



# LANDSCAPE POLICY PLAN FOR WATER EFFICIENCY

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A cooperative planning project  
City Manager's Office, Water and Sewer Department,  
Culture, Parks, and Recreation Department,  
Community Development Department



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# EXECUTIVE SUMMARY

The City of Greeley landscape code has evolved over many years. The purpose of this document is to provide policy direction that strikes the balance between preservation of the lifestyle values of the City of Greeley, and honoring the natural environment by adopting a landscape code that is appropriate for our region.

According to the draft Colorado Water Plan, municipalities use 7% of the state's water, approximately half of which is used for outdoor irrigation. During the public participation process for the development of this policy, the two main reasons given for not installing low water landscapes were high cost and lack of knowledge. Information and education initiatives include

- the development of an extensive plant database;
- developing model landscape designs based on hydro zones (zones of high, moderate, low water and very low water use plants as described in the plant database),

- providing information and examples as demonstrated in City projects of low water use landscapes,
- providing information on best management practices and best technologies,
- providing timely information on irrigation water need, and
- supporting or providing training for professionals and trades people in how to implement best management practices.

Policy direction can range from education and reform to incentives and code changes. This document opens discussion of all of these approaches. We do not know what the impact of these measures will be on water demand. Our purpose is to collect related data over the next several years to analyze its effect.

CITY OF GREELEY, COLORADO

ORDINANCE NO. 40, 2015

AN ORDINANCE ADOPTING THE  
LANDSCAPE POLICY PLAN FOR WATER EFFICIENCY

WHEREAS, Article XIX, Section 19-1 C of the Greeley City Charter indicates that the City Council shall adopt a Comprehensive Plan as a guide to land use and development; and,

WHEREAS, water use, landscaping as an element of the built environment, and efficient water use are prominent themes throughout the adopted 2060 Comprehensive Plan, having many Goals and Policies devoted to the subjects, most particularly in the Chapters devoted to Environment, Growth, and Land Use; and,

WHEREAS, it is a common practice to have sub-elements of the Comprehensive Plan that provide more detailed policies that apply to a specific topic, such as Transportation or Parks, Trails, and Open Lands; and,

WHEREAS, the City desires to further promote those goals pertaining to the efficient use of water, particularly in the areas of landscaping, which encompasses the complex interplay of landscape design, irrigation system design, installation, and sustained maintenance; and,

WHEREAS, water demand for landscaping on a single property can represent 50% or more of the water use for that property, and water is naturally limited in the natural semi-arid climate of Colorado, and projected regional growth portends a future limit on the availability of water regionally; and

WHEREAS, Greeley has a long tradition of beneficial use of water coupled with early conservation policies going back to the early 1900's, resulting in a balanced built environment that provides both the ecological benefits of landscaping such as shade, which mitigates "heat island" effects and allows for reduced water on groundcover, and the benefits of water use consistent with a City that is at the heart of an agricultural economy and county that is currently the largest agriculturally productive one in the country, outside of California; and,

WHEREAS, proposed and contemplated policies were presented and commented on by members of the public, professionals in associated industries, stakeholders, and City Boards and Commissions; and,

WHEREAS, the proposed "Landscape Policy Plan for Water Efficiency" provides a foundation and more detailed set of Goals and Policies for the City of Greeley as it seeks to further advance efforts in the areas of education, regulation, and incentives, while maintaining Greeley's existing quality landscapes and urban forest, and ensuring that the City "lead by example," and;

WHEREAS, the proposed "Landscaping Policy Plan for Water Efficiency" also contemplates many potential action items that would implement such Goals and Policies, and provide for on-going and continued investigation by the City as to how to further achieve the vision to "maintain or enhance Greeley's quality landscaping in both private and public areas, while improving landscape irrigation water efficiency."

NOW THEREFORE BE IT ORDAINED BY THE CITY COUNCIL OF GREELEY,  
COLORADO:

Section 1. The Landscape Policy Plan for Water Efficiency, as set forth in "Exhibit A," which is attached hereto and incorporated by this reference, is hereby adopted.

Section 2. This ordinance shall become effective five (5) days after its final publication as provided by the Greeley City Charter.

PASSED AND ADOPTED, SIGNED AND APPROVED, THIS 15th DAY OF  
December, 2015.

ATTEST:

THE CITY OF GREELEY

  
\_\_\_\_\_  
City Clerk

  
\_\_\_\_\_  
Mayor

# INTRODUCTION

This policy is intended to implement recommendations of the Greeley 2060 Comprehensive Plan adopted in 2009, the Water Master Plan adopted in 2003, the Water Conservation Plan adopted in 2010, and the updated Water Conservation Plan recently submitted for approval to CWCB. It is intended to guide development of incentives, information, training programs and amendments to the City Code as they relate to conservation through landscaping.

This Landscape Policy for Water Conservation is intended to be a sub-element of the Greeley 2060 Comprehensive Plan. As described in state statutes, a community master plan “shall be made with the general purpose of guiding and accomplishing a coordinated, adjusted and harmonious development of the municipality and its environs which will, in accordance with present and future needs, best promote health, safety, morals, order, convenience, prosperity, and general welfare, as well as efficiency and economy in the process of development, including among other things, adequate provision for light and air, the promotion of healthful and convenient distribution of population, the promotion of good civic design and arrangement, wise conservation, and the adequate provision of public utilities and other public requirements “ (CRS 1973 31-23-207, revised 1977).

This Plan was developed with staff from the City Manager’s Office, the Water and Sewer Department, the Culture, Parks, and Recreation Department, and the Community Development Department. During the development of the initial draft of this policy, 15 meetings with identified groups (stakeholders) including four open houses with interested members of the public were held. The 237 people who attended submitted 90 written comments, which were carefully evaluated and considered. (See appendix B, Input Received.)

Landscape has economic, environmental and health benefits, so our goal is to encourage residents to maintain their landscape, rather than let it die.

There is a long window of opportunity to start changing the perception of what the landscape in Greeley could look like. This Plan describes a series of actions designed to create an incremental impact on irrigation water conservation and allow sufficient time to analyze those impacts. As with the impact of interior water conservation measures, results may be relatively small in a given year, but cumulatively over a period of years they can lead to an increase in water use efficiency. Similarly, a reduction of demand for irrigation water in newly developed areas may seem

insignificant for the first few years but, over time, can become meaningful.

Approximately half of Colorado's treated water is used for landscape irrigation. Conservation offers an opportunity to lessen the use of this valuable water resource by choosing plants and trees appropriate for our region. The challenge is to conserve this water without damaging Greeley's landscape tradition, aesthetics and economy. Meeting this challenge is the purpose of this Landscape Policy Plan for Water Conservation.

## Purpose and Need

The City has a long history of water conservation and has recognized the need for a policy to reduce the demand for water to irrigate landscapes through at least three adopted plans: the Greeley 2060 Comprehensive Plan the Water Master Plan, and the Water Conservation Plan.

### Limited Water in Colorado's semiarid climate

The City of Greeley is located in an area with a semi-arid climate where the potential loss of soil moisture to the atmosphere is greater than the amount of precipitation that falls each year. The result is a short-grass steppe where few plants commonly used in landscapes can grow without irrigation.

### Importance of agriculture to Greeley

Since Greeley's founding, agriculture has been an important part of its economy. Weld County is ninth in agricultural production value in the U. S. at \$1.9 billion dollars. It is the most agriculturally productive county outside of California (Bureau of the Census). Most of this production is based on converting forage from irrigated cropland to animal protein and processing it.



**Figure 1.** Early agricultural crops being delivered to Greeley. City of Greeley History Museum

## **Regional growth and projected water limits**

Within the South Platte and Denver Metro watersheds, the population is expected to grow from 3,490,000 in 2008 to 5,244,000 in 2035, and from 5,826,000 to 6,599,000 in 2050 respectively (West Sage Water Consultants, 2014). As a result of this population and related economic growth, Colorado's annual water demand will grow by an additional 110,000 acre-feet. Within the South Platte and Denver Metro watersheds, there is only 46,000 acre-feet available for development. At a 70% success rate for identified projects and programs, there will still be a shortfall of 64,000 acre-feet. In fact, in the South Platte and Denver Metro District basins, it is estimated that there is less than 50% of the necessary water resources to meet projected demand caused by growth between now and 2050 (West Sage Water Consultants, 2014).

Throughout the western United States, the development of new water resource diversion and storage projects has become more challenging. As a result, environmental laws and regulations have made the development of new water supplies more difficult.

## **Greeley's landscape tradition**

### **Historical perspective**

During the 1870s, irrigation water was diverted along the streets of Greeley so trees could be planted. While many of these initial plantings were unsuccessful, the people persisted and established a thriving urban forest in spite of an adverse climate. When Greeley completed the construction of the first Bellvue Water Treatment Plant in 1907 at the mouth of the Poudre Canyon, capacity was provided to continue to irrigate high quality landscapes of trees, shrubs, perennials, and grasses. In addition, Greeley developed an extensive park system with high quality landscaping of grass, trees, shrubs, and flowers. This vegetation provided both shade and evaporative cooling, offering improved comfort during hot, dry summers. It also reduced the impacts of high winds during winters, reducing heat losses from buildings and saving valuable heating fuel.



