



CLIMATE, ECOSYSTEMS AND COMMUNITY



Emerging Challenges and Opportunities



This community report outlines the work of both the city organization and the broader community in 2018 to address the connections between climate change, climate action, community, and ecosystems. It summarizes some of the key ecological issues identified, describes initiatives that have been launched to address them—both inside and outside the city organization.

The report also describes areas for further action, particularly at the community level. An important starting point in this journey is a review of the dynamics that surround carbon, the foundation of all life on this blue planet.

CARBON & ECOSYSTEMS: THE CYCLE OF LIFE

In the growing concern about climate change and the focus on CO₂ as a driving factor, we frequently hear carbon described as though it were an enemy to be defeated or eliminated. One recently published book characterizes this approach, starting with its very title—“Life After Carbon: The Next Global Transformation of Cities.”

Unfortunately, this approach can obscure our recognition that carbon is in fact the foundation of nearly all life on the planet and one of the single most important elements in both sustaining and regenerating a stable, habitable world. Our bodies and much of what surrounds us is built of carbon, and the foundation of the energy we need to fuel our bodies and much of our lifestyles is derived from it.

This history of life on Earth is the history of *Life* figuring out how to capture and use carbon to create the structure and stored energy necessary to support life and maintain relatively stable ecological and climatic systems.

While it is now indisputably true that the large-scale production and burning of fossil fuels has dramatically accelerated global warming, a less recognized consequence of this combustion of carbon materials is the way it has disrupted and depleted ecological functions critical to stable, healthy living systems.

Many of the ecological challenges that will be described in the sections that follow can be traced back to the ways our current extraction, consumption and waste cycles—energy, development and land management—impact the carbon and water cycles. Consequently, one of the critical areas of focus in climate stabilization is to restore and regenerate these cycles and the ecosystems that help maintain them.



ECOSYSTEMS: LIFE SUPPORT SYSTEMS

Ecosystems Services: The source of critical public goods—clean air, clean water, healthy food

Living systems are the foundation of all “goods.” As noted earlier, ecosystems produce the basic necessities of all living organisms—air, water, food and stable environments. We often take these services for granted. Trees, for example, not only gather and store carbon, they moderate the flow of stormwater and cleanse the air of pollutants. Their roots and leaves build soil and provide habitat for native wildlife. Trees’ shade cools neighborhoods and lowers the need for air conditioning. Our bodily and mental health is also improved when we live and work near trees, partly because they promote social interconnection and well-being.

Bees, particularly the thousands of species of wild bees, and other pollinators provide similarly essential life support services.

The majority of food crops and over 80 percent of species in natural environments require some form of pollination assistance. And in the soil, millions of species of insects, bacteria and fungi provide the essential decomposition and detoxification support that clean water, remove waste, and metabolize compounds that support nutritionally dense food.

Soils likewise provide an enormous range of essential life sustaining services. Healthy soils filter and purify water, sustain vegetation that minimizes erosion and maintains stable slopes, healthy soils absorb flood waters, and soils are the primary source of the wide range of macro and micro nutrients essential to human health. Beyond these material benefits, healthy ecosystems are also the foundation for the sensorial beauty that so many of us draw on for relaxation, recreation, and a place of retreat from the bustle of our human constructed environments.

These and many other life sustaining functions are provided by healthy ecosystems. This multitude of “goods” are produced without us even recognizing the complex and dynamic living systems that are required for their ongoing production. It is often only when these systems are disrupted that we become aware of how vital they are to our well-being. Ecosystems are the dynamic, interdependent relationships formed by living organisms and their surrounding environments that enable a constant circulation of energy and resources among its members.

These systems result in all of the basic life support services we rely upon—clean air, clean water, nutritious food, non-toxic waste conversion. A brief review of some of

these key life support services provides a basis for considering some of the issues and challenges now impacting these systems.

Ecosystems as carbon sinks: The unseen carbon sponge

Our climate depends on soil. This great hidden ecosystem captures and holds at least half of the Earth’s carbon on land. One of the first developmental steps that enabled life to emerge from the primordial seas over 400 million years ago was an innovation of collaboration between algae and fungi.

Algae had developed the capacity to capture and convert carbon into sugars. Fungi had developed the capacity to use sugars to create vascular structures and synthesize compounds that could metabolize rock. Together, as lichen, they were able to occupy rock, break it down for its base nutrients, and insert carbon that reduced its “hardness” and enabled the formation of soil. Soil in turn enabled more life to occupy previously dead land surfaces, capturing and depositing carbon as it went.

The water cycle is responsible for more than **90%** of the temperature moderation of the globe

Over millions of years, this living “carbon sponge” dramatically altered the atmosphere, the climate and set the stage for all terrestrial life as we know it.

