greenokc

environmental & natural resources

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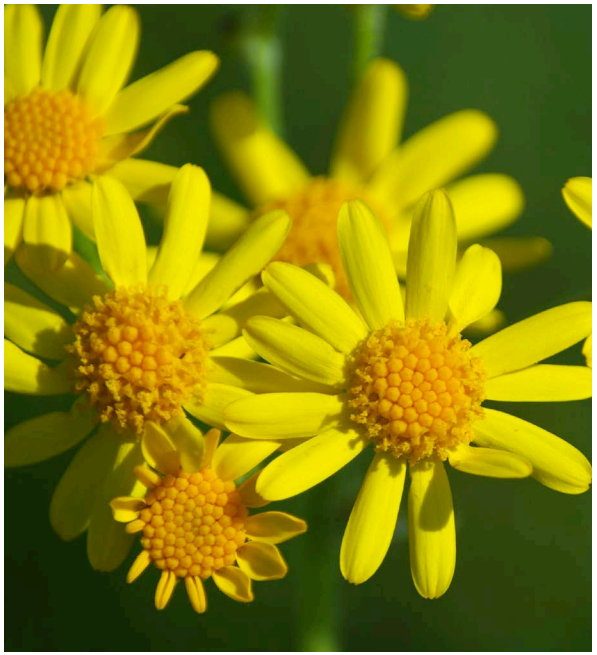
MARTIN PARK NATURE CENTER

Martin Park in northwest Oklahoma City epitomizes many of the ecologies and habitat areas that make the region distinctive. The park is home to many species of animals, including birds, butterflies, squirrels, fox and reptiles.



Our Situation

Oklahoma City's 621 square mile area includes many ecosystems, with 130 years of urban development overlaid on the original rolling prairies and forests of the Great Plains. While the prairies, streams, and forests have been occupied for millennia, large scale land conversion to cultivation, pasture, and urbanization began with the Land Run of 1889. As agriculture and urban development accelerated, we modified waterways, tilled soil, and built structures to meet human needs. Today, the developed city includes everything from farms to soaring skyscrapers. The natural environment – the land below and the sky above – envelops all of our human activity, and its health has a profound effect on the health of the city and its people. We value our environment for its beauty, recreational qualities, and the refuge it offers from the demands of city life. Too often; however, we take for granted a safe water supply, clean air, and rapid removal of waste products and stormwater. These resources are much more vulnerable than we might think.

Oklahoma City's urban and suburban neighborhoods, rural areas, agriculture, and natural landscapes are interdependent. The foundation of any city is based on its ability to provide clean water, fresh air, healthy food, and safety to its citizens, and a healthy natural environment is critical to this enterprise. Though urban development can threaten the very resources that help sustain us, successful planning for the wise use and preservation of our environmental assets begins with understanding some of our challenges.

greenokc is the environmental and natural resources element of planokc. This element assesses the impacts of development on ecological systems and recommends policies and practices that minimize negative impacts of land use and development on those systems. If we focus on the conservation of our valuable natural resources, we can successfully harmonize development and market demands with preservation of a healthy natural environment.

Land

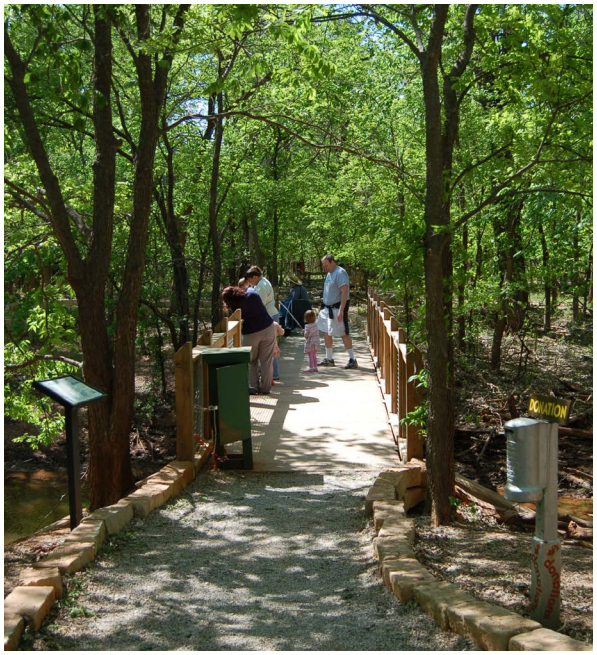
Like any city, Oklahoma City has an enormous, and inevitable, impact on its natural environment. Significant issues that we must address include the impact of development on natural features, loss of prime farmland, loss of natural features, and pollution. These issues and some solutions are discussed here.

Development. Oklahoma City's dispersed development pattern consumes open space, modifies floodplains, and disrupts other natural features and processes. This pattern increases threats to sensitive species, reduces biodiversity, and alters ecosystem functionality.

Agricultural Land. Dispersed development patterns consume prime agricultural lands. Because of its large area, the city encompasses extensive agricultural resources and active farming. Yet, of our prime

RIGHT

The park space shown here integrates built elements with natural elements creating an exciting public space.



farmland, 46% has already been converted to residential use (including acreages) and another 25% is zoned residential. With local and global food security issues on the horizon in the coming century, conversion of prime farmland to other uses should only be done in extreme circumstances.

Ecosystem Decline. In addition to farmland, our expansive city also incorporates extensive natural areas. One unique feature is the Cross Timbers, a mix of savanna, glade, and woodland that marks the transition between the Great Plains and eastern forests. The city also includes expansive prairie grasslands, which are the most altered and endangered ecosystem on the planet, and a variety of streams and wetland environments. Successful nature conservation requires not only that ecosystems be protected, but also that they be contiguous, with corridors for wildlife movement and sufficient space for plant and animal populations to flourish. Unmanaged development fragments ecosystems, making them less viable for wildlife and less useful and attractive to people.

Brownfields. Brownfields are properties that are or may be contaminated with environmental pollutants. Cleaning up abandoned or vacant brownfields can return the properties to productive use. Successful examples, such as the Skirvin Hilton Hotel and various MAPS projects, have increased awareness of brownfields and the federal, state, and city resources available. But past history, uncertainties about costs and liabilities, and lender and investor caution continue to hinder brownfield redevelopment. For projects not participating in the federal brownfields program, local regulations and due diligence requirements are inadequate for creating a predictable marketplace for brownfield development.

Land Conservation. Conservation is a solution to many of the environmental issues identified in greenokc. Conservation easements, for example, preserve landscapes while offering economic benefits to developers and landowners. Yet Oklahoma City has lagged in this area, reserving only about 40 acres of land through easements. In our own region, Edmond and Norman have been more effective in conservation through planning and acquisition of important land with local land trusts and can serve as examples for improvements in our city.