**Figure 2.** The native landscape of Greeley is a short grass steppe. Photo by John Barnett



**Figure 3.** Lincoln Park in 1870; an early example of landscape irrigation in Greeley. City of Greeley Museum.

## **Ecological services provided by landscaping**

Trees and landscaping provide valuable ecological services, including energy conservation, air quality and health, flood control, erosion control, soil fertility, wildlife habitat, and increased property values. The alternatives to these services include more insulation in buildings, more air conditioning of buildings, more suffering from heat waves, and a lower quality of life in a less attractive community.

**Energy Conservation.** Effective landscaping can reduce summer cooling bills by 50% or more and winter heating bills by up to 25%. Reduction of winter heat loss is caused by the reduction of wind velocities near the building. This, in turn, reduces the pressure difference between the inside and outside of the building, leading to a reduction of heat loss by as much as 50% on cold windy days. The reduction in summer cooling demand is caused by shading of the building, leading to a reduction in solar radiation reaching windows and walls. Through the use of deciduous trees on the south sides of buildings, solar radiation can still reach buildings during the winter, warming them when the leaves are gone, and buildings can be shaded in the summer, reducing heat gain by solar radiation. (Walker, 2009)

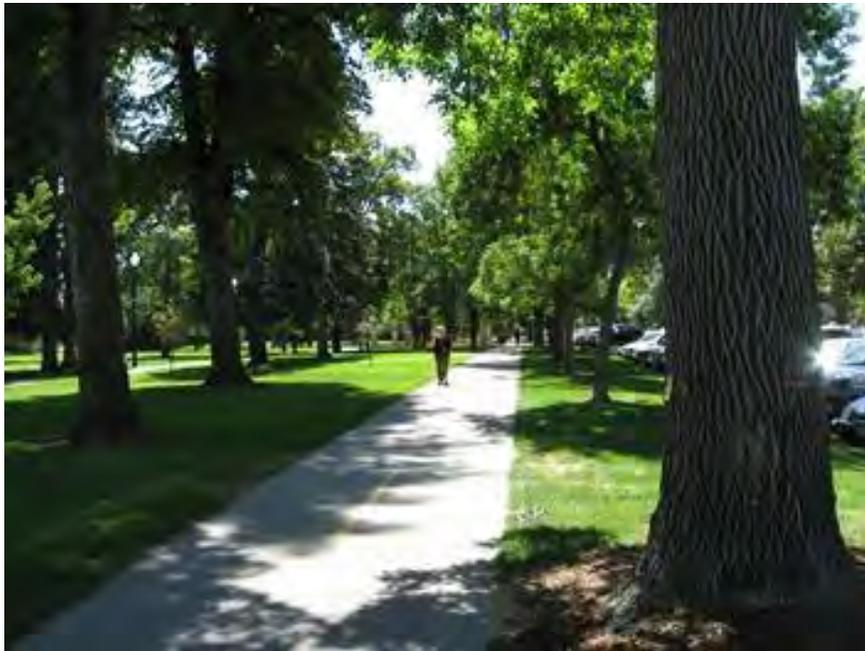


**Figure 4.** Trees can reduce the temperature of urban areas by 10° F on hot summer days with shade and evapotranspiration.

**Air Quality and Health.** Trees—especially large mature trees with large leaf areas—improve air quality by trapping fine particulates, especially very fine particulates of less than 2.5 microns (PM<sub>2.5</sub>) that, even in low concentrations, contribute significantly to public health risks such as premature death in people with heart or lung disease, nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, and increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing (U. S. EPA , 2014). Large trees reduce fine particulate concentration by altering temperatures, emitting volatile organics, altering energy use by shading buildings, slowing wind speeds, and cooling air temperatures. The interior of large patches of tree canopy have lower concentrations of fine particulate than

the edges of the patch or single, isolated trees. Removal of fine particulates by trees contributes significant public health benefits, including reducing premature death, pulmonary inflammation, accelerated atherosclerosis, and altered cardiac fluctuation (Nowak, 2013). Plants also absorb carbon-dioxide and release oxygen. Grass and shrubs improve air quality by covering the soil and reducing wind erosion that would occur with bare soil. When windblown dust settles momentarily on plant covered areas, it is frequently trapped out of range of the wind that delivered it and thus is not retransmitted into the atmosphere.

Green plants also remove carbon dioxide from the atmosphere and use the sun's energy to combine it with water to make carbohydrate and release oxygen. Research has demonstrated a clear positive relationship between the quality of landscaping and mental health (Starkey, 1978). Perhaps one of the reasons for this relationship is the beauty of high quality landscapes.



**Figure 5.** Trees especially large trees trap fine particulate improving air quality and public health.

**Flood Control.** Plants also reduce flood peaks in several important ways. By intercepting rainfall, they reduce overall precipitation from individual storms by approximately 1/10 inch. When rainfall does reach the ground, it takes longer and falls at a slower speed when compared to hitting the soil directly. In addition, plant litter roughens the soil. As animals eat the plant litter and burrow into the soil, they improve infiltration.

**Erosion Control.** Landscaping reduces both wind and water erosion. The typical vertical structure of plants with leaves and stems increases roughness thus slowing the velocity of wind and water near the ground. In addition, plant cover reduced the impact velocity of rain splash thus reducing sheet erosion.

**Habitat.** Trees and landscaping provide valuable habitat for urban wildlife and birds including migratory birds.

**Soil Fertility.** Landscaping, and especially trees, improve soil fertility by extracting carbon from the atmosphere and transferring it to the soils creating topsoil, cycling nutrients, opening root holes, loosening soil, increasing infiltration rates, and pulling nutrients trapped deep in the soil profile to the rooting zone.

**Property Value.** Ecosystem services are not the only value of trees and landscaping. People also value landscaping and trees because they are beautiful. The urban forest and quality landscaping are an integral part of the Greeley community, parks, and neighborhoods not just because of the ecosystem services. Trees frame views, create attractive streetscapes, and create attractive entryways to the City.

Most properties in Greeley have a significant investment in irrigated landscapes. Attractive landscapes are so essential that many people spend a significant amount to landscape their properties. Attractive landscaping adds to property values. Many property owners will not make significant changes in how they irrigate their landscapes after they complete installation.



**Figure 5.** The achievement of the Tree City USA designation in 1980 was an important accomplishment for the City of Greeley. Keeping that designation remains an important policy goal.

Greeley’s commitment to quality landscaping continues. Greeley was designated a “Tree City USA” by the Arbor Day foundation in 1980, and the 2060 Comprehensive Plan includes a policy to maintain this designation. The University of Northern Colorado achieved the designation of “Tree Campus USA” in 2013.

## What is Greeley doing now?

Four City departments are currently involved in activities that affect the conservation of water in landscapes: Community Development; Culture, Recreation and Parks; Public Works; and Water and Sewer.

### Community Development

The Community Development Department administers the existing landscape code and approves landscape plans through the development review process. The current Landscape Code requires a minimum of 50% coverage of the uncovered surface of a lot with approved plantings. A table in the Code prescribes bonuses for certain plants that provide layered covering of the ground. Since much of the effect of trees is above ground level, they receive less credit than their large size might seem to warrant. The Current Planning Division reviews landscape plans included in development review submittals for conformance with the landscape code and buffering requirements. In addition, the Current Planning Division assists the Code Compliance staff with reviewing designs submitted to address landscape code violations. Code Compliance staff receives complaints or observes a violations related to insufficient or non-compliant landscaping and then undertakes processes for enforcement.

### Culture, Parks, and Recreation

The Parks and Forestry Divisions have a significant role in landscape management and irrigation, based on upon customer services and demand.



**Figure 6 & 7.** Homestead Park (left) and JB Jones Park have been designed to use water efficiently. Photos by John Barnett

The Parks Division is responsible for the design, construction, and maintenance of Greeley's parks. How these parks are designed and landscaped drives their irrigation demand. To date,

four parks have been converted to low water use landscapes: Ramsier, Homestead, JB Jones and Greeley West. The design for Homestead received a 2014 award from the Colorado Parks and Recreation Association for New Park Design.

The Forestry Division is responsible for the urban forest. By City Code, the care and removal of street trees are the responsibility of the adjacent property owners. Different species require different amounts of irrigation. Careful selection of species can make a difference in the irrigation requirements of a landscape.

## **Public Works**

The Public Works Department is responsible for street construction and maintenance, as well as snow removal, ditch maintenance, and water detention areas. Many of the streets being reconstructed include significant landscape components. Street reconstruction and corridor landscape enhancements also are generally the responsibility of Public Works. For the last few years, these projects have been designed following the principles of low water landscaping.