Ecosystems as climatic buffer: The overlooked role of ecosystems as temperature thermostat

Water is the lifeblood of all ecosystems and the critical moderator of temperature. While carbon has been the focus of most recent concern about climate change and particularly global warming, it is actually the water cycle that is responsible for over 90 percent of the temperature moderation of the globe. Unfortunately, as land management has degraded the soil carbon sponge and its sequestration of both carbon *and* the temperature buffering water, cycles of drought and their associated temperature extremes have intensified. This is not simply a global problem or phenomena. The dysregulation of carbon and water cycles due to ecosystem disruption at the *local* level are now more-often recognized as the cause of increasing weather and climatic extremes *locally*.

CHALLENGES IMPACTING ECOSYSTEM HEALTH

Given this enormous range of critical services that ecosystems provide for human societies, anything that substantially degrades ecosystem functions can have enormous impacts on human well-being. As a consequence, the significant environmental changes now taking place due to climate change and these other factors will have impacts on the health and resilience of human communities.

Globally, the shocking scale of species loss now taking place is extensively summarized in a recent New York Times Magazine article, “[The Insect Apocalypse is Here](#).” In addition to the dramatic declines in insect species—45 percent on average for the majority that have been studied—the article describes the dramatic loss in populations of other living species. The article summarizes estimates that since 1970, the world’s wildlife have lost on average 60 percent of populations. A study published in 2018 in the Proceedings of the National Academy of Sciences “found that if you look at the world’s

60% Vertebrate Decline — 1970-2014



-38%

Terrestrial



-81%

Freshwater



-36%

Marine

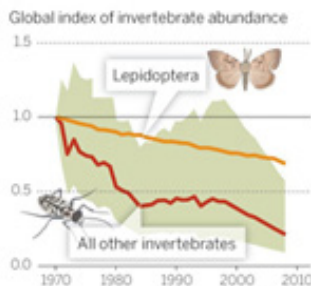
Source: World Wildlife Federation Living Planet Report

mammals by weight, 96 percent of that biomass is humans and livestock; just 4 percent is wild animals.”

Scientists are also observing similarly significant impacts locally. According to Boris Kondratieff, Ph.D., Professor of Entomology and Director of the C. P. Gillette Museum of Arthropod Diversity at Colorado State University (CSUC), “reviewing our holdings of the CSUC, using my past reports and notes, I have noticed a precipitous decline in abundance of numerous insect taxa since the mid-1980s—both here and elsewhere in the U.S.”¹ It is increasingly clear that changes are under way that have the potential to substantially impact the environmental characteristics that are a treasured part of Boulder’s identity and experience—natural beauty, clean air and water, healthy and resilient open spaces and diverse and abundant wild species.

¹ Personal communication to Rella Abernathy, City of Boulder, IPM Coordinator.

Insects are steadily declining



Source: Defaunation in the Anthropocene, Science 345, 41 (2014)

Globally, there is a shocking scale of species loss now taking place, including a dramatic decline in insect species—**45%** on average for the majority that have been studied. ... It is increasingly clear that changes are under way.



LOCAL ECOLOGICAL ISSUES

In 2018, the city formed a cross-departmental staff team to assess existing and emerging ecological issues affecting Boulder. In this effort, three categories of ecological change issues were identified with specific factors currently posing potential risks to the city. These included land cover changes, species loss and soils.

Land Cover Changes

Stable living systems require established and stable cover/shelter. Vegetation typically provides this cover, with trees playing a particularly important role in moderating temperature, moisture, storm water buffering and a host of other services. Currently, the city faces a number of significant threats to its land cover including:



Emerald ash borer

- **Urban Cover** – The Emerald Ash Borer is projected to kill nearly all un-treated ash trees across Boulder and the larger Front Range in the next 6 to 10 years. For Boulder, Ash represents from 20 to 25 percent of the urban canopy and associated shade and other ecosystem services.
- **Wildland Cover** – A 2012 National Academy of Sciences report² projects a four- to six-time increase in wildfires in this region for every degree Celsius of temperature increase. Local temperatures have already increased by nearly 1-degree Celsius and are projected to rise an additional 1 to 3 degrees within the next 20 to 30 years. The past two fire seasons across the western US and Canada have demonstrated the growing threat of these increasingly intense wildfire complexes.

Species Loss

The term *ecosystems* recognizes that the environment is created and maintained by a complex and interconnected network of living species. Loss of species can result in critical system functions being disrupted. Species loss also serves as an indicator of shock or stress factors that can lead to more far-reaching, system-level disruptions. Staff analysis indicates several species losses taking place that could negatively affect the well-being of the Boulder community.