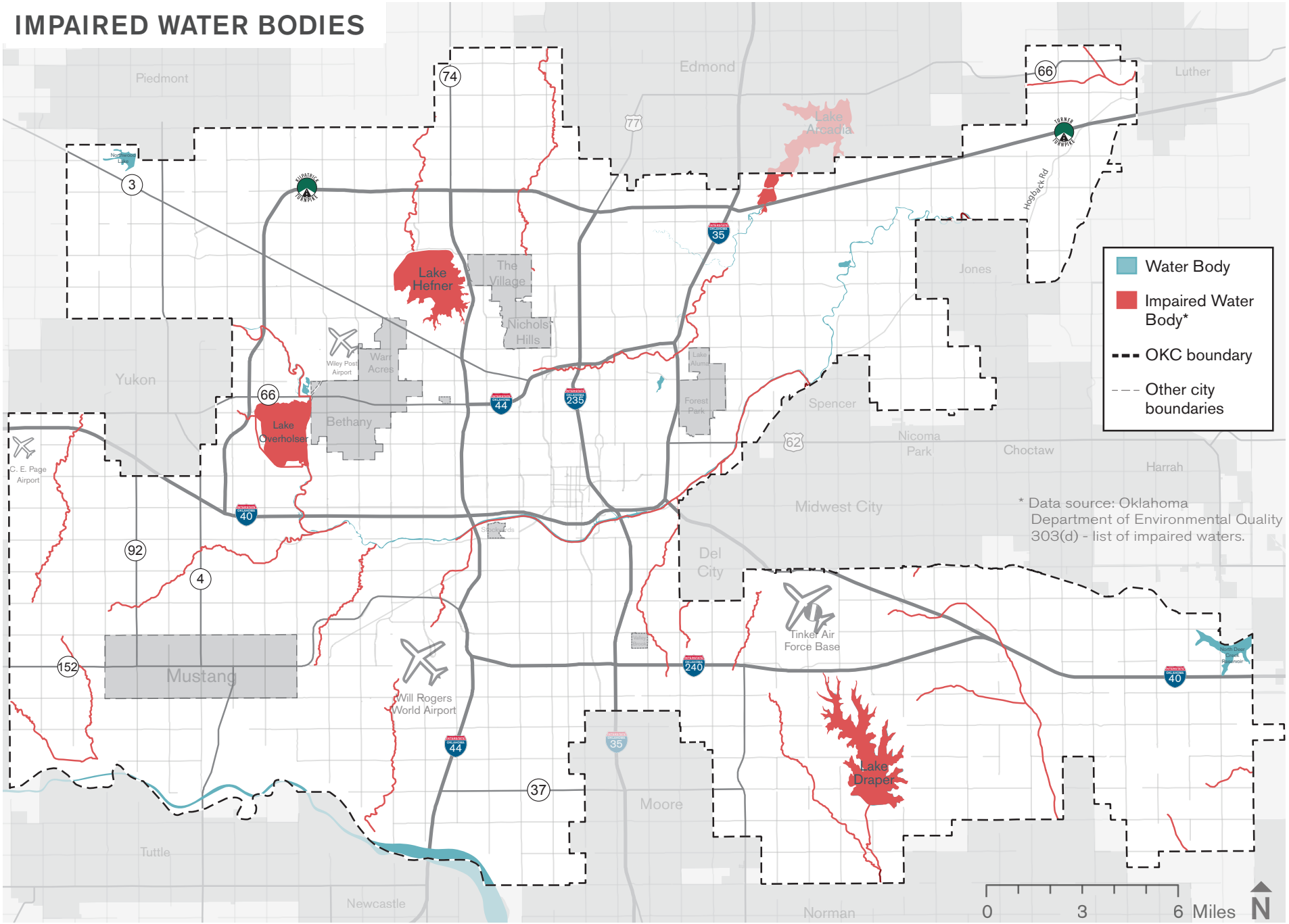
Water

The extent and nature of urban development has a major impact on Oklahoma City's critical surface water and groundwater resources. Key water-related issues include water quality, groundwater conservation, and the amount of impervious coverage, which affects both surface and groundwater.

Surface Water. According to 2011 data from the Oklahoma Department of Environmental Quality, 70% of Oklahoma City's major streams and lakes fail to meet water quality standards. These problems are largely caused by stormwater runoff that discharges contaminants into waterways and by inappropriate land use and management adjacent to surface water bodies.

Groundwater. A stable supply of water below ground is necessary to support agriculture, rural development, and some domestic water users. In Oklahoma City, our groundwater appears to be receding. According to a study released in 2014 by the U.S. Geological Survey and the Oklahoma Water Resources Board, the average depth to groundwater increased by 3.75 feet between 1987 and 2009. Based on the current maximum pumping rates allowed by the State of Oklahoma, the study indicated that if the maximum allowable number

IMPAIRED WATER BODIES



THE OKLAHOMA RIVER

A seven-mile stretch of the North Canadian (left), the Oklahoma River (right) is a series of river lakes that are bordered by landscaped areas, walking trails, and recreation facilities. Located in the heart of Oklahoma City, the Oklahoma River is home to the Boathouse District, which hosts numerous man-powered and motorized boating events, festivals, and races each year. In addition, the district is home to the OKC National High Performance Center, a training facility that has been named a U.S. Olympic & Paralympic Training Site by the U.S. Olympic Committee. Maintaining and improving surface quality is critical for the continued success, enjoyment and development of the Oklahoma River and the Boathouse District.

of wells is installed, the aquifer could be in danger of depletion in 35 to 41 years.

Impervious Coverage. Impervious coverage refers to land covered by hard surfaces, preventing the ground from naturally absorbing rainwater, which is a major cause of declining water quality. Research indicates that when 10% of a watershed has been converted to impervious surface, significant ecological damage has already been done. According to the City's Health Impact Assessment, of the city's 40 sub-watersheds, 16 are above 10%, and eight are between 5% and 10%.

Drainage solutions in use today have improved drainage but come with undesirable side effects. For example, channelization and other "hard" engineering solutions can speed the flow of contaminated runoff water into streams and lakes. Methods that manage runoff by mimicking landforms and natural drainage patterns can provide mitigation but are not widely used in Oklahoma City.

Air

The health effects of motor vehicle emissions is a serious issue for all cities, and especially Oklahoma City, where low population density contributes to the relatively high amount of vehicle travel for the movement of people and freight. Oklahoma City is already at risk of violating air quality standards, and compliance could become even more difficult if national concerns about climate change produce more stringent emissions standards in the future. Oklahoma's unusual weather patterns during the last few years give credence

OKLAHOMA CITY'S ECOSYSTEMS

Oklahoma City lies within the Cross Timbers region, an ancient ecosystem that spans much of central Oklahoma into eastern Kansas and central Texas. The Cross Timbers is a complex mosaic of savanna, glade, and upland deciduous forest dominated by post oak and blackjack oak. Historically, grasslands were interspersed throughout the oak forests, creating a rich transitional area between the eastern forests and the Great Plains.

This ecosystem once supported vast assemblages of wildlife, including great herds of bison and other grazing animals. Even today the remaining Cross Timbers area serves as habitat for significant populations of mammals and birds, which benefit from the area's rich diversity of flora.

FOREST

The relatively short, gnarled trees of the Cross Timbers belie its status as ancient woodland. Its appearance is less dramatic than other ancient North American forests. Trees average only 15-40 feet in height and 10 to 20 inches in diameter; however, many existing post oaks and blackjack oaks are 200 to 400 years old. As a result of its diminutive size, the Cross Timbers remains underappreciated as an ecosystem, and most of the forest has been cleared for agriculture. Paradoxically, the modest stature of these trees has served to protect remnant stands of ancient forest, since the forests' noncommercial timber value limits industrial logging. Important patches remain, especially on steep or rocky terrain.

The Cross Timbers are unique in the world for their assemblage of plants and animals. Existing stands of forest in Oklahoma City have been mapped and identified as Environmentally Sensitive Areas in plan**okc.** Creating wildlife corridors to connect remnant patches will help safeguard the viability of this important ecosystem.

GRASSLANDS

Globally, grasslands are the most altered and endangered of all ecosystems. Temperate grasslands, which include the North American Great Plains, are even more vulnerable, with only about 3% protected from development. Though data on the current range of grasslands exist for most other central U.S. states, no maps or range estimates are available for Oklahoma. Consequently, the extent of remaining prairie in Oklahoma City is unknown.

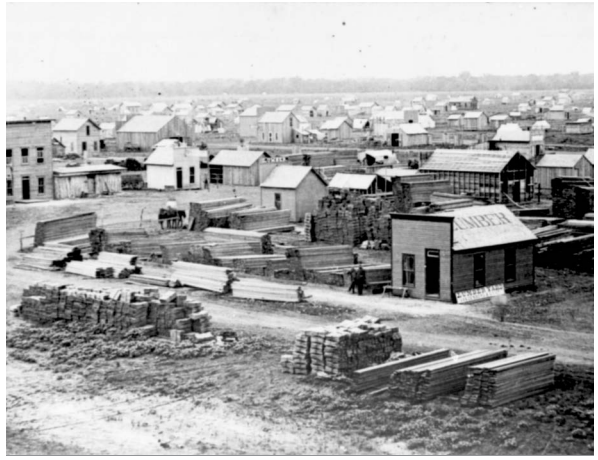
Historical data indicate that tallgrass prairie once dominated the central portion of Oklahoma from north to south. Reaching heights of nearly 10 feet, the primary species were big bluestem, little bluestem, Indian grass, and switchgrass. Numerous other perennial grasses and forbs were present. In fact, as many as 300 different plant species can grow in just three acres of North American tallgrass prairie, and insect populations can be as high as three million individuals per acre.

The decline of prairie extent in the United States ranges from 80% to 99%, primarily due to plowing and urbanization. However, ranching has preserved tallgrass prairie in some parts of Oklahoma. A major benefit to conservation of prairie is its compatibility with ranching when appropriate management practices are employed.