The Facilities Division is responsible for the design, construction, and maintenance of City-owned buildings and facilities except those owned and operated through the City's Water and Sewer Department. Many facilities have landscaping components.

The Stormwater Management Division is responsible for maintenance of stormwater detention facilities dedicated to the public. The landscaping in these detention areas can range from bluegrass lawns to dryland grasses.

## **Water and Sewer**

Greeley's commitment to quality landscaping has continued over the years through Water and Sewer Department policies and practices. Water conservation is one of the four initiatives in Greeley's Water Master Plan. Greeley's water conservation program is designed to address all areas of water demand across the City.

The City has included conservation in overall supply planning for more than 20 years, developing its first water conservation plan in 1992. In 1997, Greeley hired a full-time conservation coordinator, who has managed the City's water efficiency efforts since then. While overall water demand has grown with added population, from 1993 to 2014, Greeley's per capita water use has declined primarily because of metering and more efficient indoor water fixtures and appliances.

**Greeley's Conservation Program.** Greeley's water conservation began in 1907 with permanent watering restrictions that remain in place today. Our program has grown since 1997 to

encompass all customer sectors in the City. In 2007, the City’s conservation program budget was increased, making it one of the five largest programs in Colorado. The conservation program addresses both indoor and outdoor water use through education, ordinances, direct outreach, rebates, and information. The Greeley conservation program implements an extensive social media campaign that includes advertisements on radio, in print, on buses, and cable TV. Consequently, the Greeley program has become one of the most visible and well-publicized conservation efforts in Northern Colorado.

**Irrigation Efficiency Rebates and Grants.** The City of Greeley provides free irrigation audits, as well as grants and rebates for replacing turf with xeric plantings. The irrigation auditing program has been gradually modified each year since 2001 to meet the changing needs of customers. Greeley offers grants to schools, businesses or homeowners’ associations (HOAs) to replace turf with xeric plantings.

## **Implementation of recommendations in adopted plans and policies**

This policy is intended to implement recommendations in the 2060 Comprehensive Plan, the 2003 Water Master Plan and the 2014 Water Conservation Plan calling for the reduction of landscape water demand. These documents provide a context for this Plan and its goals, policies, and recommended actions.

### **2060 Comprehensive Plan**

The 2060 Comprehensive Plan (City of Greeley, 2009) provides a policy framework for the City’s land and growth related codes. The 2060 Comprehensive Plan, adopted by the City Council on April 9, 2009, includes the following Objective and recommended actions:

#### **Objective EN2.A Water Resources**

- A Protect, conserve, maintain, and improve the quality and quantity of water available to Greeley residents and commerce.
  - 4. Promote the most efficient use of water through conservation and related practices.
    - a. Regularly review building and fire codes to assure standards include “best management practices” concerning energy efficiency installations related to plumbing fixtures and conservation measures
    - b. Review and revise land use development codes, as appropriate, to

encourage:

- drought-resistant and xeric plantings in landscape installations
- proper installation of landscape materials to conserve water at planting, such as with soil amendments
- planting at optimal seasons to minimize water use and plant stress
- an appropriate ratio of required landscape and permeable area to site improvements consistent with the other objectives of this 2060 Comprehensive Plan

- c. Audit water use associated with City facilities and review options to convert to xeric landscape treatments or strategically redesign sites for water conservation
- d. Develop incentive programs which induce water conservation installations and practices, including irrigation systems
- e. Develop a water rate structure that provides incentives for the efficient use of water and reflects actual cost of service
- f. Provide extensive education of the public in efficient and cost effective water conservation practices, including access to water audits for developed sites to measure actual water use patterns

### **Water Master Plan**

In 2003, Greeley adopted a Water Master Plan (Water & Sewer Department, 2003) intended to assure adequate water supplies and infrastructure through 2050. This Water Master Plan sets forth a four point strategy for providing securing water for future growth:

- Improve conservation
- Strengthen infrastructure
- Continue acquisition
- Expand storage

This Landscape Policy is intended to address improving conservation.

### **Water Conservation Plan**

This Landscape Policy for Water Conservation implements recommendations from the Water Conservation Plan (Meyer P. M., 2008) adopted by the Greeley Water and Sewer Board on November 19, 2008. These recommendations include:

- Enhanced water-wise landscaping code language;

- Water-wise landscape incentives for landlords, foreclosed properties, developers, and homeowners' associations;
- Develop low-budget xeric alternatives to zero landscaping;
- Explore changes in landscape codes, new construction requirements, lot sizes, turf and landscape percentages of total lot sizes;
- Retrofits of existing landscapes to water-wise landscaping such as cash for replacing bluegrass with species that require less water.

This Landscape Policy is intended to address these recommendations.

# Vision, Goals, and Policies

Vision: Maintain or enhance Greeley’s quality landscaping in both private and public areas, while improving landscape irrigation water efficiency.

The following is a summary of the City’s adopted Goals and Policies, and potential action items designed to meet these. These Goals and Policies are adopted to address the challenges identified in the Purpose and Need sections above.

Goal 1: Maintain Greeley’s quality landscapes and urban forest.

- Policy 1.1 Maintain the designation of Tree City U.S.A.
- Policy 1.2 Maintain ecological benefits provided by trees, shrubs, grasses and perennials.

Goal 2: Provide adequate information, training, and examples of water efficient landscapes that enable the design, installation, and maintenance of quality landscapes that use landscape water efficiently.

- Policy 2.1 Maintain and distribute a plant database to assist users in selecting plants for specific water requirements that will grow in Greeley. This database will be stratified by hydro-zone, plant form (trees, shrubs, perennials and grasses).
- Policy 2.2 Create, maintain, and publicize a library of water efficient irrigation tools and information on installing, maintaining, and repairing water efficient irrigation systems.
- Policy 2.3 Provide and create training and information materials to provide homeowners and practitioners with the information necessary to design, install and maintain high quality water-efficient landscapes.
- Policy 2.4 Create design examples that people could use to create a water-efficient landscape design.

Goal 3: Revise applicable sections of the Municipal Code that address landscaping, irrigation, and soil conditioning to comply with the goals, policies, and recommendations of this Plan.

- Policy 3.1 Continue to require a minimum of 50% of required open space to be covered with long-living plants.

- Policy 3.2 Limit the use of high irrigation-demand plants in new development and redevelopment projects to no more than 25% of the on-site open space for all sites except single family lots under two acres, and agricultural uses.
- Policy 3.3 Require the design, installation, maintenance, and operation of landscape irrigation systems to meet, but not exceed, the water requirements of the allowed landscaping.
- Policy 3.4 Require saving of topsoil for new construction, and require and enforce soil conditioning for all new landscapes prior to landscape installation.
- Policy 3.5 Require professional certification for associated professionals and tradespersons.
- Policy 3.6 Require permits and inspections for sites of over two acres not used for single-family housing or agriculture, and under one ownership.

Goal 4: Explore incentives for water-efficient landscapes.

- Policy 4.1 Explore incentives to install and maintain water-efficient landscapes in new development.
- Policy 4.2 Explore incentives to install and maintain water-efficient landscapes in redevelopment projects.
- Policy 4.3 Explore incentives to convert existing water-inefficient landscapes to water-efficient landscapes and to maintain the latter long-term.
- Policy 4.4 Investigate the potential for constructing a WaterSense model home in Greeley.

Goal 5: Ensure that the City of Greeley and its departments continue to lead by example by adhering to landscape practices that may improve irrigation efficiency.

- Policy 5.1 Establish and maintain adequate management and administration mechanisms to implement this Plan.
- Policy 5.2 Apply water-efficient design principles to all City capital improvement projects.

These Goals and Policies are discussed in more detail below, along with proposed action items that might be undertaken to implement them. These recommended action items are thought

to be an appropriate approach to meeting the Goals and Policies of this Plan; however, other actions may be more appropriate in the future in meeting the Goals and Policies, at the time of implementation. Therefore, while the Goals and Policies are adopted, the specific actions outlined below should be considered as recommendations.

**Goal 1: Maintain Greeley’s quality landscapes and urban forest.**

Located in an agricultural hub, and having innovated in providing reliable water supplies, Greeley citizens have a long history of creating a rich landscape environment.

**Policy 1.1 Maintain the designation of Tree City U.S.A.**

Greeley was designated a “Tree City U.S.A.” by the Arbor Day foundation in 1980, and the 2060 Comprehensive Plan includes a policy to maintain this designation. The University of Northern Colorado achieved the designation of “Tree Campus USA” in 2013. The City has historically implemented several activities to maintain this designation.

Action 1.1.1 Continue and expand, when appropriate, programs that revitalize tree appreciation and planting in the community, making house calls to discuss tree problems and solutions, planting boulevard trees in the mature portion of the community, reviewing landscape plans regarding proper tree and plant selections and planting methods, and reviewing individual sites to make recommendations based on the unique site conditions, landscape function and surrounding characteristics.