These include:

- **Pollinators** – Boulder County area beekeepers are reporting alarming increases in bee colony population losses. In less than a decade, colony losses have gone from less than 10 percent per year to over 60 percent per year for some producers. While less information is available for native pollinators, there is growing evidence that there are similar declines in these species that are critical to the pollination and viability of a third of our crop species and over 75 percent of all flowering plants.
- **Aquatic Invertebrates** – Aquatic invertebrates in the city's creek system and wetlands are particularly vulnerable to the impacts from climate change, extreme weather events and anthropogenic factors such as water diversion, lawn chemicals, synthetic fertilizers, pharmaceutical compounds, sunscreen products and insect repellents. The city has sampled Boulder Creek macroinvertebrates for 10 years; this monitoring provides longer-term trends and is important for providing an early warning for any significant changes.
- **Neonicotinoids** – A major concern for aquatic health is the increasing use of substances in our homes and businesses that contain neonicotinoid pesticides. Studies throughout the world have found these compounds to major declines in both pollinators and aquatic species. Levels of these substances exceeding EPA's chronic exposure benchmarks have been found in Boulder Creek.

Soils

A combination of factors including climate change, past land management practices and changes in the balance of animal and plant communities are causing significant degradation in the health and viability of soil ecosystems in and around Boulder. Specific local concerns include:

- **Soil Loss and Desertification** – Over 1,000 acres within the City of Boulder's 14,000 acres of open space agricultural lands are experiencing extensive soil and fertility loss, with the number of acres still increasing. Similar dynamics are taking place across the county and around the greater Front Range.
- **Carbon Sequestration** – Soil depletion also diminishes or reverses the capacity of systems to absorb and hold carbon, further contributing to climate impacts and loss of larger ecosystem resilience to climate change.

² From "Climate Stabilization Targets: Emissions, Concentrations, and Impacts over Decades to Millennia." 2011. Pg 41.

TAKING ACTION: A CITY-COMMUNITY COLLABORATION

Facing these challenges, both the city and the larger community are already stepping forward to take substantive action. The following section outlines work already underway or in the final planning stages. The last section of this report will describe next step opportunities.

The City's Guiding Policies, Plans and Strategies Toward Ecosystem Stewardship

The City of Boulder's ecosystems efforts have been and will be guided by an over-arching strategic framework provided by the city's Sustainability and Resilience Framework. Environmental Sustainability is one of the seven core community priorities in this framework. Care for ecosystems is called out explicitly in the "Environment" category of the city's Sustainability Framework. This framework is in turn guided by the Boulder Valley Comprehensive Plan and its "Principals of Environmental Sustainability." These are shown in the figure to the right.

This framework then guides the ongoing development and implementation of the Boulder Valley Comprehensive Plan. Section 3 of the Comprehensive Plan—Natural Environment—outlines policies for maintaining and enhancing ecosystem health and the many services healthy ecosystems provide.

The Comprehensive Plan then guides development of departmental Capital Improvement Plans, annual workplans, budgets, and additional policy. Maintaining eco-

Principles of Environmental Sustainability

The city and county will strive to preserve and protect the natural resource base and environmental quality on which life depends by:

- a. Maintaining and enhancing the biodiversity and productivity of ecological systems;
- b. Ensuring the efficient use of natural resources in a manner that does not deplete them over time; and
- c. Reducing and minimizing the use of non-renewable resources.

system health and services are also recognized as one of three core action areas in the city's climate action strategy outlined in the city's Climate Commitment.

Toward an Integrated Ecosystems Stewardship Approach

As part of the city's ongoing commitment to continuous improvement and a focus on the ecosystem related areas of climate action, a cross-department staff team spent 2018 exploring opportunities to enhance coordination and integration of ecosystem related efforts across the city organization and with the larger community.

As part of that effort, the team conducted the rapid ecological assessment described in the previous section that identified three focus areas related to land cover, species, and soils.

The team also identified existing and emerging city department actions that could be enhanced through additional coordination between departments. These efforts are described in the following pages.



City Initiatives

Land Cover

Wildlands-Watershed

The city has partnered with the Colorado Forest Restoration Institute to develop a wildfire planning tool to help staff more efficiently and effectively apply limited resources post-fire to protect the water supply. The Wildfire Erosion and Sediment Transport Tool (WESTT) estimates post-fire erosion and sediment transport to drinking water diversions and infrastructure and helps inform decision making and resource allocation by estimating the effectiveness and most appropriate placement of post-fire rehabilitation strategies.

