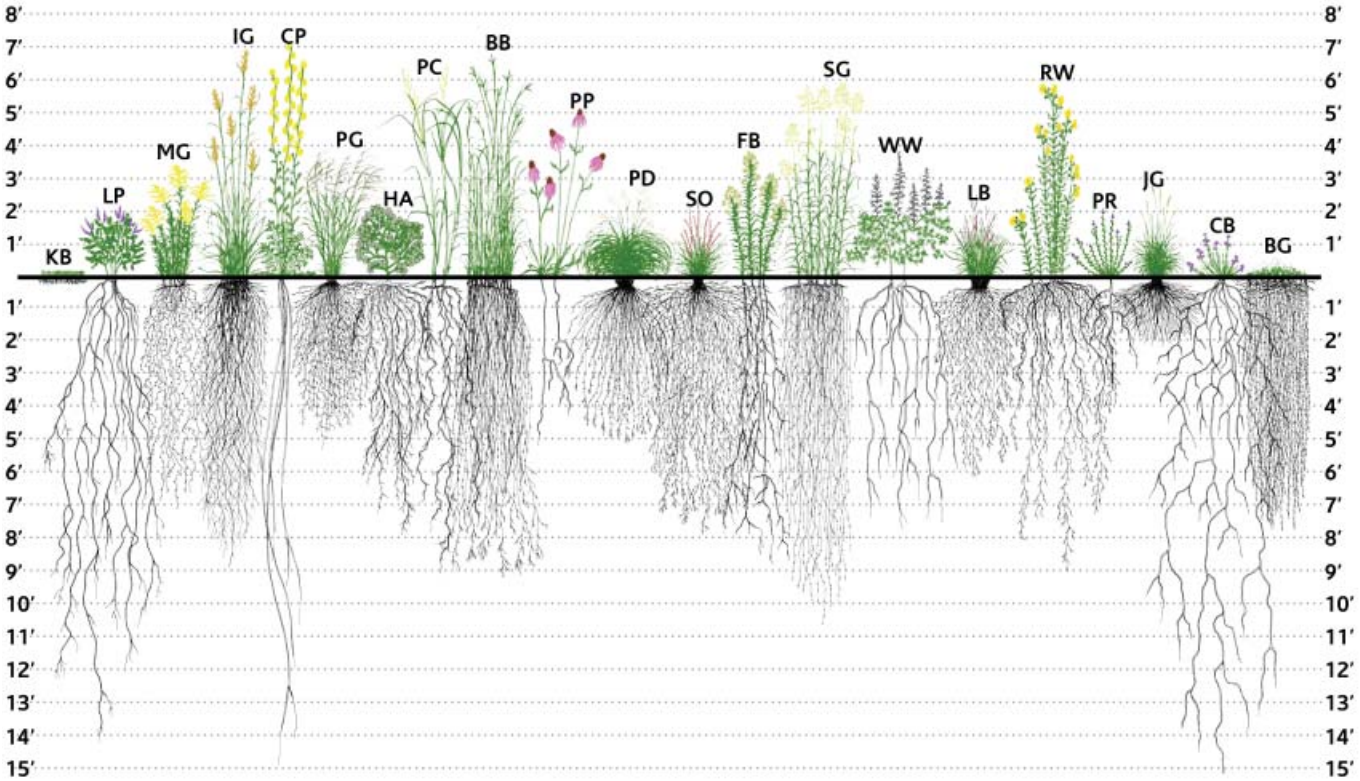
5. Diverse Transportation Choices

Competition and choice drive greater innovation, lower prices and higher quality to secure consumer interest and investment. Transportation, like other forms of commerce and nature require diverse options so that consumers can choose the best system. Adaptation therefore also means creating competition by making multiple modes of transit available. Nashville has seen significant increases in the use of its transit options, with over 10 million passenger trips in Fiscal Year 2012. The city has responded by offering more buses, more routes and the addition of a second bus rapid transit (BRT) route, which provide faster service. BRT currently exists on Gallatin Pike, is slated to be launched on Murfreesboro Pike in April, 2013, and is being discussed for the "East-West Connector."

Figure 6: Deep Roots Promote Deep Aeration and Water Storage (Conservation Research Instiller, n.d.)

Label	Name	Height (ft)	Root Depth (ft)
KB	Kentucky Blue Grass	0.3	0.3
LP	Lead Plant	2.0	14.0
MG	Missouri Goldenrod	3.0	7.0
IG	Indian Grass	7.0	9.0
CP	Compass Plant	7.0	15.0
PG	Porcupine Grass	4.0	5.0
HA	Heath Aster	2.0	8.0
PC	Prarie Cord Grass	6.5	8.0
BB	Big Blue Stem	6.5	9.0
PP	Pale Purple Coneflower	5.0	5.0
PD	Prarie Dropseed	3.0	5.0