IMPACTS

Humans have impacted the landscape in central Oklahoma for thousands of years. The first prehistoric Native Americans arrived in Oklahoma 10,000 to 20,000 years ago, and their arrival corresponded with significant changes to the fauna of the region, resulting from hunting, gathering, and use of fire to modify ecosystems. Starting in the 1830s, the relocation of Native American tribes from other regions into Oklahoma and the large influx of European settlers in the late 1800s initiated many of the trends we see today.

- Wildfire: In addition to fires started by lightning, fire was deliberately used by Native Americans to maintain open grasslands and savannas, with new regrowth attracting a wide variety of grazing animals. However, beginning with European settlement and fragmentation of the grassland, controlled fire practices dwindled. As a consequence, growth of denser forests and build-up of underbrush lead to hotter, more damaging fires when they eventually occurred. This pattern continues today.
- Herbivory: The rich faunal heritage of the plains included many grazing and browsing animals. This assemblage included bison, elk, mule deer, white-tailed deer, and pronghorn antelope, as well as many small animals.
- Drought: Recurrent droughts tend to limit native vegetation, causing periods in which vegetation abundance and range can decrease.
- Grazing by domestic animals: Less than optimal management practices, where domestic grazing animals feed on grasslands at too high a density, for too long, or during the wrong season, can lead to overgrazing. Overgrazing causes significant changes to the ecological community, as well as erosion. However, grazing can be consistent with positive environmental health in grasslands, when grazing practices mimic those of wild herbivores.
- Decline of keystone species: Keystone species, which are species that play a disproportionately large role in maintaining ecosystem function, included buffalo and prairie dogs on the Great Plains. Loss of keystone species can have major impacts on animal and plant communities and on ecosystem processes, such as groundwater recharge.
- Invasive species: Overgrazing can prime the land for invasion by non-native plant species that are often less palatable to grazing animals. Invasive species are one of the primary causes of biodiversity loss, as non-native species may out-compete native species and disrupt ecological communities.
- Plowing: Plowing causes some of the most dramatic impacts on the landscape. Destruction of the native prairie ecosystem has wide-ranging effects, altering biodiversity, erosion, soil fertility, and groundwater hydrology.
- Urbanization: Together with plowing, urbanization is among the most detrimental forces on native ecosystems. Urbanization leads to changes in ecosystem dynamics, nutrient cycles, groundwater hydrology, and a host of other natural processes. These factors are the primary concern of green**okc**.



OMRF RESEARCH TOWER

The Oklahoma Medical Research Foundation's research tower was designed with sustainability in mind, and earned LEED Gold certification. Energy management practices will save the equivalent of 44,000 gallons of gasoline and will reduce carbon dioxide emissions by 2 million pounds every year. The building's most distinctive feature is its rooftop wind farm, using 18 wind turbines to supply needed electricity to the building's systems.

to these concerns. The city's primary air quality issues involve ground level ozone, greenhouse gases (GHG), and air temperature.

Ozone & Greenhouse Gas Emissions. Ozone is a chemically active form of oxygen produced when motor vehicle and industrial emissions react with sunlight. Far in the upper atmosphere, ozone absorbs harmful ultraviolet radiation from the sun. However, when concentrated at ground level, it harms human respiratory systems and environmental health. During the last decade, our metropolitan area has seen a steady increase in the number of days per year that ground level ozone was listed as the main pollutant on the Air Quality Index.

Air Temperature. In addition to the impact of GHGs on overall climate, Oklahoma City's urbanized area creates a "heat island" that is 3.6ºF warmer during the day and 5.4ºF warmer at night than surrounding rural areas. This is caused by lack of vegetation and a high percentage of surfaces that absorb heat during the day and radiate it at night. Heat islands can impact personal, environmental, and economic health by contributing to heat-related illnesses, impaired air and water quality, and increased energy consumption.

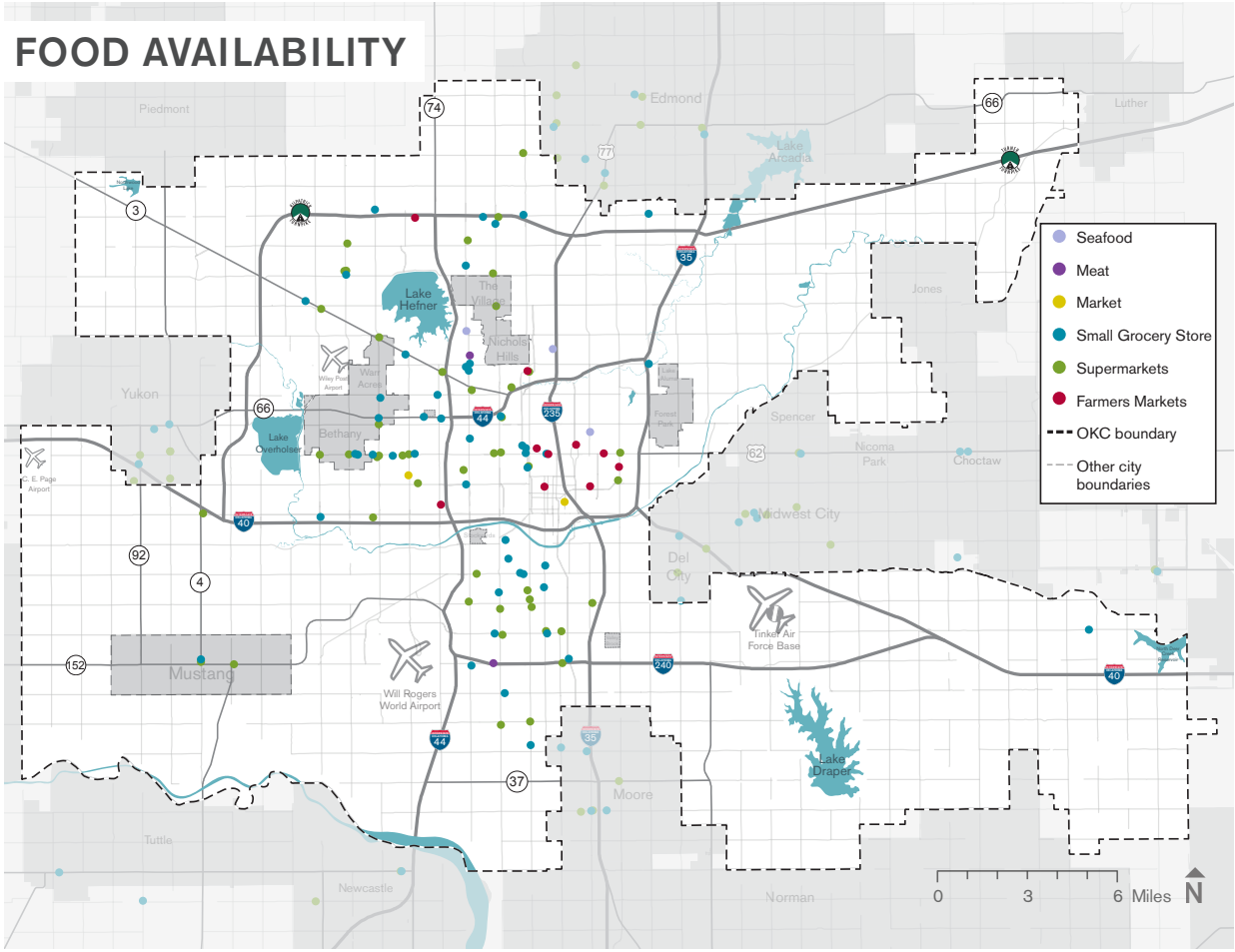
Energy and Buildings

Nationally, buildings account for a larger share of total energy use and carbon dioxide emissions than the transportation and industrial sectors, including over 70% of electricity consumption. The number of "green" buildings in the city certified under the LEED (Leadership in Energy and Environmental Design) program is increasing, led by the achievement of gold level certification by the Devon Tower and Oklahoma Medical Research Foundation's Research Tower.