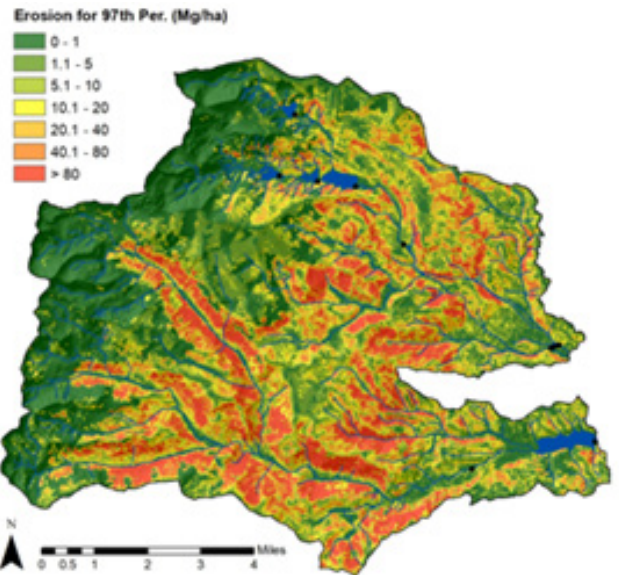
Wildland Urban Interface

The city Fire Department is launching an initiative with neighborhoods along the western edge of Boulder in areas adjacent to wildlands and forests. In this effort, the Fire Department will work with both large land owners such as OSMP, HOAs and others to develop collaborative approaches to reduce fire risk to neighborhoods while also protecting natural ecosystems from the potential for high intensity/high damage wildfire events. In addition to this work with homeowners and associations, the city's wildland fire crews conduct thinning and controlled burns on over 1,000 acres of forest land adjacent to the city each year. This helps reduce the potential for high intensity wildfires and protects both homes and ecosystems.

Urban Forest Canopy: Emerald Ash Borer Response

The city recently completed the development of the Urban Forest Strategic Plan which outlines a comprehensive approach to protecting and maintaining Boulder's urban forest canopy. In addition to this strategy, the city has developed an Emerald Ash Borer response plan that it has been actively implementing for the past four years. A critical component of both plans is the active development of community engagement and mobilization.

Nearly 90 percent of the urban forests are on private lands or lands owned by institutions other than the city. To effectively respond to the challenges facing our vital urban forest, we will need a coordinated, collaborative approach that combines public and private initiative. A profile of the recently launched community "Tree Trust" is included in the community actions section below.



Boulder Watershed erosion mapping

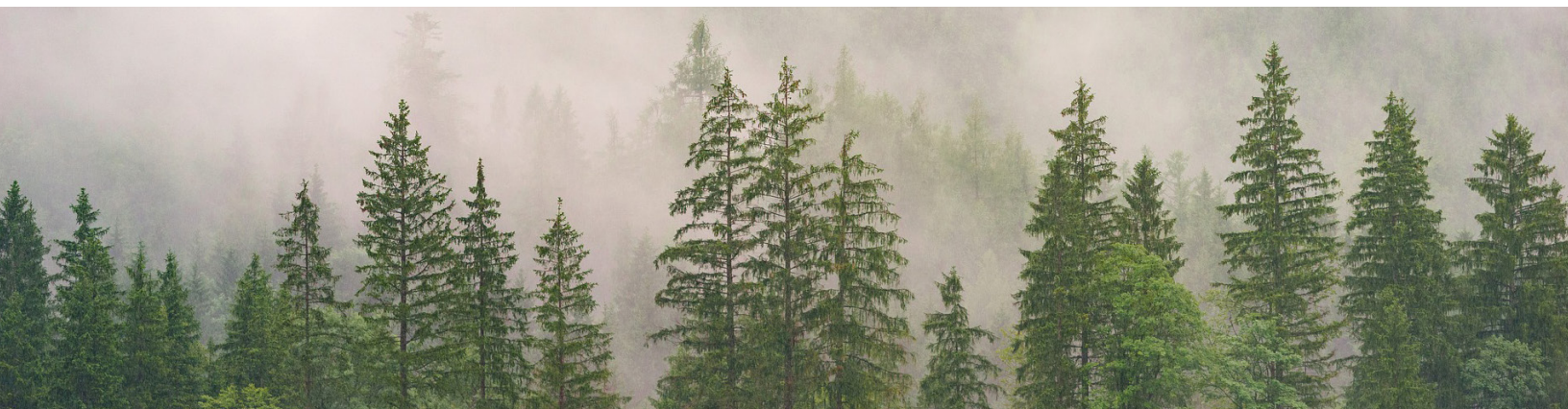
Urban Heat Island Analysis and Community Tree Planting Plan

The city has also launched a cross-departmental effort to develop a citywide tree planting strategy that can address the impacts of a warming climate. This includes the way the built environment typically magnifies temperature increases due to the heat-absorbing qualities of most building and paving surfaces—the urban heat island effect.

In this initiative, the city will work with a number of partners including CU, NCAR and others to utilize the latest satellite and computer-aided land cover analysis to identify existing and future potential hot spots and target those areas for expansion of the urban forest.

Planning & Land Use

In addition to these newer initiatives, the city continues to utilize its existing land use codes and ordinances to support sustainable landscape management. These codes ensure tree planting, protection and replacement, water conservation, appropriate species selection and other measures to support environmental objectives.”