Label	Name	Height (ft)	Root Depth (ft)
SO	Side Oats Gramma	2.0	8.0
FB	False Boneset	3.0	9.5
SG	Switch Grass	6.0	11.5
WW	White Wild Indigo	4.0	7.5
LB	Little Blue Stem	2.5	6.0
RW	Rosin Weed	6.0	9.0
PR	Purple Praire Clover	2.0	4.0
JG	June Grass	3.0	2.0
CB	Cylindric Blazing Star	1.5	15.0
BG	Buffalo Grass	0.5	8.0



6. Net Zero Energy

Corporations today increasingly use the term net zero management. Net zero management includes designing buildings to have zero net energy consumption. Through efficient building design and the use of renewable energy systems, many companies are creating net zero buildings that save the company's significantly on operational costs over a building(s) lifetime. These include net zero approaches to water, waste, product packaging, and carbon/energy. Major corporations are moving toward this and similar standards. Wal-Mart, Kohl's, and Target now require suppliers to complete quarterly surveys and to use their scores to improve each year in a manner transparent to consumers. (Kohl's Cares, 2012).

7. Local Food

Climate change will reduce the productivity of southeastern farms. Sustainable and resilient communities enhance the support structures for food with local food systems. Local food systems have other benefits. They reduce energy use, increase food options and support public health and market resilience. Local food systems are also distributed across a community and region, and are less prone to single source impacts. They are also adaptable to changing demand. Another focus of local food system enhancement should be individual food production opportunities. Recent interest in and local government measures now encourage urban chickens, honey production/ bees, and vegetable production. These are small but effective examples of local food trends that increase community and individual resiliency.

The Nashville Food Policy Council is a local nonprofit whose mission is to increase the availability of, and access to, healthy and affordable food through education and awareness on food security; the creation of strategic partnerships to address access to food; the cultivation and support of local food resources; and by influencing policy and regulations to promote a more sustainable food system. The Nashville Food Policy Council and its allies have been crucial in strengthening local food systems in Nashville.

8. Healthy Neighborhoods

Healthy people are not only more resilient against hazards like extreme weather, but are also more available to contribute to and be more engaged in executing the general plan vision of adaptation. Obesity, inactivity and limited recreational opportunities erode community vitality and resiliency.

In the past, Nashville permitted neighborhoods and commercial areas to be built without sidewalks, which reduced the opportunities for Nashvillians to incorporate walking into their daily lives. Over the past decade, Mayor Dean and his predecessor, Mayor Purcell, lead a concerted effort to add to the city's sidewalk, bikeway and greenway network. Meanwhile, the city

Figure 7: Diversity in Davidson County

Population ethnicity (10-county region)	2010 Census		2040 projection		2010 – 2040 change		
	count	%	count	%	count	%	share
White (non-Hispanic)	1,274,970	72.5	1,896,016	61.2	621,046	48.7	46.4
Black (non-Hispanic)	279,427	15.9	465,750	15.0	186,323	66.7	13.9
All other races, non-Hispanic	83,220	4.7	128,857	4.2	45,637	54.8	3.4
Hispanic or Latino	120,829	6.9	605,979	19.6	485,150	401.5	36.3
Total population	**1,758,446**	**100**	**3,096,602**	**100**	**1,338,156**	**76.1**	**100**

committed to a "Complete Streets" policy with an Executive Order signed by Mayor Dean, charging Metro to commit to Complete Streets – streets that provide access to pedestrians, cyclists, motorists and freight.

9. Diversity and Equity

While White and Black populations are the predominant demographics in Nashville today, future projections show a Nashville in 2040 where there is no majority race or ethnicity, but Hispanics make up the largest percentage of the population. In its own way, encouraging demographic diversity and equity is also an effective adaptation – recognizing that when a community is filled with diverse perspectives and ideas, it will be more resourceful and resilient in the face of change and challenge.

10. Freedom to Innovate in Business, Lifestyle and Learning

Only three brief points need be made about this characteristic:

- Business is the critical force in job creation and the transfer of innovation, efficiency, reliability and efficient financial investment into the rest of society.
- The quality of people's lives and recognition of demographic trends will increasingly drive the design and vision for communities that seek higher standards of living.
- Education innovation will be central to the birth of the next advancements in community practices and higher standards of living.

The Challenge of Our Generation

Given the cultural and political polarization surrounding the sources and causes of climate change and the human response needed, many communities are turning to hazard adaptation as the theme of their response. In fact, some recent findings assert that community level adaptation may be the response of last resort given the potential tipping point of carbon concentrations in the atmosphere that will continue to build " . . . even if the most ambitious level of pledges and commitments were implemented by all countries and under the strictest set of rules . . ." (Chestney, 2012). This does not mean, however, that hazard adaptation should not, does not or cannot include sustainability strategies to mitigate, eliminate or reduce Nashville's carbon emissions. Eliminating energy waste and risk is a fundamental business concept and is reason enough to seek more efficiency and to maintain quality of life.

Hazard Adaptation Planning Steps

Appendix A is a summary document that addresses much more comprehensively the documentation developed for Chicago's hazard adaptation plan for climate change. Figure 8 represents the planning process steps that Nashville should consider during the NashvilleNext process. Each is an individual and separate planning process.