While headline projects like these provide excellent models for what can be done, sustainable practices and their benefits are within reach of everyone. However, many of our buildings use outdated design and construction techniques and materials. For example, conventional development continues to favor low-density, single purpose buildings over vertically integrated structures. This increases the amount of exterior wall in relation to floor area and, consequently, air conditioning requirements. Poor ventilation coupled with interior finishes like carpeting, paint, and adhesives that contain chemicals can degrade indoor air quality. Outside the building, we use landscape materials that require a great deal of water and energy to maintain, in turn requiring civic infrastructure investments that lead to higher costs for water customers. All too often, projects focus on short-term finance, using techniques

FOOD AVAILABILITY IN OKLAHOMA CITY

Many neighborhoods lack access to supermarkets, small groceries, and other outlets for fresh and healthy food. This low accessibility is especially pronounced in the northeast part of the city. According to the planokc Health Impact Assessment, simply having access to a grocery store does not mean that a person has access to healthy options, as many stores may only offer low-quality foods or may charge a much higher amount for organic or healthier options. In order to account for this, the NEMS-S (Nutritional Environment Measures Survey - Supermarkets) was used as an evaluation tool to provide a solid metric by which to compare the quality of major grocery stores in Oklahoma City. This score, combined with a service area of 1 mile, gives a better understanding of those in the city who have access to healthy foods. Based on this approach, it was determined that only 1 in 5 Oklahoma City residents live within a mile of an above average grocery store that provides affordable, healthy options, while 62% of residents have no grocery stores whatsoever within a mile of their home.



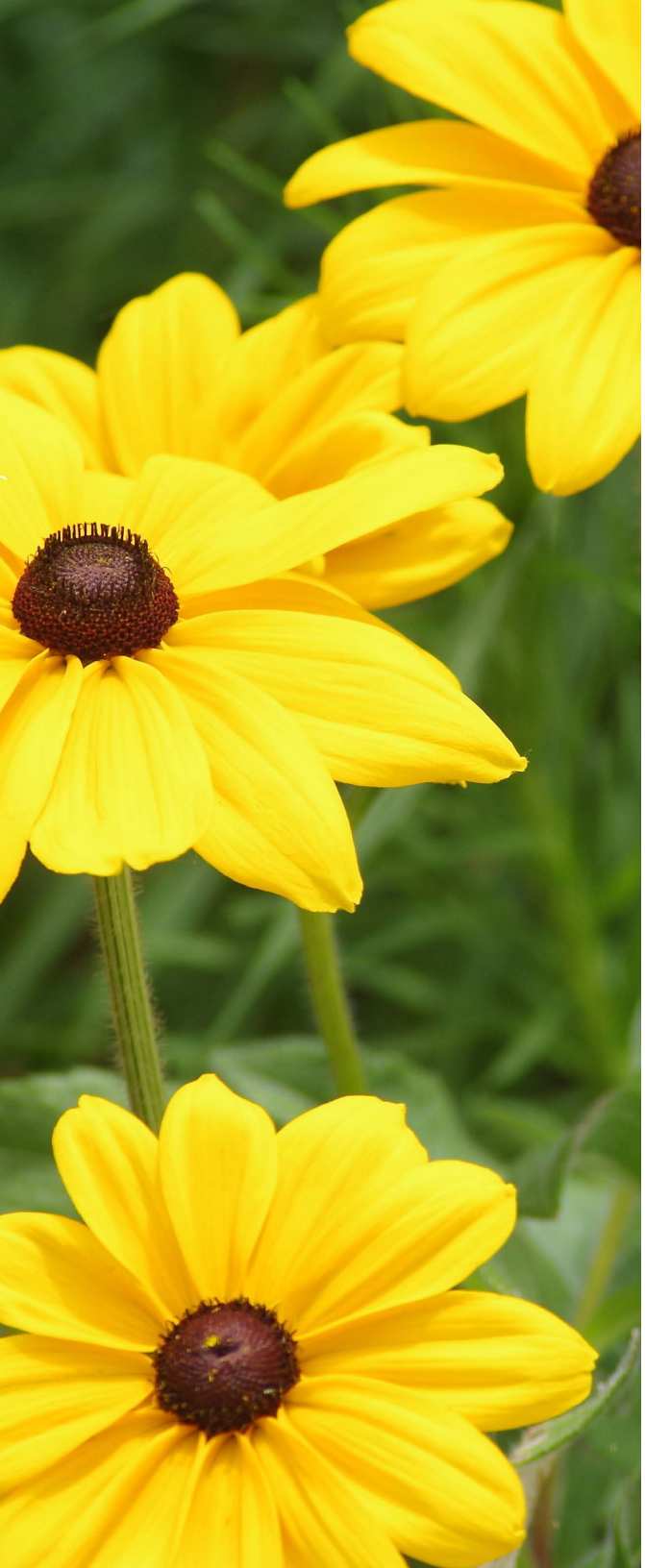
and materials that appear economical up front but are ultimately very expensive to maintain over the life of a building.

People often equate "green" or "sustainable" design with exotic technologies and high cost. Yet buildings that lack green certification can also benefit from improved efficiency. Application of the EPA's Sustainable Design and Green Building Assessment to Oklahoma City found a variety of barriers, many of which can be addressed through policy change and incentives. We can also provide an example to developers and save taxpayers money by adopting sustainable and green building standards in municipal buildings.

Local Food Systems and Accessibility

Two food issues affect Oklahoma City: food accessibility and locally produced food. Some Oklahoma City neighborhoods lack access to fresh, healthy, and affordable food. These neighborhoods, referred to as "food deserts" by the U.S. Department of Agriculture, are low income communities with few grocery stores, supermarkets, or farmers markets. Lack of grocery access leaves people with few options, leading to higher consumption of unhealthy foods from convenience stores and fast food restaurants.

Locally produced food, which is locally grown and/or processed, benefits people, the economy, and the environment. Consuming sustainably grown fresh fruits and vegetables benefits health, and the economy benefits because a higher percentage of money remains in local circulation when food is purchased directly from the producer. Environmental benefits derive from decreased transportation emissions and because many small producers use more environmentally friendly growing practices. Due to these benefits, demand for locally grown food is high, and it generally outpaces supply in Oklahoma City. More must be done to stimulate production and distribution, particularly of fruits and vegetables, which are in high demand.



Our Plan

Our plan for implementing greenokc begins with understanding the relationship between how we develop land and the health of our environment. Equipped with this information, we can move forward on three tracks: 1) protecting our most important environmental features, 2) restoring and enhancing natural richness in urban, suburban, and agricultural areas, and 3) increasing sustainability by improving the built environment, supporting food access and local food systems, and fostering a culture of environmental stewardship. In the process, we will produce a greater harmony between the built and natural environments, to the benefit of both.

Oklahoma City's environment is approached in different contexts: the built-up city, the developing city edge, and rural areas that are beyond the reach of projected development. In built-up urban areas, we focus on the impact of the built environment and providing access to green space. At the urban fringe, concerns center on the use of land and protection of greenway corridors in newly developing areas. In rural areas, issues include both the protection of environmental features and the control of pollutants that can degrade land and waterways. Our policies must protect these important land-based assets.

Our Goals

BIOLOGICAL RESOURCES

1. Oklahoma City values, protects, and preserves its biological resources.

WATER RESOURCES

2. Oklahoma City enjoys safe drinking water, conserves waterways, wetlands and other water resources, and employs practices that protect water quality.
3. Flooding risk is minimized.

ENVIRONMENTAL HAZARDS

4. Oklahoma City manages, remediates, and/or mitigates environmental hazards to minimize risks to the public.

ATMOSPHERE AND CLIMATE

5. Oklahoma City consistently meets and exceeds federal air quality standards and actively pursues ways to protect air quality.
6. Oklahoma City's built environment is designed to minimize the effects of urban heat islands.

AGRICULTURE AND FOOD

7. Oklahoma City protects and supports the ability of residents and businesses to produce, process, distribute, and sell food products.