Species Recovery

Pollinator Protection

Enhancing or creating pollinator habitat on city properties

Boulder City Council adopted a **resolution** prohibiting the use of neonicotinoid insecticides on city properties and discouraging use on private property. Neonicotinoids are commonly used products that are associated with precipitous insect decline, including pollinator and aquatic insects, which is **threatening ecosystems worldwide**. Plants are often pre-treated with pesticides, including neonicotinoids, in nurseries. The city preferentially purchases pesticide-free plants and does not apply pesticides to landscaped beds to provide safe habitat. Staff across departments are installing pollinator habitat on public properties, including city parks, natural lands and Greenways. City environmental planners and project managers received training from the Xerces Society to learn how to incorporate pollinator conservation



principles into existing and future projects. Operations staff received special training from the Butterfly Pavilion to maintain landscaping to support pollinators.



Outreach and Education

The city is providing information to the public through the city website, festivals, workshops, conferences, demonstration gardens, bee houses and guided hikes. Every September, city council declares September Pollinator Appreciation Month, bringing community partners and the city together to host a range of events for people of all ages.

Multiple city departments are providing information and events for the public, including Boulder Public Library's Seed to Table program, OSMP, Parks and Recreation, Planning and Utilities. Utilities' water conservation programs encourage replacing turf grass with pollinator-friendly native plants.

Aquatic Insects

Wetlands are the most productive ecosystems on our planet. In addition to supporting a rich variety of wildlife, wetlands clean and improve water quality, regulate flooding, control erosion and lessen extreme storm damage, sequester carbon and provide nutrients for wildlife and other ecosystem types. Healthy and high-functioning wetlands are fundamental for the safety and wellbeing of the community. See more information on wetlands [here](#).

The foundation of wetland food chains are aquatic insects. The city recently updated its mosquito management plan to better protect wetland health. Adult mosquitoes are food sources for bats, birds, reptiles and amphibians. Mosquitoes feed on flower nectar and some act as pollinators.

Disturbances, alterations to naturally occurring biodiversity from insecticides and other inputs into wetlands harm ecosystem health. Fully functioning wetland ecosystems **naturally lower mosquito populations**, and can **lower the risk for disease**. The city is monitoring wetlands to better understand and use natural processes to keep mosquito numbers low, while improving basic wetland ecosystem services.



Mosquito larvae assessment

Soil Regeneration: Regenerating soils for health and carbon sequestration

Agricultural: Carbon Farming Pilot Project at OSMP's Bennet Property

The city has a number of Open Space and Mountain Parks (OSMP) agricultural land holdings that have been impacted to the point that they are no longer suitable for agricultural leasing due to a combination of past management practices, climate change and the inability to effectively manage prairie dogs. The city has selected one of these sites, the former Bennett Homestead near 63rd and Nelson Road, as a pilot project to test different soil regeneration and soil sequestration approaches.



Soil treatment test plots

In this project, the city has created a unique land regeneration contracting mechanism designed to leverage investments from multiple sources including adjacent land owners, the Natural Resource Conservation Service and outside funding sources. The goal is to regenerate the ecological systems on the site to support both viable agricultural uses and contribute to carbon sequestration objectives. Actions already under way at the site include establishment of a 2-acre set of trials of four different treatment strategies and testing of innovative soil cultivation systems designed to improve water infiltration and soil regeneration.

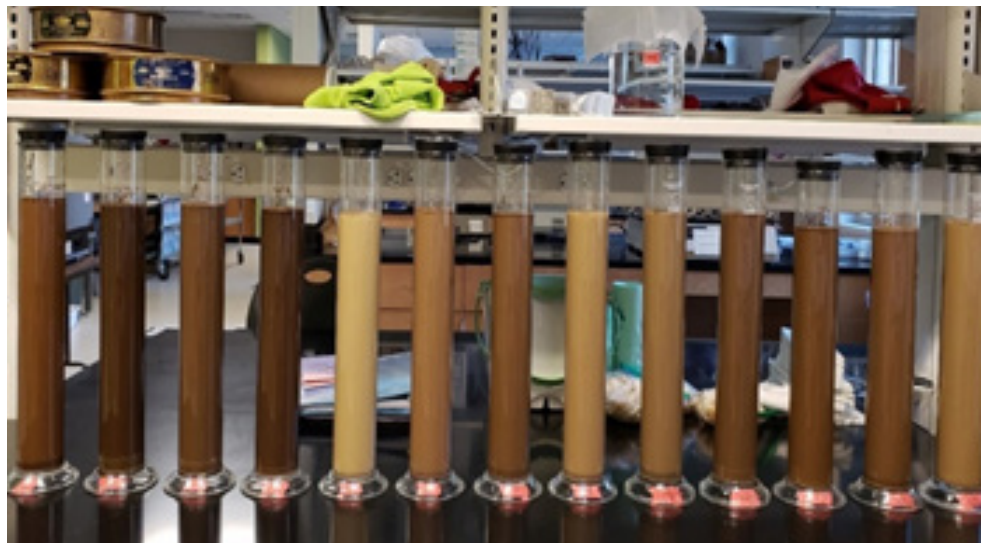
The city is also working with a local regenerative agriculture organization named Mad Agriculture to develop one of the first "Carbon Farm Plans" in Colorado. This plan will outline how treatments are being designed to increase the carbon sequestration capabilities of the site. This plan is being developed in coordination with the National Resource