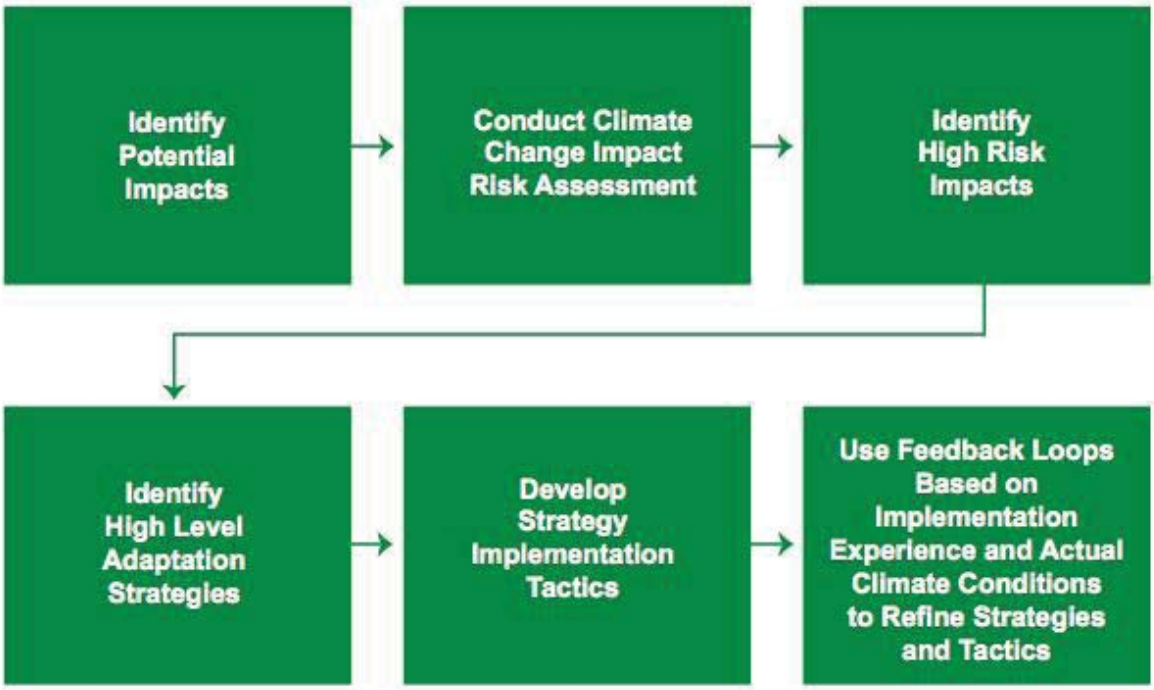
Fundamentals of Risk Management

Risk management is the core of a hazard adaptation process. A recent presentation at Vanderbilt University (Abkowitz, 2012) describes the process in the following manner.

First, the goal is to define the hazards and their controls that have been prioritized based on the community's tolerance for that risk. This process begins with a thorough inquiry by asking:

- What can go wrong?
- How likely is it?
- What are the consequences?
- What can be done to better manage risk within our available resources?

Figure 8: The City of Chicago's Climate Adaptation Planning Process



Then policy makers identify risk factors such as flooding, tornado events, average and maximum summer heat gain or extreme weather events such as more frequent ice storms or extreme snow. These are assessed, rated and ranked by probability.

Figures 9, 10 and 11 (Abkowitz, 2012) show examples of risk assessment tools.

Example of Infrastructure Adaptation Measures:

- Define weather variables and projections (possibly using a portfolio approach bounded by extremes);
- Develop an infrastructure inventory based on type and relative importance;
- Analyze risk to infrastructure for vulnerability and resilience;
- Prioritize infrastructure according to risk; and
- Develop adaptation strategies for infrastructure risk.

Adaptation strategies can include things like:

- Improved warning and preparedness systems;
- More frequent and targeted maintenance activities;
- Hardening [or naturalizing] assets;
- Relocating assets to less vulnerable areas;
- Expanding system redundancy;
- Resource conservation and re-use; and
- Regulatory actions – modifying building codes, design standards [and realigning land use objectives].

By combining concepts from sustainability and hazard adaptation, more effective responses can be crafted. For example, if we considered the "true cost" of replacing poorly planned infrastructure or "true cost" of maintenance, we would invest more wisely. In this manner, future taxpayers, ratepayers and the children of today's citizens will avoid the price of inadequately, informed tolerances. Today's citizens

Figure 9: Sample Event Frequency Rating Scale
(Abkowitz, 2012)

Score	Rating	Description
5	Virtually certain	95% probability that event will occur within the next 10 years
4	Very likely	75% probability that event will occur within the next 10 yeares
3	Even odds	50% probability that event will occur within the next 10 years
2	Unlikely	25% probability that event will occur within the next 10 years
1	Remote	5% probability that event will occur within the next 10 years