OPEN SPACE, CONNECTIVITY, AND FRAGMENTATION

8. Oklahoma City has an interconnected network of natural areas and protects its environmental assets.

GREEN BUILDING AND SUSTAINABLE DEVELOPMENT

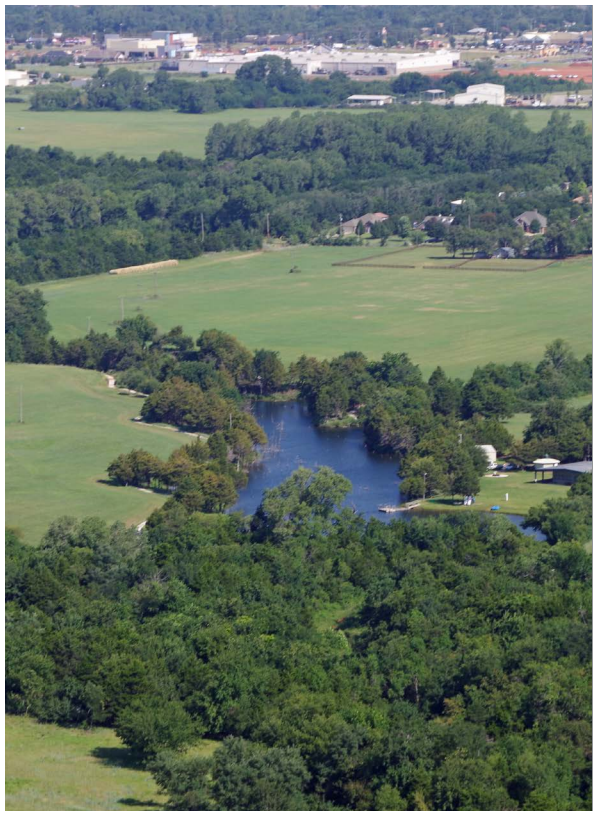
9. Oklahoma City is a model of energy efficiency and conservation, and sustainable building practices and products.
10. Context-sensitive development and redevelopment support a healthy balance between the built and natural environments.

Our Initiatives

greenokc Initiatives	greenokc Goals 1	2	3	4	5	6	7	8	9	10
1. Preserve or enhance natural areas and open space connectivity.	■	■						■		
2. Improve water quality and conserve water resources.		■	■							■
3. Establish a comprehensive urban forestry program.	■							■		
4. Reduce the impacts of environmental hazards.			■	■						
5. Improve air quality.					■	■			■	
6. Increase the use of green building practices.									■	■
7. Increase the availability of locally grown food.							■			
8. Promote environmental stewardship.		■		■					■	
9. Enrich biodiversity and natural habitats in urban, suburban, and agricultural areas.	■	■								■

"The intersection of lifestyle and conservation is urbanism... The good news is that truly great urban places also happen to be the most environmentally benign form of human settlement and are at the heart of a green future."

- Peter Calthorpe, 2012



PRESERVE NATURAL CHARACTER

70% of Oklahoma City residents support preserving natural areas through regulations, and 68% of residents support preserving natural areas through incentives when asked as part of the 2013 planokc ***Citizen Survey***.

WILDLIFE AND VEGETATION CORRIDOR

Development designed to maintain corridor connectivity through a subdivision (Montgomery County, MD)

INITIATIVE 1

PRESERVE OR ENHANCE NATURAL AREAS AND OPEN SPACE CONNECTIVITY

We will protect significant natural features. The boundaries of Oklahoma City encompass a variety of well-preserved natural features, such as grasslands, riparian areas, upland forests, and sensitive aquifers, which contribute to the landscape in a number of ways. They contribute to our economic strength by increasing the attractiveness of the city, which improves competitiveness in the global marketplace. They provide ecosystem services, such as filtering water, cleaning the air, and providing food and habitat for birds that eat insect pests, and bees that pollinate crops. Moreover, they contribute to quality of life for residents and visitors, providing the benefits of recreation, beauty, and distinctive character.

Protection of significant natural resources is based on a map of Environmentally Sensitive Areas (ESAs), which has already been completed. The resulting regional inventory provides information for developers and property owners to use as they design developments to ensure they avoid impairing significant features. Using mapped ESAs as a baseline, we will elaborate a policy to protect ESAs that specifies methods to mitigate damage to natural features (see Chapter 2 for overview).

We will develop and protect a network of green spaces that preserves environmental assets and connects habitats for wildlife. An effective conservation plan will ensure not only that environmentally significant areas are protected, but also that they are connected via wildlife corridors, remain minimally fragmented by roads and other infrastructure, and represent the natural ecosystem diversity of the area.

Connectivity: Connections between protected areas maintain the viability of wildlife populations, enhance biodiversity by accommodating more species, and provide corridors that allow wildlife to move safely between habitats. Current development patterns often break connections between green spaces, particularly where they cross boundaries of ownership or development projects. We will identify opportunities to develop a connected network of ESAs and other green spaces using existing and potential trail corridors, greenways, open spaces, wetlands, forests, waterways, and natural areas. The resulting guidance for development will ensure that connections between green spaces are maintained.

Minimal fragmentation: Current practices allow large natural areas to be fragmented into multiple smaller areas by infrastructure, such as roads, fences, pipelines, and transmission lines. These features, as well as noise, disrupt the dispersal of plants and animals. Guidelines will be adopted to minimize fragmentation by directing infrastructure to locations with least impact, minimizing the amount of habitat disruption around the infrastructure, and utilizing best practices to restore damaged habitat.

Representativeness and heterogeneity: A strategy to protect ESAs will employ principles of representativeness and heterogeneity. Representativeness ensures that green spaces exemplify the range of natural diversity in our area, including diversity of species, ecosystems, and geology. Heterogeneity favors green spaces that include a mix of ecosystems closely grouped together, as these spaces are shown to harbor greater biodiversity than more homogenous green spaces.

We will develop a package of incentives and requirements to ensure developments near natural features minimize adverse impacts. The ESA inventory and green space network will be protected through a combination of requirements and incentives. Requirements will minimize disturbance of targeted areas with highest ecological value. In addition, because property owners and developers should not be penalized for responsible development of land near ESAs and corridors, we will establish tools and incentives for properties to be developed in ways that minimally impact natural areas and

LOW-IMPACT DEVELOPMENT

Low-impact projects incorporate innovative and attractive design features such as pervious pavements, rain gardens, chokers, vegetated swales, landscaped parkways, and alternative curbing and green drainage designs.

incorporate green features into their designs. For example, one such technique is conservation design, which preserves permanent open space while allowing an equal or greater development yield to that permitted by the site's underlying zoning. Permanent open space is often protected through conservation easements, which may be donated to a public or nonprofit body in exchange for tax advantages.

Policies G-1, G-2, G-3, G-4, G-5, G-6, G-7, G-8, G-9, G-10, G-13, G-14, G-15, G-16, G-18, G-20, G-21, G-22, G-23, G-24, G-25, G-27, G-29, G-30, G-35, G-36, G-43, G-44, SU-8, L-34, L-41, P-4, P-18, P-25, P-31, and ST-17 implement this initiative.

Oklahoma City's urban water resources include both surface water, in its lakes and streams, and groundwater. We must develop and manage water resources in ways that guarantee safe drinking water, conserve water-related resources and environments, protect water quality, and minimize the risk of flooding and related injury and property damage. Initiatives to accomplish these overall goals include controlling the volume, velocity, and quality of stormwater runoff; maintaining the quality of lakes and streams; and avoiding unnecessary use of water in a dry climate.

INITIATIVE 2

IMPROVE WATER QUALITY AND CONSERVE WATER RESOURCES

We will develop a comprehensive strategy to improve water quality in Oklahoma City's major watersheds, including standards against which development and management practices can be measured. Most of Oklahoma City's water bodies are impaired and do not meet state or federal water quality standards, which increases costs and has negative impacts on recreation, public health, and fish and other aquatic species. We will take a comprehensive approach to address development standards and management practices to reverse water quality trends and bring water bodies into compliance with clean water standards. The approach will specify the water quality goals to be achieved in each watershed, identify the contributors to impaired water quality in each watershed, and utilize a combination of development standards, management practices, and targeted projects to achieve specified performance targets. Because water quality impairments arise from contamination at multiple scales, from individual properties to full watersheds, solutions must also be identified across scales.

We will make maximum use of green infrastructure, on-site storm water management, and other best practices to reduce the negative impact of floods and other significant events on water quality. Most waterway pollution in Oklahoma City results when rainwater or irrigation washes across lawns, agricultural areas, and impervious surfaces such as streets and parking lots. As it moves, it picks up fertilizers, pesticides, heavy metals, and microbes and deposits these contaminants into waterways. Water is naturally filtered when it is allowed to seep into the ground, when it moves slowly enough that sediment settles out, and when it is taken up by trees and plants. However, while much of the infrastructure constructed to move stormwater, such as channelization of waterways and rerouting or disconnection of streams, is efficient at moving water, it also increases the volume and velocity of runoff. This creates additional problems such as polluting waterways, diminishing biological features, and even flash flooding.