**Policy 1.2 Maintain ecological benefits provided by trees, shrubs, grasses, and perennials**

Greeley has had a history of high quality landscaping since its founding. Early settlers imported trees from the eastern and midwestern areas of the United States and attempted to grow them via irrigation systems. Over time, they learned what could grow with certain irrigation practices. The continuation and refinement of these landscape practices continues to this day. Indeed, this Plan can be seen as a continuation of the process of refining the practice of landscaping to meet the realities of the 21<sup>st</sup> Century when the ability to expand irrigation water availability in Colorado will be limited.

**Goal 2: Provide adequate information, training, and examples of water efficient landscapes that enable the design, installation, and maintenance of quality landscapes that use landscape water efficiently.**

Bluegrass requires as much as or more water than any other plant used in Greeley landscapes. Therefore, if the bluegrass is healthy, so is nearly everything else. Bluegrass also acts as a low-water “canary in the coal mine” since it is quite forgiving by going dormant long before any plants are adversely affected by low water. In these ways, bluegrass is an easy default landscaping option. Using low water plants in a low water environment, on the other hand, requires more knowledge related to design, installation, maintenance, and irrigating.

It is important to increase irrigation efficiency without increasing weed invasions. Some actions — reduction in live plant coverage, increased use of mulch, or landscaping with perennials – can reduce water demand, but they can have the effect of increasing weed invasion, unless there is more maintenance.

**Policy 2.1 Maintain and distribute a plant database to assist users in selecting plants for specific water requirements that will grow in Greeley. This database will be stratified by hydro- zone, plant form (trees, shrubs, perennials and grasses).**

A major barrier to landscaping for water conservation is the complexity in matching the varying seasonal water needs of plants, the delivery of irrigation water, and the weather to deliver the appropriate amount of water to plants at the appropriate time. By providing specific information on the amount of water needed by each plant species and by providing enough variety in species, people can make appropriate choices and still be assured that they will be able to find plants on the list at the nursery or retail location of their choice.

Given the area climate, all of the following hydrozones can be achieved in Greeley with irrigation:

Hydro-Zone	Irrigation Water for an Average Year	Land Use	Plants That Can Grow with Irrigation in the Climate and Soils of Greeley
High Water Use	17-19 gallons per sq. ft. per year or 27.3 to 30.5 inches	High performance turf for athletic fields	Any plant that can grow in Greeley. Many of the plants that need this amount of moisture are wetland plants.
Moderate Water Use	10-14 gallons per sq. ft. per year or 16.0 to 22.5 inches	Light use. Areas provide visual interest, ecological services, and visual interest.	Most plants that can grow in Greeley. This includes some low water using varieties of bluegrass.
Low Water Use	5-10 gallons per sq. ft. per year or 8.0 to 16.0 inches	Limited uses. Areas provide visual interest, habitat and ecological serves	Most plants that are native to Greeley
Very Low Water Use	0-5 gallons per sq. ft. per year or 0.0 to 8.0 inches	Limited uses. Areas provide visual interest, habitat and ecological serves	Bunch grasses, perennials, native shrubs, and a few trees

Greeley has a challenging climate. Nearly all other places that reach Greeley’s cold temperatures have more precipitation, and nearly all places in the world that are as dry are hotter. These circumstances, together with the extreme and rapid changes in temperature that occur during winters, limit the number of plants that can grow in Greeley.

Action 2.1.1 Develop a plant database of plants that will grow in Greeley and require less water.

The list would be made available in a user-friendly way for professionals in the landscape industry and members on the general public to learn about plants, many of which are already being used in Greeley landscapes but require less water than is typically applied to Greeley landscapes. This plant database should group plants into one of four hydro-zones as described above -- high water use, moderate water use, low water use, and very low water use. It should further group plants by form into

deciduous and evergreen trees, deciduous and evergreen shrubs, perennials, and perennial grasses. For each plant species, it should include the botanical name, common name, height, spread, sun/shade preference, soils requirements, and additional information such as flowering time and color. The plant database can provide information for each species on water requirements, height, spread, plant form, sun and shade preferences, soil preferences, and information about why people might wish to plant it. The plant database should be updated as new information becomes available. Plants can be added or deleted as appropriate.

The following chart summarizes the potential number of plants in a plant database that are well-suited to Greeley. While such a database might show what plants grow well in Greeley and would be initially intended for informational purposes, another possibility would be to potentially limit the number of high-water use plants allowed in a given landscape.

Summary of a Sample Plant Database, and the number of plants well-suited for Greeley:

Hydro-Zone	Irrigation Water for an Average Year	Deciduous Trees	Coniferous Trees	Deciduous Shrubs	Coniferous Shrubs	Perennials	Grasses	Total
High Water Use	17-19 gallons per sq. ft. per year	12	0	14	3	32	1	62
Moderate Water Use	10-14 gallons per sq. ft. per year	68	17	103	4	194	6	392
Low Water Use	5-10 gallons per sq. ft. per year	24	11	88	6	273	10	412
Very Low Water Use	0-5 gallons per sq. ft. per year	1	4	15	5	29	6	60
<b>Total</b>		105	32	220	18	528	23	926

**Policy 2.2      Create, maintain, and publicize a library of water-efficient irrigation tools and information on installing, maintaining, and repairing water efficient irrigation systems.**

Irrigation technology is the combination of sensing the need for additional soil moisture, turning on the irrigation system, applying water to the landscape, and turning off the water. To use irrigation water more efficiently, the irrigation system should not apply water at a rate faster than the soil can absorb it and the system should not apply more water than the plants need before the next watering. Irrigation technology can be as simple as a water user hand-operating irrigation devices such as setting up hoses and sprinklers by hand, simple irrigation controllers operated by clocks, or automated controllers using real time soil moisture or precipitation information and applying the appropriate quantity of water at an appropriate time. Nearly all plants used in landscapes in Greeley, including very low water using plants, require at least some irrigation. Even most very low water using plants require supplemental water for establishment. Therefore, effective irrigation technology is essential to maintain high quality landscapes. In addition, effective irrigation technology is essential to avoid overwatering low water landscapes that do not need much water. Irrigation heads that reduce evaporation loss and deliver water more evenly are available. Operating irrigation systems within their designed water pressure range can also reduce evaporative losses. Drip systems can apply water to specific plants that require higher water than surrounding plants.

- Action 2.2.1      Create and maintain a library focused on best practices for water conserving landscapes. This library should include publications on landscape design, plant design, plant characteristics, the use and value of plants, ecosystem services, plant water requirements, irrigation design, irrigation technology, landscape irrigation practice, and operation and maintenance of landscape irrigation systems.

**Policy 2.3 Provide and create training and information materials to provide homeowners and practitioners with the information necessary to design, install and maintain high quality water-efficient landscapes.**

While the design, installation, and maintenance of a bluegrass lawn can be a relatively simple task, the design, installation, and maintenance of a water-efficient landscape requires more thought and skill. The interaction of plants, soil, water, irrigation systems, soil texture, irrigation systems, climate and weather, and people are complex and changing. One frequently mentioned reason for not following water efficient landscape practices is a lack of knowledge of what plant materials and other practices are likely to be successful, and how much or how little water is required for plant survival. It is therefore recommended that the City support and coordinate with other organizations to provide training, and create training programs for landscape professionals and trades people, residents, and property managers to effectively address the need to conserve landscape irrigation water. Some or all of these training programs could be offered regionally rather than just locally.



**Figure 8.** A water efficient landscape design can be beautiful. Photo by Ruth Quade

Many in the green industry are recommending professional certifications and licensure at either the local or state level. A requirement for this professional licensure or certification would justify the expense of the training and continuing education necessary to obtain and keep the credentials. Information, training, and technical assistance are essential in addressing the goals of this plan. It can be unreasonable to ask people to meet a landscape water conservation goal when they do not know how to design, install, or maintain a low water landscape.

Action 2.3.1 Before Greeley develops additional training programs, staff should research available training programs to determine which programs could meet Greeley’s needs. Research and coordinate available training programs for landscape professionals and trades people, residents, and property managers in water-efficient landscape design, construction, and maintenance provided by others. Absent alternative training options, the City should develop and sponsor training programs.

Action 2.3.2 Provide homeowner training opportunities. In some communities, nurseries provide training in landscape subjects. Absent existing training options, the City should develop and sponsor training programs.

**Policy 2.4 Create design examples that people could use to create a water-efficient landscape.**

Action 2.4.1 Create water-efficient landscape design templates and sample site layouts for water-conserving landscapes. These templates should reflect a variety of lot sizes, lifestyle choices, and should also include a variety of plant species choices for each location shown. The designs for a variety of lifestyle choices could include designs for people who want an outdoor living room, people who wish to host backyard gatherings, people who enjoy gardening, people who want to attract wildlife, people who want minimal maintenance responsibility, and others as necessary. (See Appendix E Water Conserving Landscape Design Examples.)