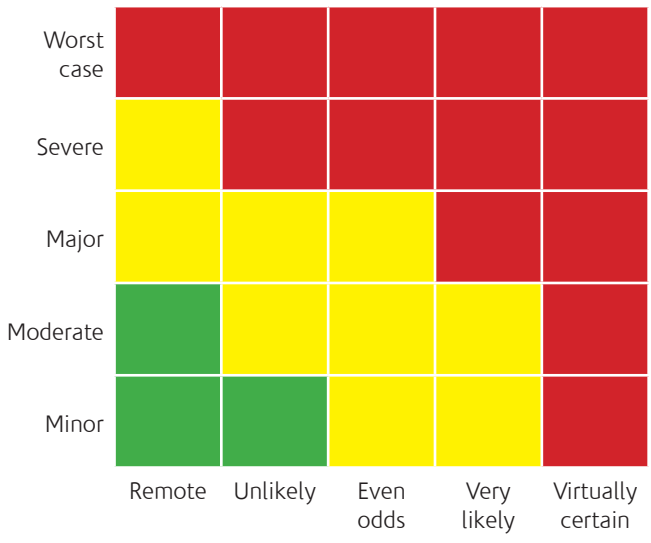
Figure 10: Sample Consequence Rating Scale
(Abkowitz, 2012)

Impact factors

- Fatalities & injuries
- Long-term health effects
- Environmental degradation
- Loss of assets
- Business & community interruption
- Cash flow & credit worthiness
- Clean-up
- Recovery

Score	Rating
5	Catastrophic
4	Severe
3	Major
2	Moderate
1	Minor

Figure 11: Plotting Risk Assessment Results - Risk Heat Map
(Abkowitz, 2012)



could instead enjoy natural, sustainable, and regenerative investments that add value now and that grow in value forever. For example, by investing in a sustainable world class park system, our long-term cost would be minimal and we would create an amenity that would last for generations. Nashville has committed to creating a system of publicly and privately-held open space – parks and preserves – to protect some of Nashville's natural systems for their hazard mitigation properties and for their scenic, cultural and recreational value.

The Nashville Open Space Plan, released in 2011, calls for "Four Corners, Nine Bends, and a Heart of Green: an anchor park in each quadrant of the city, preserves in each of the nine bends of the Cumberland River, and a greener more pedestrian friendly downtown that includes trees, parks, greenways, and a revitalized riverfront area." Public and private sector efforts are underway now to make this vision a reality.

Conclusion

Although there are many other aspects that could be summarized here concerning hazard adaptation, one key lesson emerges. Abkowitz notes the communities that most effectively address hazard adaptation risks usually share the following characteristics:

1. They have strong proactive leadership.
2. They have recently experienced a natural disaster that prompted public awareness (Abkowitz, 2012).

Recently, in another U.S. city, a skillful mayor, on the heels a recent rare storm event, held a press conference.

> *Severe storms, rainfalls and heat waves in recent years show that the dangers from extreme weather are already here. The power system is 'the glue that all the systems depend upon.' Power may be considered the most important need of infrastructure functionality in the immediate aftermath of a major disaster and called for the region's utilities to make power grids, transportation networks, telecommunications systems and hospitals capable of handling a Category 2 hurricane, record-breaking heat wave or other natural disaster. Mayor Bloomberg also called on phone companies to provide more than eight hours of backup battery power for cellphone towers and said the city would look for ways to encourage hospitals and big buildings to create their own power-generation systems.* (Peltz, 2012)

Given the broader policy making authority of the NashvilleNext planning process, this moment in history has the momentum that is Nashville's to lose. Nashville should utilize the rare occurrence of an extremely competent mayor and the recent experience of a major flood event to shape a better future.

Case Studies: Sources of State-of-the-Art Best Practices and Metrics for Success

This background report intentionally chose to focus on the best examples of the most aggressive adaptation and mitigation practices and not just adaptation planning processes because of the sense of urgency to act effectively. Three criteria drove the selection of the case studies selected and the metrics provided in this background report:

1. The case study shows the most honest response to Nashville's biggest threats.
2. The metrics are currently being used in practice and show real progress.

State of the Art Case Studies for General Sustainability Characteristics

These are identified in the Summary Table that follows this section.

State of the Art Case Studies Representing the Urgency of Hazard Adaptation

Cities that are taking climate change and hazard adaptation the most seriously are converting to fossil fuel free, net zero energy functions or are making significant shifts to minimize wasteful demand and to seal "leaky" buildings. Many communities and individual homeowners around the world are altering their way of lives completely to be the most competitive or to just save money and simplify their lives. Ultimately, most are doing it to be prepared for the ultimate hazard adaptation, a world with less or without any fossil fuels.

Radically Effective Energy/Carbon Related, Hazard Adaptation Measures

1. At the first American Net Zero Cities Symposium, the City of Fort Collins was showcased as having "established a zero energy district", in 2009. The FortZED initiative encompasses the downtown district of Fort Collins, Colorado and the Colorado State University campus (Net Zero Cities, 2012).