Alternative solutions, such as green infrastructure and on-site stormwater management, are designed to address both flood control and water quality. Examples include vegetation buffers adjacent to lakes and streams, maintenance of natural drainageways, permeable pavement, low-impact development, and landscape designs to slow water runoff from parking lots and

other large expanses of pavement. These methods can be incentivized or regulated in order to achieve specified performance standards. We will maximize the use of these practices, which conserve natural features and work with, rather than against, the landscape's natural drainage patterns.

We will make maximum productive use of water resources by promoting appropriate and safe use of recycled water. Currently, most water that is used for irrigation comes from the drinking water supply or from underground aquifers. In the summer and during times of drought, irrigation on large sites, such as golf courses, depletes the water supply. Some cities have effectively used reclaimed water for large-scale irrigation. Reclaimed water is former wastewater that is treated to remove solids and impurities. Oklahoma City has tested this on a limited basis and found it to be safe and effective at limiting the use of water resources that are best reserved for other purposes.

We will restrict development densities or require community wastewater treatment in areas without sanitary sewer service. Most of the city's territory outside the urbanized area lacks sanitary sewer service. Feasible sewer extensions will provide service that supports urban density to some of this area. However, much of the area lacks the population density or has topographic characteristics that make sewer extensions unlikely in the foreseeable future. In these areas, developments typically use on-site treatment systems, usually septic systems, to manage wastewater. These practices require large minimum lot sizes and are sometimes inadvisable because of soil conditions. In these areas, new development should either be limited to very low densities or required to use integrated conservation design with a centralized treatment facility or other environmentally sensitive systems for wastewater treatment.

Policies G-2, G-4, G-5, G-6, G-7, G-8, G-9, G-11, G-12, G-13, G-14, G-15, G-16, G-17, G-18, G-19, G-22, G-27, G-30, G-35, G-36, P-18, P-25, and P-27 implement this initiative.

Oklahoma City's urban forest is one of the most important components of our natural and built environment. This resource, like any major asset, requires careful management to ensure its health. This is especially true now as our urban forest is facing several challenges. One such challenge is associated with the overuse of popular species and the threat of diseases to these species. Another challenge involves the use of introduced, non-native, or invasive species that can require additional resources and endanger the natural environment around us. Utilizing the right tree in the right place is essential to the success of our urban forest. Yet, the lack of an urban forestry program and a City Forester limits our efforts to manage and protect this asset.

POOR SEDIMENT CONTROL

Establishing and improving performance standards for sediment control have both localized and watershed-wide benefits.

INITIATIVE 3

ESTABLISH A COMPREHENSIVE URBAN FORESTRY PROGRAM

We will establish an urban forestry program, directed by a city forester, to manage and improve the city's tree canopy. This program's primary function will be to preserve and manage the existing tree canopy, increase the area with tree cover, and ensure that new projects utilize landscape materials appropriate to Oklahoma City's climate and environment. This will be accomplished by:

- Monitoring and managing the City's "urban forest," the trees on public lands and right-of-ways;
- Providing technical assistance and advice to private residents, businesses, and property owners; and
- Developing enforceable standards and incentives through preparation of an Urban Landscape Guide and revision of the existing landscape ordinance. Ordinance revisions should improve landscape requirements and provide both requirements and incentives for tree preservation in new projects.

Policies G-2, G-4, G-5, G-7, G-8, G-14, G-21, G-24, G-25, G-26, G-27, G-29, and G-30 implement this initiative.

EDUCARE

Above: Redevelopment of a brownfield site for a new early childhood education facility focused on disadvantaged children.

In some parts of Oklahoma City, previous uses have left environmental hazards behind. These may range from a former gas station that has left gasoline in the soil to large sites that could have a variety of serious contaminants. In other locations, hazards may exist due to other factors, such as weather / storm damage, flooding, tree diseases, pesticide and herbicide use, and others. Regardless of the cause, it is important to deal with hazards whenever possible. Hazards, even when latent, can pose significant harm to people and should be remediated, mitigated, and/ or neutralized whenever possible. Also, hazards can make sites unusable which may affect surrounding neighborhoods and prevent productive reuse.

INITIATIVE 4

REDUCE THE IMPACTS OF ENVIRONMENTAL HAZARDS

We will maintain our active brownfields redevelopment program. The Environmental Protection Agency defines brownfield sites as "real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant." Many of these sites were occupied by industrial operations that used or produced hazardous materials, salvage yards, and some types of commercial uses. A lack of knowledge of the prior uses of these sites could lead to contamination of ground or surface water and other hazards to public health. Oklahoma City has an active brownfields mitigation program in place that maintains information on sites. The City will also continue to assist potential developers by identifying available financing options and other incentives, and helping to assemble funding packages that can encourage redevelopment.

We will require that sites with environmental hazards are properly cleaned up and mitigated before issuing development permits. The brownfields site inventory helps ensure that future reuse of these sites includes proper mitigation procedures. To this end, proof that hazards have been removed in compliance with federal, state, and local requirements will be required before the City issues grading, building, or any other type of development permit.

Policies G-1, G-10, G-14, G-18, G-19, G-20, G-27, G-28, G-30, G-31, G-32, G-34, G-35, L-29, E-18, and P-29 implement this initiative.

Discharges into the atmosphere affect us at all levels, from our own individual wellbeing to the wellbeing of our entire world. Nothing ties the citizens of Earth together more than the air above us, and nowhere do individual actions have a greater impact on everyone else. Ultimately, we all quite literally breathe the same air. At a city scale, the variables that most significantly influence the atmospheric environment involve how we travel, build, generate power, and protect the natural resources that mediate the environmental impact of the city.

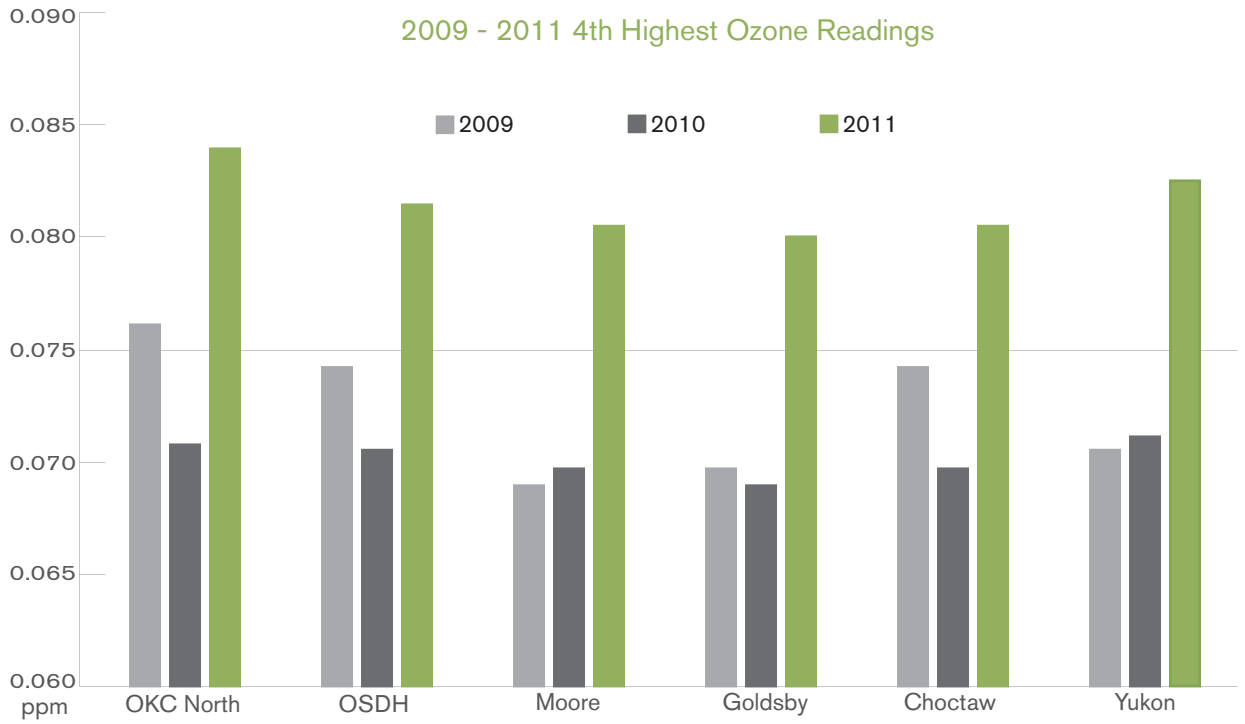
INITIATIVE 5

IMPROVE AIR QUALITY

We will adopt land use and development practices that reduce the distance people must drive to meet their daily needs. In Oklahoma City, transportation is the principal cause of our most significant air quality problems. The policies included in the land use and transportation elements of plan**okc**, which promote more compact development, mixed use, and improved transportation choice, will have a beneficial effect on automobile emissions. While cars will continue to be the primary means of transportation in Oklahoma City, even

REDUCE EMISSIONS

69% of Growth Scenario Workshop participants indicated that the City should guide new development so that it is more compact, walkable, and transit friendly, thereby reducing automobile emissions.