Conservation Service (NRCS) with the intention of creating a model that can be replicated by other agricultural operations throughout Colorado and the broader US.

Preliminary results from the 2018 field season substantially exceeded initial expectations. One of the four treatments tested on the site resulted in significant soil and plant growth improvements. Soil sampling is now also underway to track increases in carbon capture and sequestration on the site. These efforts are intended to eventually form the basis for developing a viable market for this carbon capture service, initially on city owned properties but eventually as a widely available market for regenerative practices taking place on lands throughout the region.

Wildlands: Grassland soil assessment and monitoring

As part of OSMP's ongoing monitoring of city open space holdings, OSMP has contracted with researchers to develop a soil sampling assessment that will develop baseline information about the current conditions on OSMP grasslands. This assessment will provide valuable information on the existing soil characteristics with particular focus on plant community changes, soil chemistry, carbon and soil moisture. This study will provide essential reference points for monitoring ongoing changes taking place as a result of climate change.



Representation of soils collected from OSMP-managed lands. The diversity of colors represents different amounts of organic matter in grassland soils around Boulder

Community Initiatives

Land Cover

THE URBAN FOREST

Outreach Campaign and Collaboration with the PLAY Boulder Foundation Tree Trust: The city continuously communicates with the public around ongoing EAB projects and efforts. For example, when conducting the pilot projects along Boulder Creek, the community and target audiences were notified using standard communication methods such as social media networks, press releases, Channel 8, signage on-site, etc. In addition to ongoing communication efforts, staff are organizing a tree canopy campaign – Plant and Protect 25 x 25 – to be implemented in 2019 to educate the community on the threats to the tree canopy and how to take action.

An outreach campaign team will design materials, activities and key messages to target audiences. Campaign effectiveness will be measured to the extent possible through evaluation activities and/or surveys. Partners and community organizations, such as the Tree Trust, will be used when possible so messages are delivered effectively. The campaign will aim to be creative and innovative, so the audience is most likely to learn, retain and act on the delivered messages.

SPECIES PROTECTION

Boulder Pollinator Garden Project: The Boulder Pollinator Garden Project was launched in 2017 to coordinate pollinator-related conservation efforts of the city and other public organizations, including the University of Colorado and Boulder Valley School district, as well as non-profits, businesses, universities and individuals. The purpose of the Boulder Pollinator Garden to encourage the creation of high-quality pollinator habitat throughout Boulder, both on public and private properties.

The city is mapping pollinator habitat in parks, open space and other city-owned properties and reaching out to other public entities to share and map their habitat. Home and business owners and other residents are encouraged to map their yards and gardens. The long-term goal for this program is to coordinate the efforts of local organizations and individuals to create pollinator pathways and connections to open space. More information can be found at BeeBoulder.org. Participating organizations can be found at boulder.earth/pollinators.



The Wild Foundation: Wild Boulder: Like many other cities across the globe, Boulder's landscape and wildlife are experiencing a number of threats from a changing climate, fracking, human development, and more. In an effort to understand how these changing conditions are affecting our wildlife, WILD, with its colleagues at the City of Boulder and Boulder County, launched the Wild Boulder program in 2016. Wild Boulder utilizes citizen science to document local wildlife and help land managers improve open space while deepening community respect for nature. A major goal of this program is to recruit and mobilize new advocates for wild nature, with much of its efforts centered around the annual City Nature Challenge – a global competition to see which urban areas have the most biodiversity as well as the most engaged residents. Learn more about Wild Boulder and how to get involved in the upcoming April 26-29, 2019 City Nature Challenge by visiting wild.org/wildboulder.



SOILS

Community Carbon Farming Campaign: EcoCycle has launched an exciting new initiative to support 300-400 local residents in the development and launch of a citizen's soil science initiative that will recruit and train local residents to gather soil samples from their own properties to assess the effects of different soil improvement techniques residents may implement. The process will be designed to raise community awareness and ecological literacy regarding the role and importance of soil health and provide potentially useful data on the effects of a range of different treatments. The results of this process will help inform soil stewardship and conservation program and education efforts being offered by a number of community organizations.