2. Much of the criticism being directed at green buildings today (Frank, 2012) is really connected to human behavior in the building after it is designed to be operated efficiently (World Business Council for Sustainable Development, n.d.).

   Summary:

   - The behavior of occupants in a building can have as much impact on energy consumption as the efficiency of the equipment.
   - User behavior is influenced by economic, social and psychological factors that influence both the buying of equipment and the use of energy.
   - Energy use is determined by information/awareness and energy costs, plus social, educational and cultural factors.
   - The rebound effect limits potential energy savings by substituting new consumption for some of the energy saved.

   Therefore, all gains attained through sustainable design can be destroyed by the actions of the user(s) of the building.

3. Shifts in Behavior and Lifestyle – Some Americans are choosing to retrofit much smaller homes with very high quality features which result in much lower energy bills, lower taxes, less maintenance, and more leisure time. (Wadler, 2012).

4. "Växjö Sweden shall become a municipality where it is easy and profitable to live a good life without fossil fuels." (City of Vaxjo, Sweden, 2011) by:

   - Reducing the fossil carbon dioxide emissions by 41 percent per inhabitant from 1993.
   - Adding renewable energy to achieve 60 percent of generation using biofuels and wind.
   - Achieving the 2015 target to reduce the emissions of fossil CO2 by 55 percent per inhabitant.

5. Kristianstad, Sweden chose to move away from fossil fuels:

"The city and surrounding county, with a population of 80,000, essentially use no oil, natural gas or coal to heat homes and businesses, even during the long frigid winters. It is a complete reversal from 20 years ago, when all of their heat came from fossil fuels." (Sustainable Energy for Europe, 2010)

Other Energy Mitigation and Adaptation Measures:

1. Net Zero Buildings produce all the energy they need. "Pike Research released a report . . . indicating that net-zero construction will become a $1.3 trillion global business by 2035, driven largely by demand from Europe where zero-energy requirements are increasingly becoming required by building codes." (Pike Research, 2012)

2. According to (Shinn, 2012) "The American Society of Heating, Refrigerating, and Air-conditioning (ASHRAE) is using the energy reduction "schedule" established by the 2030 Challenge to upgrade its energy design and construction standards, 90.1 and 90.2 on a regular 3-year cycle."
    - By 2030, all new buildings (and renovations) under this code must use no more than 20% of its annual energy from fossil fuels, and that they have to use "grid connected renewable energy offsets to compensate" achieving lifetime no net use of fossil fuels.
    - Shinn also adds that it is not clear whether or not this tool will be enough to reverse climate change impacts and assure the world that this will truly slow warming. It should be noted that the City of Nashville has yet to update to the new ASHRAE standards which are included in the 2012 International Energy Conservation Code. The City is currently using the 2006 International Energy Conservation Code.

3. The City of Vienna, Austria has embarked on a two-fold approach:
    - Add Renewable Supply: A 5.3 kilometer deep geothermal plant, solar PV, biomass, biofuel and wind energy offset growth.
    - Significantly Reduce Demand or Load through Building Insulation: Vienna has chosen super efficient passive design standards and super efficient electronics selection.
        - Passive design load reductions are 10 times lower than any Energy Star home and the amount of energy saved can be nearly triple the amount of LEED buildings.
        - Incentives and energy costs are motivating building owners to add 12-30 centimeters of Styrofoam insulation of the exterior of older buildings and to replace older windows.

Nashville's Current Efforts in Adaptation and Sustainability

The following table provides a brief overview of Nashville's general progress to date in comparison to example practices, cases, information and recommendations identified by this background report.

The table is not an exhaustive list, but does highlight some private and public sector efforts per topic. The chart notes where the Metropolitan Nashville can achieve more progress/action and where significant progress has been made. Each program or project identified in the table has a corresponding report or website listed in the Bibliography for more background.

The following definitions are used in the table.

Study *means that Metro and/or private sector entities, Mayor or by other parties have directed significant investment to:*

- Analyze general strengths, weaknesses, opportunities and threats,
- Identify best practices and technical criteria, and
- Determine possible next steps.

Pilots *are projects that have been executed to test new methods of hazard adaptation and sustainability in order to:*

- Take on risk to make early adoption details easier;
- Introduce and/or test the viability of the concept (i.e., to determine technical suitability);
- Advance cultural acceptance and educate designers and the public; and
- Catalyze broader use through social norms.

Partial Implementation *means that hazard adaptation and sustainability projects have increased in scale and have been:*

- Embraced as feasible (technically and culturally acceptable);
- Successful (proven to work); and
- Scaled up and tested further for adoption on a community wide scale.

Full Scale Implementation *means that the hazard adaptation and sustainability concept has been:*

- Widely accepted as a common practice in most of the City of Nashville.