GROUND LEVEL OZONE

Due to Oklahoma City's high reliance on single occupant commuter vehicles and continued population increases in historically rural areas, Oklahoma City's air quality is at risk of further decline. The current standard for ground level ozone is 0.075 ppm. Data courtesy of the Association of Central Oklahoma Governments.

A QUICK CALCULATION

Oklahoma City has about 227,000 households, according to the Census Bureau's American Community Survey. Most studies and trip generation estimates indicate that the typical household generates 10 trips daily. In Oklahoma City, this equals about 2.3 million trips. Estimates of the percentage of trips under two miles range from 25% to 40% of the total. For OKC, this ranges from 575,000 to 920,000 trips per day. If only one-quarter of these trips were made by active transportation modes (on foot or by bike), between 143,000 and 230,000 trips would be diverted from cars – the total number of trips on two of our busiest freeways. Assuming an average trip length of one mile, this means that in a course of a year, Oklahoma City residents would drive between 52 and 84 million fewer miles per year! According to the Environmental Protection Administration's report on Average Annual Emissions, a typical car emits .81 pounds (368.4 grams) of carbon dioxide per mile driven. So if one-quarter of short trips in our city were made by walking or biking, we would reduce CO_2 emissions per year by between 42 and 68 million pounds annually.

small changes in the number of miles driven, combined with greater fuel efficiency and technologies that reduce emissions, will substantially improve air quality.

We will coordinate initiatives and regulatory changes with local, regional, and state agencies to reduce motor vehicle emissions. In addition to reducing the number of miles that each person must drive, we need to make the vehicles that we use more efficient. We will improve overall fuel efficiency and reduce emissions by taking actions alone or in concert with other agencies that will increase use of alternative fuels in public and private car fleets, and consider new legislation and implement educational programs to reduce unnecessary emissions.

We will develop incentives and adopt regulatory standards to reduce transportation emissions. In addition to reducing the number of miles driven, we must also improve vehicles fuel efficiency and emissions standards. Working in collaboration with local, regional, and state agencies, we will seek to increase use of clean fuels in public and private automobile fleets, consider new legislation, and implement educational programs.

We will preserve forests and encourage tree planting to improve air quality. Vegetation, particularly trees, plays a large role in both regulating and improving air quality, especially in urban areas. Trees absorb carbon dioxide and other gases, while replenishing the atmosphere with oxygen. They also help trap particle pollutants that can damage human lungs. We will

BENEFITS OF TREES

Trees absorb carbon dioxide and potentially harmful gasses such as sulfur dioxide from the air and release oxygen that humans, and other species, need for survival.

According to the North Carolina State University Cooperative Extension, trees provide the following benefits related to air quality and air pollution reduction:

- One large tree can supply a day's supply of oxygen for four people.
- A healthy tree can store 13 pounds of carbon each year. For an acre of trees, that equals 2.6 tons of carbon storage.
- Each gallon of gasoline burned produces almost 20 pounds of carbon dioxide. For every 10,000 miles driven, it takes 7 trees to remove the amount of carbon dioxide produced if the vehicle gets 40 miles per gallon (mpg); it will take 10 trees at 30 mpg; 15 trees at 20 mpg; 20 trees at 15 mpg; and 25 trees at 12 mpg.

improve our landscape ordinance to more effectively increase tree cover, reduce airborne pollutants, and reduce surface temperatures in the summer. We will also preserve existing trees and forested areas and encourage new tree plantings associated with development and streetscape projects.

Policies G-9, G-10, G-23, G-24, G-25, G-29, G-30, G-31, G-32, G-33, G-34, G-35, G-36, SU-2, SU-19, C-11, C-13, C-16, C-20, C-21, C-29, C-35, C-36, C-38, C-39, and C-42 implement this initiative.

INITIATIVE 6

INCREASE THE USE OF GREEN BUILDING PRACTICES

We will develop and adopt performance standards for buildings. When used appropriately, green building techniques reduce energy consumption, lower greenhouse gas emissions, and improve indoor air quality, among other benefits. An example of a green building standard is the use of building and roofing materials that reduce undesirable summer heat gain both in and around the building. We will adopt standards that focus on the most important results and are generally accepted as reasonable by builders, building managers, architects, and others in the development industry. The standards will offer substantial efficiency and emission control improvements over current codes and be cost effective over the life cycle of the building.

While new performance standards are principally designed for multifamily residential and non-residential uses, a parallel "Healthy Building Standards Code" will be developed and implemented for single-family homes and other smaller residential structures. This code will encourage construction of long-lasting, health-promoting, and energy efficient homes that incorporate proven building materials, low water use fixtures, and innovative design and construction techniques.

We will improve the energy efficiency of City buildings. City government should lead the effort to demonstrate the economic and environmental benefits of buildings that operate more efficiently, especially when good practices can provide significant improvements in air quality and long-term savings to taxpayers. In providing this leadership, the City should develop and implement an energy management plan for its buildings that emphasizes practical steps that provide the best return per dollar spent. A key part of the plan involves establishing energy efficiency and emission standards and practices for new and retrofitted City facilities. Execution of the management plan involves careful monitoring of energy consumption and water use to track progress and identify opportunities for improvement.

Policies G-1, G-2, G-3, G-5, G-9, G-10, G-12, G-14, G-18, G-19, G-20, G-29, G-30, G-31, G-34, G-35, G-36, E-36, P-27, and SE-8 implement this initiative.

LOCALLY PRODUCED FOOD

Farmers markets are a great place to find locally-grown produce for a reasonable price.

Residents and businesses in our city should have the ability to produce, process, distribute, and sell food products, and should have a healthy environment that provides convenient access to healthy food choices for all citizens. Agriculture on the city edge and on an urban scale within the city can advance environmental conservation, return land to productive use, and address local food issues. Indeed, food choices and consumption are linked to the health and wellness of the community, the quality of life for its members, and the amount of private and public resources devoted to health care.

In Oklahoma City, and other peer cities, knowledge of and access to healthy food are not equal in all areas, and low-income and older neighborhoods are especially at risk. Oklahoma City, with its large areas of agriculture and rural land and significant vacant areas within the city, has a unique opportunity to use local food production to increase economic opportunity and improve the health of both our environment and our people.

INITIATIVE 7

INCREASE THE AVAILABILITY OF LOCALLY GROWN FOOD

We will establish an awareness of agriculture in and around the city as important to both food security and open space preservation. We tend to think of farming around cities as a temporary use that disappears when development takes over. Yet our city includes rural land that is likely to remain in agricultural use. This gives us the unique ability to integrate farming into the structure of the city. We can build public awareness and

A HEALTHY FOOD AWARENESS CAMPAIGN

An effective and far-reaching campaign that introduces people to the benefits of healthy eating and makes healthy food options available and affordable to all can help develop a market that the private and community sectors can economically satisfy. Elements of this campaign may include:

- Strategies for selection and preparation of healthy food that is cost-and time-competitive with manufactured food
- Selecting and preparing nutritious food for use in schools, recreation centers, senior centers, technical/trade schools, farmers markets, and anywhere people might go to learn.
- Linking training for unemployed people and welfare-to-work programs with opportunities for living wage jobs in urban food-related businesses.
- “Edible Schoolyards”, a school-based program that integrates nutrition and gardening to connect healthy food choices and locally grown fresh produce.
- Farm-to-school programs.
- Farm-to-institution programs that offer healthy food choices to hospitals, universities, prisons, and businesses.

appreciation of agriculture's environmental, economic, open space, and food security benefits and provide assistance to farmers that address the challenges of agriculture within the corporate limits of a big city.