Citizens Soil Science Initiative: The Citizen Science Soil Health Project is a grower-driven project which uses the collective knowledge of its participating growers to find local strategies to improve our county's soil health. Participants have been asked to make a 10-year commitment to build a long-term body of data and experience.

The Project provides free annual soil health tests (Haney and PLFA soil tests from Ward Labs), which give each grower a soil health score. Growers will try to improve

their soil health scores over the 10-year study period through management actions which align with their operation.

The Project continues to recruit conventional growers and Open Space wildland managers, and hopes to enlist 4 more sugar beet growers. The first annual meeting and soil class was Jan. 30, 2019. Baseline questionnaires have been completed. Soil testing will begin in May 2019, with baseline results analyzed and compiled by the end of 2019.

Carbon Farm Planning: Mad Agriculture is an evolutionary change organization supporting farmers, ranchers, public lands managers, and residents of the land in finding a path back to a form of land stewardship that regenerates and revitalizes both the land and land-based communities. Mad Agriculture has worked closely with the leading regenerative agriculture initiatives like the Land Institute and the Marin Carbon Farming Project to bring to Colorado the Carbon Farm Planning tools initially developed in collaboration with the Natural Resource Conservation Service (NCRS) in California.

Mad Ag is working with the City of Boulder, NRCS, McCauley Farms and other local agricultural operators to put together Colorado's first Carbon Farm Plans. These plans are intended to open new avenues of funding for local farmers who are actively integrating farming practices that have been shown to capture carbon and improve soil health. Mad Ag is also coordinating efforts to develop carbon markets that will reward farmers using these practices. More information can be found at madagriculture.org.

The Community Ecosystems Summit: On Nov. 16, 2018, a broad coalition of organizations including the city, Boulder County, CU Boulder and a number of civic and non-profit organizations, co-hosted the first Annual Community Ecosystems Summit at the CU Sustainable Energy and Environment Center.

More 170 people registered for the event and over 200 participated either in person and on-line. Participants were asked to answer the same two questions posed to staff and advisory boards:

1. What ecological issues are you most concerned about?
2. What do you see as the highest positive impact opportunity?



Table 1 below summarizes the issues and prioritization conducted during the summit. Participants were asked to rank issues within each of four broad areas. The number of “votes” for each issue’s perceived level of importance or priority is shown in the table. The issue areas themselves were not ranked. The community responses largely corresponded to the issues identified by staff and members of citizen advisory boards with a substantial additional focus on issues that could be characterized as social/cultural concerns about feelings of powerlessness around disruptive ecological changes now taking place.

Table 1: Issues and Rankings by Ecosystem Summit Participants

TOPIC	ISSUE	NUMBER OF VOTES
Emerging Issues	Feeling hopeless and lack of empowerment	31
	Lack of education and connection to nature	6
	Lack of equity in access to nature	6
	Not addressing root causes	6
	Population growth and balance	7
	Unsustainable food systems	6
	Use of chemicals and pesticides	3
	Water (supply and demand, quality, aquatic life)	2
Land Cover	Habitat loss (human encroachment and sprawl)	11
	Fragmentation	-
	Lack of green space	2
	Lack of native landscapes	-
	Reconceive Beauty to support native ecosystems	5
	Protection of trees	4
Species	Addressing non-native species	4
	Bird ecosystems	3
	Loss of biodiversity in urban/suburban ecosystems	9
	Pollinator decline	8
	Species loss	9
	Wildlife corridors	8
Soils	Agricultural soil degradation and the extractive food and agriculture system	8
	The role of soil and native grasses in carbon sequestration	14



NEXT STEPS

Protecting and regenerating the health of ecosystems will require a long-term coordinated and sustained effort. In this critical work, the city will be just one of many collaborating partners that include other large institutions such as the County, University, School District, and Irrigation Districts, and perhaps most important, the residents of Boulder and the surrounding area. This understanding and commitment is a part of the history and legacy of Boulder. It has been the residents of Boulder, that established so many of the features that have maintained Boulder's remarkable environmental legacy—Chautauqua, the Open Space and Mountain Parks, the amazing network of parks and greenways and many other aspects.

As Boulder is now drawn inextricably into larger regional and global dynamics of change, we must consider what this generation's legacy actions must be to ensure that future generations will enjoy the remarkable endowments we have received. Through the extensive efforts of many individuals and organizations over the past year, a framework of action is emerging. Important next steps in this action framework are detailed on the following pages.

Protecting Urban Forests

The city will be working closely with the newly formed Tree Trust to launch and expand the Tree Tender program. This is intended to create a whole corps of volunteer foresters who can support their neighbors in adapting to the die-back of ash and to assist in both replanting and expanding the urban forest. Through this effort the city hopes to not only restore the level of urban forest cover that existed before the Emerald Ash Borer (16 percent), but to expand it by thousands of additional trees by 2030. It will be vital that these new plantings are compatible with the changes in climate now taking place and projected for the future.