Table 1 - Nashville's Adaptation and Sustainability Progress

Baseline inventory of greenhouse gas emissions		
Level 1:	**Study**	Some private corporations
Level 2:	**Pilots**	Some private corporations
Level 3:	**Partial Implementation**	Vanderbilt University, Carbon Emission Reductions
Level 4:	**Full Implementation**	Metro - Baseline Inventory of Greenhouse Gas Emissions Report (2009)
Best practices		• Chicago Climate Action Plan (City of Chicago, 2010) • PlaNYC (City of New York, 2012)
Comprehensive climate risk assessment for Metro		
Level 1:	**Study**	• State-wide only
Level 2:	**Pilots**	Unknown / Progress Needed
Level 3:	**Partial Implementation**	Unknown / Progress Needed
Level 4:	**Full Implementation**	Metro - Assessment conducted to study flood impacts only
Best practices		• Chicago Climate Action Plan • PlaNYC
Climate risk reduction		
Level 1:	**Study**	Unknown / Progress Needed
Level 2:	**Pilots**	Unknown / Progress Needed
Level 3:	**Partial Implementation**	Metro - Assessment conducted to study flood impacts only
Level 4:	**Full Implementation**	Unknown / Progress Needed
Best practices		• Chicago Climate Action Plan • PlaNYC
Development of climate adaptation tactics and strategies		
Level 1:	**Study**	Metro: Study of adaptation tools for floods
Level 2:	**Pilots**	Metro - Pilot projects to test adaptation tools for floods only
Level 3:	**Partial Implementation**	Metro - Creation and implementation of adaptation tools to address floods only
Level 4:	**Full Implementation**	Metro: Flood only
Best practices		• Chicago Climate Action Plan • PlaNYC

Reduce energy loads/demand through super highly efficient buildings and devices		
Level 1:	**Study**	Some Progress Made
Level 2:	**Pilots**	• LEED building certification (though LEED is a well-established program, voluntary third-party certification amounts to many individual pilot programs). • Lipscomb University geothermal use • Montgomery Bell Academy geothermal use • Goodwill solar array
Level 3:	**Partial Implementation**	• More Progress Needed • Note: The existing building certification tools used by the City of Nashville (LEED Silver) reduce energy waste but will not be sufficient to meet necessary energy use reduction goals. • Effective energy management begins at LEED Platinum, the highest level of LEED certification.
Level 4:	**Full Implementation**	More Progress Needed
Best practices		• Net Zero City Concept: First U.S. Conference (Net Zero Cities, 2012) • European Energy Efficiency Goals (European Commissions, 2012) • ASHRAE 90.1 & 90.2 (ASHRAE, n.d.) • Example of U.S. Culture Trends: The Big Shrink (Wadler, 2012)
Reduce Energy Loads/Demand through altering human behavior, altering use of energy in building, retrofitting buildings for more efficiency		
Level 1:	**Study**	Some Progress Made
Level 2:	**Pilots**	Unknown / Progress Needed
Level 3:	**Partial Implementation**	• Go Green Nashville • Change for Chestnut • Home Energy Savings Program • Belmont University Sub-Metering and Use of TRANE Energy Management Systems • MDHA addition of solar panels on existing public housing • LEED for Neighborhood Development Certification of The Gulch
Level 4:	**Full Implementation**	• Unknown / Progress Needed • Metro: Nashville Energy Works (NEW) Program • Mayor's Green Workplace Challenge
Best practices		• Vienna Retrofits • Balfour Beatty (with an office based in Nashville) manages US Military Base Housing Energy Use with New Behavioral Management Tools (Business Wire, 2012)

Add Supply / Diversify with Renewable Energy through micro-scale, distributed residential energy practices		
Level 1:	**Study**	Some Progress Made
Level 2:	**Pilots**	Some Progress Made
Level 3:	**Partial Implementation**	Only Solar PV and Solar Thermal Hot Water and only a small percentage of Nashville homes, commercial and industrial buildings are using them - More Progress Needed
Level 4:	**Full Implementation**	Some Progress Made
Best practices		**Public**: European Renewable Energy Council (EREC, 2012) • US DOE: Residential Renewables (US Department of Energy, 2012) • US EPA: Renewable Energy Ready Homes (EPA, n.d.) • Balfour Beatty (with an office based in Nashville) manages US Military Base Housing Energy Use with New Behavioral Management Tools (Business Wire, 2012) **Private**: Home Power: Small Scale Residential Renewables (Home Power, 2012)
Add Supply / Diversify with Renewable Energy through macro-scale, commercial energy practices		
Level 1:	**Study**	Some Progress Made
Level 2:	**Pilots**	Some Progress Made
Level 3:	**Partial Implementation**	Tennessee Valley Authority Generation Partners
Level 4:	**Full Implementation**	More Progress Needed
Best practices		• European Renewable Energy Council (EREC, 2012) • 70 Percent of New Power in the EU Came from Renewables in 2011 (Shahan, 2012)
Ten Characteristics of a Sustainable Community		
1. Rural Natural Infrastructure		
Level 1:	**Study**	Some Progress Made
Level 2:	**Pilots**	Public Sector: • Fort Negely Native Grasses
Level 3:	**Partial Implementation**	• Metro Nature Center Parks & Greenway Riparian Lands • Mayor's Open Space Plan with Land Trust for TN • The Mayor's Complete Streets Executive Order
Level 4:	**Full Implementation**	More Progress Needed in Flood Mitigation Lands – Floodplains and Steep Uplands
Best practices		• Chicago Wilderness (Chicago Wilderness, 2012) • Knox County Beaver Creek Green Infrastructure Plan (DeKay, 2006) • The Way Ahead, City of Edmonton, Canada (City of Edmonton, 2012) • Tennessee Exotic Pest Plant Council (TNEPPC, n.d.) • Hydrogeomorphic Assessment: Literature (ACE, 2010) • Ecosystem Functional Assessment Tools (EBM Tools Network, 2011)