Action 2.4.2 Develop pilot projects where citizens create water-efficient landscapes, and then analyze the results and challenges so that future programs can be successfully implemented and adopted by residents.

Action 2.4.3 Maintain detailed instructions on best practices for water-efficient landscapes that can be understood by lay people. The vast majority of landscaping projects after initial installation are completed by homeowners, so there is a need for detailed instructions on how to follow best low-water use best practices geared to the average homeowner.



**Figure 9.** Water efficient landscape designs can use many plants already used in Greeley and fit in any program.

Action 2.4.4 Teach and publicize at every opportunity the seven principles of Xeriscaping® developed by Denver Water and listed below. Modifications to reflect Greeley policy are in brackets. These principles are as follows (Greeley, City of, 2015):

Xeriscape isn't only types of plants; it's a system. Whether or not you install a full water wise garden, the 7 steps of Xeriscape are good landscape practices in Greeley's semi-arid climate.

1. *Planning and Design:* Plan before you plant. Think about landscape needs, backyard activities, and existing features to determine how you should plan it.
2. *Soil Amendment:* Soil will retain 30% more moisture when compost is added. The City Code requires 4 cubic yards per 1,000 square feet of new landscaped area. This equals approximately 1.3 inches in depth.
3. *Reduced Turf:* Instead of a large expanse of bluegrass, plant shrubs, trees, ground covers, and other plants that require less water.
4. *Efficient Irrigation:* Drip irrigation and bubblers are efficient ways to water plants at the ground level to reduce evaporation.
5. *Appropriate Plant Selection:* Choose low water use plants. Group plants with similar water, sun, and soil needs in the same area of your yard.
6. *Use of Mulches:* To minimize evaporation, impede weed growth, slow erosion, and help prevent soil and temperature fluctuations.
7. *Appropriate Maintenance:* Proper pruning, weeding, fertilization and proper attention to the irrigation system will preserve and enhance the quality of your Xeriscape. A landscape adapted to the environment will require less maintenance, less fertilizer, and reduce the use of pesticides and other chemicals.



**Figure 10.** Periodic irrigation audits are an important part of irrigation maintenance.

**Goal 3: Revise applicable sections of the Municipal Code that address landscaping, irrigation, and soil conditioning to comply with the goals, policies, and recommendations of this Plan.**

The purpose of this document is to provide policy direction that strikes the balance between preservation of the lifestyle values of the City of Greeley, and honoring the natural environment by adopting a landscape code that is appropriate for our region. Recommended implementation strategies are based on 1) adapting the soil in a landscape to efficiently hold water and nutrients, 2) using plants that, while needing less water because they are appropriate for our region, perform the same services as higher water use plants and 3) irrigating efficiently and only applying as much water as the plants need. Reduced irrigation water demand should not create an undue hardship. Actions which place an undue burden upon specific sectors of Greeley's population or on the entire community are neither necessary nor desirable.

**Policy 3.1 Continue to require a minimum of 50% of required open space to be covered with long-living plants.**

Since 2009, Greeley has required a minimum of 50% coverage of the unpaved portion of front yards and parkways (the area between the sidewalk and curb, most common in older parts of the City) with live plants. Prior to this the minimum requirement was 75%. Coverage is based on the area actually covered by the plants as a percentage of the pervious surface of the front yard or parkway, with bonuses given for plants that have larger mature sizes such as shrubs, ornamentals, evergreen trees and deciduous trees. Given the number of trees, shrubs, ground covers, and perennial grasses that will grow in water-conserving landscapes, it is appropriate to continue to require a 50% minimum coverage standard.

Action 3.1.1 Revise the landscape code to accomplish both quality landscaping and increased efficient use for irrigation water, while retaining the historic Greeley vision of landscaping aesthetics.

The existing City Code provides for square footage bonuses for certain plants based on their contribution to the

coverage of the ground surface. Bonuses for all large shade trees are 50 square feet and large conifers, 100 square feet. This does not reflect the ecosystem service contribution of these large trees. It is recommended that bonuses for large trees more closely follow the actual area of the canopy to reflect the value of their ecosystem services.

**Policy 3.2 Limit the use of high irrigation-demand plants in new development and redevelopment projects to no more than 25% of the on-site open space for all sites, except for single family lots under two acres and agricultural uses.**

Action 3.2.1 Action 2.1 provides a definition of high water use plants. Review the City Code to potentially limit the use of such plants and turf to no more than 25% of the on-site open space. Such a requirement would still permit between 25% and 75% of the on-site landscape to be in moderate, low, and very low water grasses, perennials, shrubs, or trees. As shown in the plant database there are several varieties of bluegrass that are moderate water use plants. The use of these varieties would not count against the high water use limit.

Action 3.2.2 Reduce the minimum size of required trees in water-efficient landscapes. Studies have shown that reducing the minimum size of trees at the time of planting does not contribute to a reduced tree size after approximately five years. Planting smaller trees, on the other hand, reduces the shock of transplanting and improves survivability. It also reduces the volume of required water over the first few years. Therefore, landscape regulations should differentiate between the minimum size of trees planted in water-efficient landscapes by permitting a smaller size (1-1/2 inches caliper instead of 2 1/2 inches) in water-inefficient landscapes, except for street trees.

**Policy 3.3 Require the design, installation, maintenance, and operation of landscape irrigation systems to meet, but not exceed, the water requirements of the allowed landscapes.**

Efficient and effective irrigation is essential to provide high quality landscapes that provide the ecological services expected by Greeley residents. These irrigation systems must provide enough water to

meet the needs of the hydrozone they serve without excessive watering and waste.

Action 3.3.1 Explore how “smart” irrigation systems can be integrated into the current system of fixed irrigation days.

Action 3.3.2 Amend the City Code to require separate meters for all sites except single family lots under two acres, and agricultural uses.

**Policy 3.4 Require saving of topsoil for new construction, and require and enforce soil conditioning for all new landscapes prior to landscape installation.**

One of the most valuable natural resources in the world is topsoil. Topsoil is a complex physical and biological material made up of living and dead mineral and organic particles. It is the product of climate, topography, geology, biology, and time. Nearly all terrestrial life, including human life, is dependent on topsoil. The presence or absence of topsoil can make a profound difference in whether plants survive and how much moisture and fertilizer they require to grow. Therefore, topsoil should be saved wherever it exists during any construction project and stockpiled to be spread as the final layer of soil over a site. In this way, it can resume its natural function.

Action 3.4.1 Amend the City Code to require saving of onsite topsoil wherever it is feasible and spreading it over the site prior to landscaping.

Action 3.4.2 Retain the Code requirement to incorporate four cubic yards of organic matter into every 1000 square feet of landscaped area. Organic matter holds nutrients rather than permitting them to be dissolved in water and leached out of the soil profile. These nutrients can then be released by soil microbes and made available to plants.

**Policy 3.5 Require professional certification for associated professionals and tradespersons.**

Each of the professions or trades involved in the design, construction, or maintenance of commercial landscapes has organizations appropriate to certify their qualifications. In addition, the State of Colorado requires the licensure of persons practicing landscape architecture or representing themselves as landscape architects. Greeley does require that people who

audit irrigation systems be certified. Both professional engineers and landscape architects are required to be licensed by the State of Colorado. The Greeley City Code requires engineering designs and studies submitted for development review to be prepared under the direction of a professional engineer licensed to practice in the State of Colorado, but does not require that landscape or irrigation plans for commercial and multi-family projects be prepared by a licensed landscape architect or certified irrigation designer. This requirement would affect landscape designs for commercial, industrial and multi-family projects, and for common areas of residential subdivisions. It would not affect landscape designs on single-family residential lots.

- Action 3.5.1 Amend the City Code to require the certification of professionals and tradespersons involved in the design, construction, and maintenance of commercial landscapes in Greeley. (See Policy 2.3 for training and scholarship programs).

**Policy 3.6      Require permits and inspections for sites of over two acres not used for single-family houses or agriculture, and under one ownership.**

- Action 3.6.1 Explore a permitting and inspection system for sites of over two acres not used for single-family housing or agriculture, and under one ownership. This would require submittals of landscape designs over a certain minimum size for review by qualified City staff and inspection of construction.

**Goal 4:      Explore incentives for water-efficient landscapes.**

Incentives are actions undertaken by the City to encourage people to provide a public benefit by reducing their cost burden or offering rewards. Incentives could address one of the reasons given by members of the public for not implementing water-efficient landscape design—a concern for higher costs of design, installation, and maintenance. Developers and homeowners’ associations may also have concerns about potential loss in property values or marketability because of a lack of understanding about water-efficient landscapes. The high cost of converting existing non-water efficient

landscapes to water efficient landscapes is certainly a factor in preventing such conversions. Incentives can encourage the installation and conversion to more water-efficient landscapes. Consideration should be given to how much water efficiency is appropriate in return for receiving an incentive. Issues to consider include the amount of water-efficient irrigated or non-irrigated common areas; landscaping on individual lots; whether the incentive should be provided to the developer, builder, or homeowner; the permanence and enforceability of the water- efficiency commitment; how disclosure of the commitment to future buyers is handled; how enforcement takes place; and the manner in which the commitment to provide adequate maintenance is handled. A pilot study will help to answer specific questions about the effectiveness of various incentives and approaches prior to adoption of specific measures on a City-wide basis.