OBJECTIVES, TIMELINES & RESOURCES

- Objective & Timeline: Restore all lost canopy by 2030 (16 percent). Increase the city's urban tree canopy to 20 percent by 2050.
- Community Resources: The Tree Trust, playboulder.org/treetrust.

Pollinator Protection

Boulder is working closely with a wide range of community organizations to rapidly expand the development of pollinator habitats around the city.



OBJECTIVES, TIMELINES & RESOURCES

- Objective & Timeline: Develop a pollinator assessment and monitoring initiative and begin implementation by 2019; launch first pollinator garden neighborhood in 2019; map pollinator habitat on city-owned and other public properties by 2020; encourage residents to include 100 pollinator gardens on the project map on private property by 2020; develop a strategic pollinator habitat conservation program by 2020; develop incentive and support programs to expand the number of residents engaged in pollinator protection by mapping 300 pollinator gardens by 2023 and 500 by 2025.
- Community Resources: Boulder Pollinator Garden Project partners: boulder.earth/pollinators.



Toxics Reduction

The city will continue to conduct monitoring of streams and other water bodies to assess the presence of pesticides and other contaminants. The city will also continue its policies of eliminating and reducing pesticides in its Parks and Open Spaces.

In addition to the city's efforts, non-profit organizations are also taking the lead to increase community awareness around the potential risks associated with many of the products currently being sold or used in yards and gardens.

OBJECTIVES, TIMELINES & RESOURCES

- Objective & Timeline: Continue to monitor for systemic pesticides in local waterways; continue outreach and education programs with partners to encourage residents to eliminate the use of pesticides.
- Community Resources: People and Pollinators Action Network, peopleandpollinators.org; Sierra Club Indian Peaks Group, sierraclub.org/colorado/indian-peaks.

Soil Regeneration & Sequestration

The city will continue to coordinate soil regeneration and sequestration work with a wide variety of community partners. The goal of this work is to restore and regenerate degraded soils and enhance the ability of soils to capture and hold water and carbon in ways that support climate stabilization and local climate change resilience.

OBJECTIVES, TIMELINES & RESOURCES

- Objective & Timeline: Complete an assessment of soil conditions on city agricultural lands by 2020; expand soil regeneration and sequestration treatment pilot projects to 300 acres by 2020; implement soil regeneration and sequestration treatments on 1,500 acres by 2030; catalyze the implementation of carbon farming practices on over 5,000 acres in Boulder County by 2030.
- Community Resources: Citizen Science Soil Health Project; contact Elizabeth Black: elizabeth@elizabethblackart.com; Community Carbon Farming Campaign, ecocycle.org/recycle-compost-reuse/compost/carbon-farming.

Community Ecosystems Monitoring & Reporting

Both the city and the community recognize the critical importance of enhancing our ability to monitor both existing and emerging threats to local ecosystem health. The 2018 Community Ecosystems Summit was an opportunity to report on existing efforts and coordinate additional initiatives that are taking shape. The Center for Sustainable Landscapes and Communities at CU has agreed to take a leadership role in helping coordinate a recurring Community Ecosystems Summit, with the next one planned for 2020. The Boulder Community Foundation has also pledged to enhance the environment section of its Boulder County Trends report to expand on environmental reporting.

The city is also working on the development of a cross-departmental ecosystems assessment team and process to enhance the city's ability to identify and prepare proactive responses to ecosystem changes taking place due to climate change and other factors.

OBJECTIVES, TIMELINES & RESOURCES

- Objective & Timeline: The city is developing a coordinated ecosystems assessment and monitoring system in collaboration with a variety of local partners; the Boulder Community Foundation works with the city, the Center for Sustainable Landscapes and Communities, and other partners to expand environmental coverage in its 2019 Boulder County Trends report. The Center co-hosts the 2nd Community Ecosystems Summit in later 2020.
- Community Resources: Boulder County Trends Report, commfound.org/trends; The Center for Sustainable Landscapes and Communities, colorado.edu/center/sustainable-landscapes-and-communities.

Table 3: Summary of key objectives across the four major action areas

ACTION AREA	2025 OBJECTIVE
Urban Forest Protection	Coordinate planting of over 10,000 trees, public and private; achieve a 16 percent canopy cover.
Species Protection	Coordinate planting of 500 pollinator gardens; implement pollinator monitoring program; stabilize pollinator populations.
Soil Regeneration & Sequestration	Formalize carbon accounting and offset program to provide funding for soil carbon treatments; implement regeneration and sequestration treatments on 1,000 acres of city lands; verify sequestration of 1,000 tons of carbon/year through project efforts.
Ecosystems Monitoring & Assessment	Implement ongoing collaborative ecosystems assessment & monitoring; develop early warning system to identify emerging ecosystem threats.