2. Urban Natural Infrastructure		
Level 1:	**Study**	Some Progress Made
Level 2:	**Pilots**	**Public Sector:** • The Mayor's Complete Streets **Private Sector:** • McKay's Books Pervious Pavers • Montgomery Bell Academy's Bioretention and Pervious Parking Stalls
Level 3:	**Partial Implementation**	• Metro Water's Green Infrastructure Master Plan • Metro Green Streets - Deaderick and 28th Ave./31st Connector
Level 4:	**Full Implementation**	More Progress Needed
Best practices		**Public Sector:** • Portland Green Street Program (Portland Bureau of Environmental Services, 2012) • Seattle Green Stormwater Program (Seattle.gov, 2012) **Private Sector** • Serenbe Natural Infrastructure Community Region (Serenbe, 2012) • NC State Green Stormwater Engineering (NCSU, n.d.)
3. Native Landscapes		
Level 1:	**Study**	No real progress made in regard to basic native genetic seed labeling or distribution.
Level 2:	**Pilots**	More Progress Needed in Seed Genetics
Level 3:	**Partial Implementation**	More Progress Needed in Seed Genetics
Level 4:	**Full Implementation**	Significant progress made in native plant re-introduction and restoration . . . but not local genetic seed labeling
Best practices		**Private Sector** • Tennessee Nature Conservancy • Roundstone Native Seed Company, Upton, KY • Minnesota Native Ecotype Seeds (MCIA, 2011) • Tennessee Pest Plant Council • GroWild Nursery, Fairview, TN (largest native plant Nursery in the SE)
4. Sustainable Building Design		
Level 1:	**Study**	Progress Made
Level 2:	**Pilots**	Public Sector: Renewables lag Private Sector Adoption (Solar & Geothermal) are Growing
Level 3:	**Partial Implementation**	• Public Sector: Metro's commitment that metro buildings will be LEED certified • Downtown Code incentives for LEED construction • Private Sector: Residential and Commercial Efficiency and Renewables (Solar & Geothermal) are Growing
Level 4:	**Full Implementation**	More Progress Needed
Best practices		Net Zero and Fossil Free Cities Concepts

5. Diverse Transportation Choices		
Level 1:	**Study**	• 2009 & 2011 Bicycle and Pedestrian Counts • East-West Connector • Regional ITS Architecture Update 2010 • Regional Bicycle and Pedestrian Study • Northeast Corridor Mobility Study • Regional Freight & Goods Movement Study • Northwest Corridor Conceptual Feasibility Study • Southeast Corridor Transit Alternatives
Level 2:	**Pilots**	• Bike Corrals
Level 3:	**Partial Implementation**	• Implementing Complete Streets: Major & Collector Street Plan • Strategic Plan for Sidewalks & Bikeways • Strategic Transit Master Plan • Greenways Master Plan • Bike Lane & Route System • Expansion of greenway system • Nashville B-Cycle • Nashville GreenBikes • Transit Signal Priority - Gallatin & Murfreesboro Roads • Murfreesboro Road Bus Rapid Transit Lite • West End, Downtown, North Nashville, & East Nashville Pedestrian Wayfinding Program
Level 4:	**Full Implementation**	• Hillsboro Village Streetscape Project • Jefferson Street Gateway to Heritage Project • Music City Bikeway • Gallatin Road Bus Rapid Transit Lite • NashVitality Mobile App • Music City Star • Music City Central Downtown Transit Station • Deaderick Street (First Green Street) • 28th Avenue-31st Avenue Connector (Complete Street) • Shelby Street Pedestrian Bridge Conversion • Cumberland River Pedestrian Bridge (Shelby Bottoms to Two Rivers)
Best practices		• The Transit Alliance (The Transit Alliance, n.d.) • See Transportation Background Report