**Policy 4.1 Explore incentives to install and maintain water-efficient landscapes in new development**

Action 4.1.1 The Water and Sewer and Community Development Departments should consider working with (a) willing developer(s) to design and implement a pilot program that would provide appropriate incentives for water conservation in new development areas that meet the goals of the Greeley Comprehensive Plan and are effective, permanent, and enforceable.

**Policy 4.2 Explore incentives to install and maintain water-efficient landscapes in redevelopment projects.**

Action 4.2.1 Design and implement a pilot program that would provide appropriate incentives for landscape water efficiency in redevelopment areas.

**Policy 4.3 Explore incentives to convert inefficient existing landscapes to water-efficient landscapes and to maintain the latter long-term.**

Action 4.3.1 Design and implement a program that could provide appropriate incentives to convert existing inefficient landscapes to more water-efficient landscapes.

**Policy 4.4 Investigate the potential to construct a WaterSense model home in Greeley.**

Action 4.4.1 Investigate the potential to construct a WaterSense model home

and landscaping in Greeley and whether incentives or partnerships would be the most appropriate mechanism for implementation.

Action 4.4.2 Provide assistance to assure new Greeley Urban Renewal Authority and Habitat for Humanity homes are WaterSense certified.

**Goal 5: Ensure that the City of Greeley and its departments continue to lead by example by adhering to landscape practices that may improve irrigation efficiency.**

The City of Greeley is the largest land owner and manager within the Greeley City limits. Therefore, it is the largest landscaper and whatever it does with its landscaping of streets, parks, and rights-of-way shall serve as an example to all other property owners contemplating the design or installation of landscapes. The success of this Plan depends on how effectively the City staff is able to design landscapes and administer City Code amendments intended to conserve water.

**Policy 5.1 Establish and maintain adequate management and administration mechanisms to implement this Plan.**

The following City departments and divisions have responsibilities for administering sections of the City Code that affect landscaping and landscape irrigation water demand: Community Development, Planning, Code Compliance, and Engineering Development Review Divisions; Culture, Parks, and Recreation Forestry Division; Public Works Department, Streets Division and Facilities Division; and Water and Sewer Department, Water Resources Division.

Action 5.1.1 Review the administration of the Landscape Code and Water Conservation Plan to improve compliance. As part of the code revisions, convene staff from the responsible departments and divisions to review administrative procedures to determine the most effective strategy for administering the code.

**Policy 5.2      Apply water-efficient design principles on all City capital improvement projects.**

A significant portion of water used for landscape irrigation is used to irrigate City parks, rights-of-ways, and other City facilities. The City is currently practicing effective irrigation water conservation through how it designs some of the landscaping in its parks, how it landscaping along street rights of way, and how it designs landscapes related to City facilities.

By definition, water-efficient landscapes reduce water demand for the areas they cover. Cumulatively over time, many of these designs may reduce future demand for landscape water. By publicizing the designs, especially the plant species lists related to hydro-zones, and irrigation plans, perhaps with exhibits on-site, online, or using them in training programs, completion of these projects would help to provide information on how to implement low water landscapes for homeowners.

Action 5.2.1    Practice low water landscape design in City parks. Greeley has begun to apply low water landscaping designs in parks where it is appropriate. In parks where there are sports fields or areas with intensive use areas, it will be necessary to continue to install and maintain irrigated turf areas. In parks, bluegrass or other high water demanding turf grasses should be reserved for athletic fields and similar intensively-used areas. These areas would be designed with a high water hydro-zone. As new parks are developed or existing parks are redeveloped, turf areas that will be used at a moderate intensity should be lowered to a medium high hydro-zone. Where trees are present, this change should be accomplished over several years to allow trees to develop deeper root systems as irrigation is reduced.

Action 5.2.2    It is recommended that the City continue to convert parks to water-efficient landscapes when it is consistent with the uses present in those parks and following such procedures as necessary to maintain the health of trees. Areas not needed for intensive uses such as athletic fields could be converted to more water-efficient landscapes. New parks should be designed to have 35-50% non-irrigated turf landscaping, depending on the

planned use. Passive parks could be converted to lower-water landscapes. In select cases, converting athletic play turf areas to artificial turf may be an appropriate alternative that reduces water demand, while at the same time allowing more play on the field. This, in turn, limits the wear on non-artificial grass fields, which can require less watering of these places.

Action 5.2.3 Practice water-efficient landscape design in City rights-of-way.

The City is now practicing water-efficient best management practices and effective irrigation water conservation in its new landscape designs along street corridors where possible. It is recommended that this process be continued and enhanced to demonstrate the potential for enhanced landscapes that require limited irrigation. Within street and road rights-of-way and at major City entryways, it is possible to achieve attractive landscapes using irrigation water more efficiently, featuring large trees, ornamental trees, colorful flowering shrubs, and beautiful flowering perennial beds. This approach is recommended as a demonstration of what is possible.

Action 5.2.4 Practice water-efficient landscape design for City facilities.

As City facilities are developed and redeveloped, it is recommended that water-efficient landscape design principles be followed to demonstrate the potential for enhanced landscapes that require limited irrigation. Such facilities should be using large trees, ornamental trees, colorful flowering shrubs, and beautiful flowering perennial beds. This approach is recommended as a demonstration of what is possible.

Action 5.2.5 Retrofit existing detention ponds to native turf, trees, shrubs, or perennials. Where feasible, convert City owned and maintained stormwater detention ponds from bluegrass to native turf and vegetation.

Action 5.2.6 Provide assistance to assure new GURA & Habitat for Humanity homes are WaterSense certified.

# Appendices

## Appendix A, Definitions

While some of the readers of this document have an excellent understanding of the language of water resources, some may not. Here are some of the key terms:

- Acre-foot—the amount of water that covers one acre one foot deep; (43,560 cubic feet, or 325,851 gallons) the approximate amount of water to serve one to two average family single family homes;
- Demand Management—any of a number of actions taken by a water provider to reduce the need for water;
- Evapotranspiration—the transfer of liquid water from the soil to water vapor in the atmosphere by either direct evaporation of water from the soil or transpiration through the plants and their leaves. Plant species have widely varying evapotranspiration rates which also vary throughout the year with seasonal temperatures.
- Excess irrigation—the amount of water applied to plants that exceeds the amount lost to evapo-transpiration. This water either seeps into the ground where much of it is lost to groundwater flows that return to the river, or runs off directly. Water that is applied at rates in excess of the infiltration rate of the soil also runs off.
- Hydro-zone—an area with plants having a need for and receiving a similar amount of water in a landscape. In this policy, the hydro-zones can be characterized as high, medium, low and very low water use.
- Infiltration—the process where liquid water from irrigation or precipitation is absorbed by the soil and becomes soil moisture. With very few exceptions in the world, plants receive water only from soil moisture
- Irrigation rate—the amount of water applied to a land area within a period of time (usually inches per hour). Any amount of water in excess of the maximum infiltration rate that the soil can absorb becomes runoff.
- Irrigation volume—the volume of water per area applied to a landscape. This is usually expressed as gallons per square foot or inches of depth. A volume of 0.6233 gallons per square foot would cover that square foot with one inch of water.
- Return flow—the amount of water diverted by a water provider that is returned to the river and not lost to evapotranspiration. It includes most of the water used by indoor water uses that passes through wastewater treatment plants and is released to the river or that is used for irrigation and other outdoor purposes and flows back to the river. Most of the outdoor water is consumed by evapotranspiration.
- Runoff—water that flows from or runs off the land. Some runoff is cause when rainfall or irrigation rates exceed the infiltration capacity of the soil. Runoff can also be

generated when the soil is saturated so that it cannot absorb any more water until some water emerges downslope through seeps or springs.

- Xeriscaping® —a term coined by the Denver Water Board to describe a process for creating water-efficient landscapes following seven defined steps: planning and design, using turf appropriately, irrigating efficiently, conditioning soil, mulching, selecting appropriate plants, and maintaining landscapes.

## Appendix B, Input Received

During the development of this Plan, 13 public events were held, two Open Houses, six stakeholder Meetings, and five presentations before the City Council and various boards and commissions. Over 225 people attended these various events and submitted 82 written comments. These comments are shown below. To enable staff to apply these comments most effectively, they were classified as shown below by relevance as shown in the right-hand column.