We will maintain the ability of agricultural operations to exist and thrive at different scales, from large farms to small urban gardens. Land use policies should support and encourage farming and gardening activities in rural parts of Oklahoma City and on small parcels in the city. The directions and policies contained in the Land Use Plan and the sustainokc element cluster rural residential development and discourage the spread of very low-density residential acreages into agricultural areas, preserving the integrity of farms. Similarly, we should discourage conversion of land designated as Prime Farmland to non-agricultural use, and ensure that these uses support agriculture and reinforce the rural quality of the landscape. Within the city, we should encourage use of vacant or underused sites for raising food, at least on a temporary basis, and identify sites where more permanent urban gardens may be established on civic land.

We will maximize healthy food options for all neighborhoods and citizens. We cannot require people to eat certain kinds of foods or restrict access to the wide range of items that the food industry produces. However, people should not be forced into unhealthy diets by gaps in the food supply system or lack of knowledge. Our strategies addressing the food system should follow two paths. On the supply side, we should increase the number of places that provide affordable healthy food options in underserved neighborhoods. On the demand side, we should increase awareness and knowledge of citizens about diet, health, and practical ways that they can incorporate healthy eating habits into their routine.

Policies G-13, G-37, G-38, G-39, G-40, G-41, G-42, and L-42 implement this initiative.

Most people want to do the right thing, given sufficient awareness and knowledge of the importance of individual actions; however, all too often on environmental issues, our actions and their consequences are separated by time and distance making the relationship more difficult to see and measure. Education programs can help make these connections, and more knowledge can have a dramatic effect by decreasing the impacts that we make as individuals by increasing our awareness.

INITIATIVE 8

PROMOTE ENVIRONMENTAL STEWARDSHIP

We will promote water conservation and waste reduction among users of municipal services. Based on research in applied conservation, we will use a combination of awareness messaging, personalized usage data, and comparative feedback to encourage households to use less water, particularly during times of water shortage, and produce less garbage. Initial efforts will be tested on heavy consumers of services, and a university partnership will be sought to determine effectiveness.

We will foster a culture of environmental stewardship in Oklahoma City. We will solicit partners to participate in a large-scale community initiative, similar to that used by wellness campaigns and safety councils, with emphasis on the goals of greenokc. This partnership will be recognized as a continuing effort, just as campaigns like traffic safety also require continuity. This program will be based on sound market research and demonstrated techniques to affect specific environmental outcomes. Research will include focus groups in Oklahoma City to determine what topics are of greatest interest and effect, and techniques will go beyond education, awareness, and crisis response to promote a culture of environmental stewardship. The program's effectiveness will be monitored regularly and strategies continually refined for maximum impact.

ARBOR WEEK POSTER CONTEST

Environmental education and appreciation at an early age leads to good practices as adults. Image courtesy of the Oklahoma Forestry Services.

Educational and awareness programs targeted to all age levels can be effective in changing behavior and addressing environmental problems created by our daily routines. The content of these campaigns could address such topics as:

- Awareness of Oklahoma City's natural features and resources
- Water and energy conservation
- Promoting walking and bicycling in lieu of automobile trips
- Effective actions for high ozone days
- Environmental, social, and economic impacts of local food
- Proper use of pesticides and fertilizers
- Minimizing household pollutants and safe disposal of household contaminants
- Support for neighborhood-based disposal efforts and cleanups

- Proper disposal of trash, debris, and organic material
- Land management practices that address fire suppression, invasive species, appropriate use of herbicides and pesticides, and overgrazing
- Agricultural benefits of crop diversification, grass-fed livestock, raising bison, nature-friendly mowing practices

Policies G-9, G-24, G-27, G-28, G-31, G-32, G-36, G-37, G-40, G-41, G-43, G-44, and L-42 implement this initiative.

INITIATIVE 9

ENRICH BIODIVERSITY AND NATURAL HABITATS IN URBAN, SUBURBAN, AND AGRICULTURAL AREAS

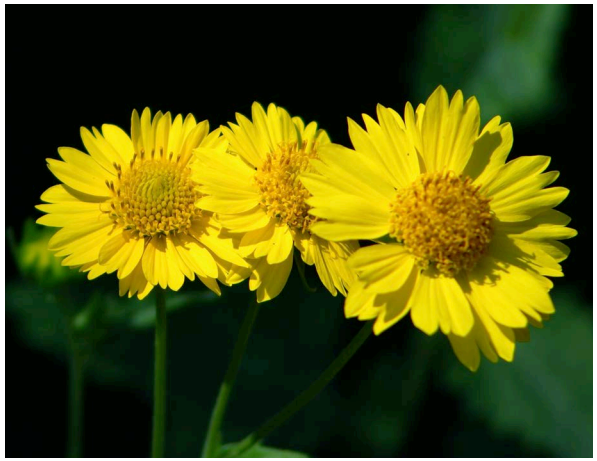
We will work with developers, property owners, and neighborhoods to increase the amount of biodiversity-rich green space in urban and suburban areas. While protecting high-priority environmental features is critical to preserving Oklahoma City's ecological heritage, there is also much that can be done in areas that have already been highly modified by human activity and development. Urban and suburban areas can support biodiversity, bringing nature closer to people and spreading its benefits throughout the city. In urban and suburban areas, natural areas can be integrated in the form of parks, gardens, trails, and green roofs. Each of these features can be enriched when planted with native plants to create urban forests and "micro prairie" environments that not only offer low maintenance green space but also create stepping stones for biodiversity by providing food and habitat for bees, butterflies, and hummingbirds. Individuals and neighborhoods can engage in activities to support nature on their own properties by planting native trees and vegetation, especially those that serve as sources of food and shelter for indigenous fauna.

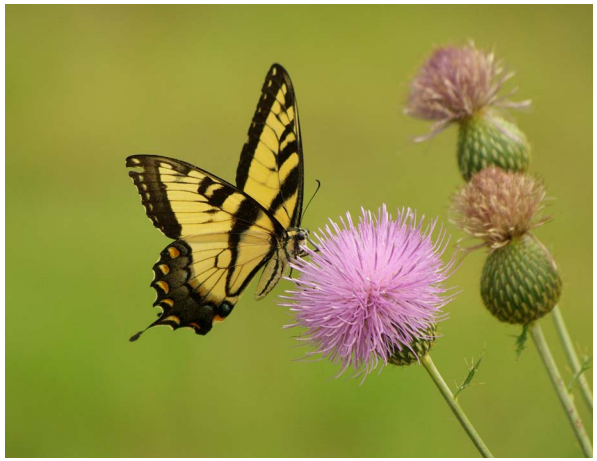
We will enrich natural biodiversity in agricultural areas by promoting practices that provide food, water, and habitat for wildlife and minimize negative impacts. We will convene farmers, ranchers, conservationists, and other stakeholders to develop a plan to conserve nature in farming and ranching landscapes. Some techniques are simple, such as implementing optimal mowing strategies, increasing nesting habitat, and adopting best practices for fertilizer and pesticide application. Intermediate strategies include developing landscape conservation cooperatives; promoting safe, controlled use of fire to mimic natural burn cycles; encouraging grassland ranching as an ecologically beneficial alternative to cultivation, particularly practices such as "mob grazing" that mimic natural grazing patterns; and promoting ranching of bison, which benefit conservation efforts by dispersing seeds, increasing plant biodiversity, and enhancing groundwater recharge. More challenging strategies with significant impacts on biodiversity include grassland restoration on previously cultivated landscapes, development of agricultural parks that combine recreation and food production, and sustainable intensification, which increases production and profitability while providing rich sources of habitat for biodiversity.

Policies G-1, G-2, G-3, G-4, G-5, G-6, G-7, G-9, G-13, G-15, G-16, G-43, and G-44 implement this initiative.

"Prairie happens to be quick, easy, and affordable to create. Our native grass and wildflower seeds grow prolifically... Our highway roadsides... could be converted to prairie habitat, full of beautiful indigenous wildflowers that reflect our natural heritage."

- Resident comment from the draft planokc public review process





"A diverse ecosystem will also be resilient, because it contains many species with overlapping ecological functions that can partially replace one another. When a particular species is destroyed by a severe disturbance so that a link in the network is broken, a diverse community will be able to survive and reorganize itself...In other words, the more complex the network is, the more complex its pattern of interconnections, the more resilient it will be."

- Fritjof Capra