6. Net-zero Energy		
Level 1:	**Study**	Only private sector initiatives.
Level 2:	**Pilots**	• GM's water re-use at its Spring Hill Facility • Nissan's goal of zero landfill waste in Smyrna • Mars' goal of "Sustainable in a Generation"
Level 3:	**Partial Implementation**	More Progress Needed
Level 4:	**Full Implementation**	More Progress Needed
	Best practices	• Mars Sustainable in a Generation (MARS, 2012) • Nissan Zero Waste (Nissan, 2011) • European Pathway to Zero Waste (EPOW, 2012) • Johnson Controls: Absolute Zero (Nesler, 2009)
7. Local Food		
Level 1:	**Study**	Progress Made
Level 2:	**Pilots**	Progress Made
Level 3:	**Partial Implementation**	• Hands On Nashville Urban Farm • Hermitage Hotel Farm Acquisition • Sloco Deli • Jim and Nick's "Farm to Restaurant" Agreements • Middle TN Local & Organic Farms Growing in Number • Growing number of neighborhood based farmer's markets and revamp of Nashville Farmer's Market with focus on local foods
Level 4:	**Full Implementation**	More Progress Needed
	Best practices	See Health and Livability Background Report
8. Healthy Neighborhoods		
Level 1:	**Study**	Nashville Civic Design Center study on Health and the Built Environment, forthcoming
Level 2:	**Pilots**	• Mayor's Field Day • Walk 100 miles with the Mayor
Level 3:	**Partial Implementation**	• Nashville Greenways Plan • NashVitality • Nashville Open Space Master Plan
Level 4:	**Full Implementation**	• Mayor's Field Day • Walk 100 miles with the Mayor • Mayor's Challenge 5K
	Best practices	See Health and Livability Background Report
9. Diversity and Equity		
Level 1:	**Study**	Unknown
Level 2:	**Pilots**	Progress Made
Level 3:	**Partial Implementation**	[Progress Made in international diversity and pending Hispanic/Latino growth]
Level 4:	**Full Implementation**	More Progress Needed
	Best practices	See Equity and Diversity Background Report

10. Freedom to innovate in business, lifestyle and learning		
Level 1:	**Study**	Progress Made
Level 2:	**Pilots**	Progress Made
Level 3:	**Partial Implementation**	Progress Made
Level 4:	**Full Implementation**	• 40,000 businesses • Attracted more diverse & new business from across the country than any city its size over the past 20 years • "Who's who" of corporate relocations, HCA, Asurion, Bridgestone Americas, Nissan North America and more. • Mayor's Green Workplace Challenge
Best practices		See Economic Development Background Report; Education, Arts and Culture Background Report; and Health and Livability Background Report

Nashville's Current Situation and Next Steps

Status of Nashville's Progress in Comparison to Sustainable Characteristics and Case Studies

Next Steps

The following are divided into key three focus areas that demand prioritized attention to achieve needed short-term results.

Focus Area One: Hazard Adaptation Planning/Processes

1. During the NashvilleNext process, use the best practices identified in this report to develop a comprehensive Climate Risk Assessment, Climate Risk Reduction and Hazard Adaptation Strategy and Tactics Plan (described earlier in the report).
2. During the NashvilleNext process, expand the current background report exercise to include a more in depth literature search in regard to adaptation best practices and corresponding metrics for each of the characteristics and case study focus areas identified.
3. Assess and inventory land use planning and funding strategies and tools that are being used successfully around the world to effectively address hazard adaptation and sustainability in day-to-day planning department functions. Ensure that the best planning mechanisms are available for use by Metropolitan Davidson County (American Planning Association, 2011).
4. Integrate principles of eco-psychology, evolutionary psychology and the practices outlined in the book Fostering Sustainable Behavior into the NashvilleNext process and its implementation to hasten progress and to overcome likely barriers regarding cultural acceptances in Nashville to sustainability, hazard and climate change concepts and risks. (McKenzie-Mohr, 2011) (Gertner, 2009).

Focus Area Two: Hazard Adaptation / Restoring Resiliency in the Community Specifically Regarding Flood Hazards

5. To better use natural infrastructure to prepare for weather-related hazards, Metro should assemble a panel to define ecosystem-specific metrics for natural infrastructures. The panel should include academics, leaders in science and conservation and native plant professionals. A model hazard adaptation process (as described earlier in the report) should be used.
6. Conduct a "functional assessment" for local, ecosystems with specific metrics for each of the ecosystem related hazard adaptation characteristics listed in this background report. The metrics should be used to track the success of the strategies and tactics that are selected by the Hazard Adaptation Plan. They should also identify and track measures that restore and sustain natural infrastructure as regenerative systems.

Focus Area Three: Regional, Local and Individual Renewable Energy Generation and Efficiency

7. Investigate and document policies that will prioritize and reward the most aggressive adoption of progressive energy practices in Metropolitan Davidson County. These should include:

    - Significant demand tightening, strategic energy conservation practices with corresponding county specific metrics (radically efficient buildings; radical energy waste controls);
    - Micro-scale, distributed residential renewable energy generation and uses with corresponding county specific metrics; and
    - Macro or commercial scale, renewable energy generation and uses with corresponding county specific metrics.

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Appendix A – The Chicago Area Climate Change Quick Guide

http://www.chicagoclimateaction.org/filebin/pdf/Chicago_Quick_Guide_to_Climate_Change_Preparation_June_2008.pdf

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