Comment	Relevance
I think what you are doing is great. We really need to do this.	Overall approach
Conversion of existing landscapes is too expensive.	Existing landscapes
I think Astroturf and artificial trees would be all we need.	Alternative landscape approaches
I would like to xeriscape my yard but it is too expensive.	Existing landscapes
Bluegrass is easy to maintain and looks nice.	Overall approach
Landscape contractors would really be interested in this.	Stakeholder concerns
If Greeley adopted code changes encouraging Xeriscaping®, adequate maintenance should be required.	Maintenance/Regulations
Poorly maintained areas look ugly. Any regulation needs teeth. Poorly maintained areas are ugly and brown.	Maintenance/Regulations
Look at phasing this in. This is about starting to change lifestyles. Maybe do 30% for a while and then do more.	Implementation Timing
Think through the cost/ revenue side. What might happen if reducing water use requires increasing water rates?	Possible unintended financial impacts
Builder & Realtor Round Table	
If irrigation water use were limited, should water dedication requirements be reduced?	Fairness
How would reduced water use be enforced?	Incentives
Outreach and education are essential to ongoing succeed of this project.	Information and Training
We need to show people how to do this and what it looks like.	Information and Training
Agriculture is important to the community	
The scheduled presentation to local groups should be bumped from August to October because many people are gone on vacations during the summer. The Weld County Builders' Association doesn't meet during the summer. Our first meeting is the Second week of Sept.	Schedule
The Xeriscape gardens of the City and UNC have not been well maintained and do not encourage people to follow that model.	Maintenance
Comment	Relevance

There is a need for better education on water conservation to the public.	Information and Training
If conservation delays the need for a dam, doesn't the cost increase?	Alternatives to conservation
Landscape Contractors	
What happened with the Water Star program?	This was a previous effort to conserve landscape irrigation water.
There are price point barriers where customers will not spend <u>any</u> more for water conservation measures even when the payback period for the investment is one year or less and even when rebates are available.	Customer response to price and incentives
Many people are unwilling to spend 1% more for low water use bluegrass than for regular bluegrass.	Customer response to price and incentives
Water is our most valuable resource. We allow people with no qualifications to control the management of the 50% of it used for landscape irrigation. There are certifications for Landscape Technicians, Irrigation Auditors, Backflow Technicians, Irrigation technicians, and others. Water is too important to leave its management to unqualified people.	Professional qualifications
60% of irrigation water runs directly down the street.	The need for conservation measures
Comment	Relevance
If solutions are purely based on price, east Greeley will be all rock and west Greeley will be lush. There needs to be minimum landscape performance standards.	Incentives/ Regulation
Should do reminder cards about water	Public information and outreach
Comment	Relevance
Top-of-the-line irrigation systems might cost approximately \$300 more than a standard system. Most first time homebuyers will not buy the upscale irrigation system even though it has a payback of 2 to 3 years.	Customer response to price and incentives
Proper licensing such as Certified Landscape Technician or Certified Irrigation Designer can provide better protection for the City and better water savings.	Professional qualifications
Regulation for landscapers. Auditing new irrigation systems before COs rather than just inspecting commercial systems.	Incentives/ Regulation
Drought Resistant bluegrass varieties cost only 1% more than non-drought-resistant bluegrass.	Incentives/ Regulation
The City should adopt a policy that landscape professionals who practice in Greeley should be required to take continuing education training on water conservation every two to three years.	Professional qualifications/ Information and Training
There should be a City board of landscape professionals to adopt a plant list for Greeley and make decisions within guidelines and criteria set by the City Council.	Participation/ Implementation
Greeley Association of Realtors	
Opportunity: The City should work with builders who offer front yard landscaping to homeowners.	Incentives/ Regulation
Comment	Relevance
Work with current single family residents to help homeowners to simplify and keep up properties for less water usage and less maintenance.	Information and Training/ Incentives
I would love updates	Outreach
Larger older neighborhoods have larger yards and huge trees that are	Regulation/ Incentives

costly to redo.	
Can there be can there be classes or support relative to this issue?	Information and Training
Thank you for the presentation on current and future water use and landscaping. It is good to know this issue is being looked at. Water is critical and I believe some landscaping restrictions will be necessary to save and conserve water.	Regulation
I think the landscape guidelines must allow for individual preferences— not all folks are open to rock in the front yard. The City needs to offer choices of products and plant types to use.  Most, or at least a lot of us, don't know what plants to use although we would certainly like to save on water use.	Regulation  Information and Training
Offer rebates for Astro-turf	Incentives
Would you consider having classes to educate the people and give ideas?  Will the parks cut down on their grass, plants, and trees? They water when you have had a lot of rain. Is there any way to regulate the sprinklers?	Information and Training  Parks and capital investment
Stop requiring so much cement in residential areas.	Integrated stormwater management
Allow natural buffalo grasses in different %.	Appropriate plants
Save rainwater.	Non-Potable water use/ Rainwater harvesting Regulations
Change the code to allow for no plants.	
Please consider reducing the cost of a building permit in exchange for a water saving landscape plan.	Incentives
We're very interested in the plant database when it comes online	Information and Training
Weld County Builders Association	
Will there possibly be rebates on raw water fees for builders who Xeriscape before the sale of a home?	Incentives
Will the City participate with homeowners to modify existing landscaping to create new landscaping scenarios that use less water?	Incentives Training & Technical Assistance
Yes, live plants are important! Trees absorb CO2 for air quality (and produce Oxygen). Also habitat for urban wildlife and bird populations— both year round and migratory.	Coverage with live plant material.
I think the City should look at possibly doing a large central park for the community and have it be on the heavy water use. The park should have amenities to attract citizens and their families to spend time at the community park and try and pull them away from individual residences. The park should have items such as a pool, water play area, green grass, lots of trees, natural water way (if possible), and should be large enough such that the community could use the park without the feeling overcrowded. I am thinking some variation of the New York Central	

<p>Park. One place that this park could be located would be a redevelopment of the old part of the City and located the park for ease access to the down town area.</p> <p>The other question/concern would be that if the City is going to limit each residential house to 19 gallons a year for each sq. ft. of landscaping, it seem that this could be problematic in that the City would be limiting the water rights for the individual households to less than what was promised when they purchase of the tap. I realize there can be incentives such as a tiered rate schedule, or other, to help limit the water use, but it seems that this would add complexities in administration and enforcement. With the Central park idea there are a lot of taps that have old rights that the City could take control over with a scrape and rebuild.</p>	
<p>Open House 4/ 21/ 14</p>	
<p>Change the required square feet needed. Note able to follow the City Code and Xeriscape with what current plants qualify per square foot.</p> <p>Requirement for square footage coverage for plants needs to be reduced. Coverage should be 30%. Credit should be given for lower water plants.</p> <p>My current yard required coverage space is just over 1200 Sq. ft. To be in compliance with the City, I would have to plant 265 perennials [illegible]. I'm being penalized because 15 years ago, I put [artificial] turf down to help conserve water. Credit should be given to those who put in [artificial] turf and plant around it.</p> <p>Future development should be the use of irrigation water and allow [artificial] turf.</p>	<p>Coverage with live plant material.</p>
<p>I like 30% live landscape.</p>	<p>Coverage with live plant material.</p>
<p>On lawn watering, how much water is returned to the river?</p>	<p>Water Balance</p>
<p>From Facebook: Are you working with HOAs? Some of them have ridiculous requirements. A lot of water pours into the sewers every morning from people watering their bluegrass. Anything natural is frowned on. This morning they were watering the strip along 83. What a waste!</p>	<p>Outreach. Wasteful irrigation Plant species choices.</p>
<p>Open House 4/23/14</p>	
<p>I would prefer a requirement of even more soil amendment for new projects.</p>	
<p>I would prefer a requirement of only certain trees that are better suited to our winters and water usage.</p>	
<p>Maybe a list of plant recommendations that are included with the water bill.</p>	
<p>I would still prefer a 50% requirement of live plants in the front yard.</p>	
<p>I like the idea of tiered water rates, as long as it is proportional to property size. I have a large lot and don't want to be punished for that. I understand from our discussions that this is the model of interest.</p>	
<p>I support 50% water reduction. I live in a neighborhood where most of</p>	

my neighbors water 5-7 days a week to keep their lawns looking lush. They look down their noses at me because I water within the recommendations of the city, and as such, do not have as green of a lawn as they do.	
The xeriscape in a box program is great - but what I would really like to leverage is a landscaping audit. Much like the water audit that the city provides, but making recommendations for different types of drought resistant vegetation given the characteristics of an individual property.	
Open House 9/17/15	
Goals and vision plans are good. Educate the public is a must. Builders, HOAs, all of this to conserve water. Xeriscaping/ water efficient grass is the way to go. I would like updates	
As a design/build company, we have been promoting low water use landscapes for years. The challenge is to educate and incentivize the end user to change their mindset and overlook the initial cost savings to lay a bunch of high use sod.	
Q. Why can't we store water on our lot? A. Under existing state law, all water is appropriated under Colorado's prior appropriation system. The legislature is looking at permitting up to 2 55 gallon rain barrels if the storage is augmented.	
Q. What about allergenic plants in the plant database? A. All known allergenic plants have been eliminated.	
Builders of new homes have to be educated and brought along.	
Education and professionalism is critical.	
The median of 20 <sup>th</sup> Street between Buena Vista Drive and 35 <sup>th</sup> Avenue was converted from buffalo grass to bluegrass. This was a mistake	
What builders build, homeowners will maintain. They are unlikely to make changes.	
The City must incentivize developers. They want a consistent look.	
Good low water grasses include inland saltgrass, streambank wheatgrass, buffalo grass, and blue gramma.	
Open House 9/24/15	
The City needs to make all power lines be underground and encourage street trees.	
Weeds and maintenance can be a problem.	
The City needs to review landscape plans and irrigation plans at the same time. Irrigation design cannot be left to be designed by the landscape installer during construction. Otherwise it will be cheap and inefficient. City parks have been done this way.	
Most people do not understand irrigation technology.	
New home yards average approximately 3,000 square feet.	
It is dangerous to legislate landscape design.	
Sidyard setbacks could be gravel.	

The City should hire a resource person to assist homeowners with design and maintenance problems	
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## Appendix C, Semiarid environments

Prior to the settlement of Greeley, runoff from the short grass prairie was less than one inch per year. This runoff was generated primarily from intense rainfalls when the precipitation rate exceeded the infiltration capacity of the soil. A small portion of this runoff occurs when shallow groundwater encounters impervious layers where it cannot pass through and reemerges through springs. Most of the water that infiltrates into the soil stays in the top few inches and evaporates directly from the soil. The water that is taken up by plants is also transpired relatively quickly into the atmosphere. In dryer areas, where most water leaves the soil through evapotranspiration, salts and water soluble minerals tend to be carried to the surface where they are deposited by the evaporating moisture. The result is a soil profile that tends to be alkaline or salty. Plants that are drought tolerant, have deep root systems or shallow root systems that can take up water quickly, and can live with limited resources have an advantage over those that don't.

In humid regions such as eastern North America and mountain landscapes in the west, where precipitation exceeds potential evapotranspiration, much of the precipitation infiltrates into the soil where some of it is taken up by plants and most of the remainder percolates downward and through the soil and bedrock, then reemerges and flows into streams. This higher volume of water carries salts and other soluble minerals downstream to the ocean. The result is a soil profile that tends to be acidic. Plants that grow large, and can compete for light and nutrients have an advantage over others. Because of increased water, soils under irrigated landscapes where precipitation plus evapotranspiration exceeds potential evapotranspiration evolve over time to more closely resemble those of humid regions.

Unlike more humid climates with more rainfall, water is a limiting factor for plant growth in a semi-arid climate. Unless soil moisture is increased, plant growth or diversity in plant species cannot increase. Plants that survived in the native landscape had to be able to survive extensive drought. Many of them were grasses, forbs, and shrubs that had significant adaptations for survival in the semi-arid climate. The Greeley climate is characterized by wet springs and dry summers, falls, and winters. Soil conditions in winter are often exceptionally dry. Rainfalls are often brief intense afternoon thunder showers, which in the fine textured soils typical of much of eastern Colorado, favor grasses over shrubs. Cold dry windy winters prevent the natural growth of trees over nearly the entire landscape. The exceptions are along rivers and large streams where annual floods, shallow water table, and coarse textured floodplain soils facilitate the growth of cottonwoods (*Populus* spp.) and steep sided canyons and rock outcrops permit the growth of eastern red cedar (*Juniperus virginiana*). In addition, the low humidity and Chinook winds characteristic of eastern Colorado winters contribute to rapid temperature

changes throughout the winter which make survival of many trees problematic even where there is sufficient moisture. Many species which can survive in colder climates cannot survive in Greeley because of the rapidly changing winter temperatures and dry winter soil conditions. Nearly every other part of the world that is this dry is hotter and nearly every area of the world that is this cold is wetter. The result is a short-grass steppe where only a select number of plants can grow without irrigation. The early settlers who encountered this environment quickly recognized that they would need to make significant changes to this environment to survive.

With irrigation, many plants that cannot tolerate the naturally dry climate of Greeley thrive—especially if adequate winter moisture is available. Without supplemental water, trees grow along perennial streams and in rocky soils.

A number of sources exist that provide information about plant types that thrive best in low-water conditions and a compatible with Greeley's climate. They include the following: the GreenCo plant database (Wright Water Engineers, Inc., 2008), Missouri Botanical Gardens for USDA hardiness zones (Missouri Botanical Garden), New Sunset Western Garden Book for its climate zones specific to western North America (Brenzel, 2012), Plants for a Future.org (Plants for a Future, 2014), (for soils information). All or the above sources provide information on height, spread, flowering, and sun/ shade preference.

## **Appendix D, The Goal of Irrigation**

The goal of irrigation is to provide adequate soil moisture to meet the needs of the plants in a landscape. Water applied in excess of plant needs run off over the ground surface and down the gutter or infiltrate to soils below the rooting zone where it contributes to groundwater flow. Plants may use some of the excess water to increase their growth rate or size. Thus one possible outcome for overwatering bluegrass is the need to mow more frequently. Either way, the water is paid for and lost to the user.

Automated irrigation systems with controllers with preset programs offer significant opportunities for water conservation but also can be major contributors to wasted irrigation water. Residential controllers for automated sprinkler systems are frequently set for the highest seasonal demand and are not adjusted for seasonal or short-term changes in moisture demand. Water use is therefore excessive during wet periods or spring and fall when the need for irrigation is lower.

Smart irrigation technology is intended to apply irrigation water efficiently with quantifiable water savings. Smart Irrigation controllers use information about moisture conditions such as precipitation data or soil moisture to adjust the watering schedule to meet changing water needs of plants. They also adjust both seasonal and short-term weather needs. They use site-specific soil moisture or precipitation data to make these adjustments to change either the frequency of irrigation or the run-time of irrigation cycles. A rain shut-off device can override the controller and temporarily turn off the controller after a significant rainfall event. Smart Irrigation Technology is constantly evolving and irrigation technology evolution is being driven by water scarcity, increased understanding of the variability of meteorological events in time and space the evolution of information technology, and the desire to reduce costs.

Many property owners do not have irrigation systems but hand set sprinklers with above-ground hoses. As a rule, irrigators who drag hoses use less water than those with automated irrigated systems because they tend to wait until plants need water as opposed to “setting and forgetting” their irrigation systems. (Personal communication with Ruth Quade))

## **Appendix E, Discussion of Coverage Area Bonus for Plant Form**

The existing City Code provides for square footage bonuses for certain plants based on their contribution to the coverage of the ground surface. Bonuses for all large shade trees are 50 square feet and large conifers, 100 square feet. This does not reflect the ecosystem service contribution of these large trees. It is recommended that bonuses for large trees more closely follow the actual area of the canopy to reflect the value of their ecosystem services. It is recommended that revised landscape regulations be adopted reflecting both the need for high quality landscaping and the need to reduce the growth in the demand for irrigation water. It is recommended that the revised landscape regulations be amended as follows:

- Square footage bonuses for large trees should be based on actual mature size of the species and should more closely follow the actual area of the canopy (the area directly under the crown) of the tree. For example, instead of a 50 square foot credit for a burr oak, a large shade tree, it would receive a credit of 200 square feet reflecting both its large size the time it takes to reach its mature size and still significantly below its maximum canopy area of approximately 900 square feet. This added bonus would reflect the contribution of such a large, long-lived shade tree to value the urban in providing essential ecological services in reduction of the urban heat island, reduction of near surface wind speeds, improvement in air quality, and reduction of erosion.
- To offset for the potential reduction in landscape area caused by increasing bonuses for large trees, bonuses for plants of minor significance would be reduced or eliminated. For example, the bonus for a bulb which may only be effective for a three week window in the spring would be reduced from three square feet to zero and that of a low growing juniper would be reduced from 25 square feet to 10 square feet. Reflecting its lesser significance.
- To encourage the use of low water plant materials, a water efficiency factor would be applied to the area of plant coverage and any bonuses for specific plants. The area covered by plants requiring the full water budget of 19 gallons per square foot per year would be multiplied by 0.75 to reduce its credit for coverage. The area covered by plants requiring only moderate irrigation water or 10 to 14 gallons per square foot per year would receive its full credit for coverage. The area covered by plants requiring low water use or five to ten gallons per square foot per year would be multiplied by 1.25 to increase its credit to reflect the value of low water use. Finally the area covered by plants requiring only very low irrigation water or less than five gallons per square foot per year would be multiplied by 1.5 to reflect the high value of its very low irrigation water demand.

The above mentioned burr oak would receive the initial area credit of 200 square feet multiplied by 1.25 for its low water use for a total of 250 square feet.

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