Enabling Large-Scale Transformation of Non-Essential Turf in Colorado Communities

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Project Overview

Irrigated turfgrass (turf) lawns are the predominant form of landscaping across the U.S., encompassing an estimated 40 million acres.[1] Colorado is no exception, with initial estimates indicating 167,800 acres of irrigated turf statewide, which substantially contributes to the state's municipal outdoor water demand.[2] In Colorado, approximately 40% of potable municipal water is used outdoors each year, with much of this irrigating turfgrass.[3] The prevalence of turfgrass in Colorado's semi-arid climate presents a significant water supply opportunity for water providers and their customers. Replacing non-essential or nonfunctional turf with waterwise landscaping is a key strategy for meeting the state's water needs, as well as a central element of long-term drought and climate change resilience planning.[4] To achieve large-scale turf replacements, Colorado communities and utilities will need to be positioned to make significant investments in these programs and projects, as they would for other critical water infrastructure projects. When implemented at a large scale, non-essential turf replacement projects can save tens of thousands of acre-feet (AF) of water per year, serving as a source of sustainable, climate resilient water supply. Additionally, these projects can provide cost savings and numerous co-benefits, including pollinator habitat, community beautification, improved air and water quality, educational opportunities, and more. That is why a growing number of Colorado water utilities and others are investing in large-scale turf replacement incentive programs and projects.

This project, *Enabling Large Scale Transformation of Non-Essential Turf in Colorado Communities,* was led by Western Resource Advocates (WRA) and WaterNow Alliance (WaterNow). Other members of our project team included the University of Colorado Denver's Department of Urban and Regional Planning (mapping and analysis), Honey Creek Resources (economics analysis), and Ecoscape Design (initial pilot parcel landscape designs). The project focused on large-scale projects, both at the parcel and community levels, for several reasons. First, large-scale turf replacement initiatives have the potential to save more water, providing a cost-effective source of supply. Additionally, implementing large-scale, community-wide projects means funding and financing these investments with capital dollars, an issue that does not arise when these programs are smaller or are only investing in one-off projects that can be funded with operating revenues or grants.

1."Mapping and Modeling the Biogeochemical Cycling of Turf Grasses in the United States." Environmental Management, 2005, https://link.springer.com/article/10.1007/s00267-004-0316-2.
2."Updated 2024 Exploratory Analysis of Potential Water Savings, Costs and Benefits of Turf Replacement in Colorado." BBC Research & Consulting, 2024 https://dnrweblink.state.co.us/CWCB/0/edoc/223774/UpdatedBBCTurfReplacement_Final%20Report%202024.pdf?searchid=03cfd9b4-addf-4bd5-85e1-3b4c139b6c28
3. "Analysis and Technical Update to the Colorado Water Plan." Colorada Water Conservation Board, https://cwcb.colorado.gov/colorado-water-plan/technical-update-to-the-plan
4. "Financing the Future: How to Pay for Turf Replacement in Colorado." Western Resource Advocates and WaterNow Alliance, 2022, https://westernresourceadvocates.org/publications/financing-the-future-how-to-pay-for-turf-replacement-in-colorado/

Supporting nonfunctional turf removal efforts, in 2022, the Colorado Water Conservation Board (CWCB) developed a $2 million turf replacement grant program to assist local governments, districts, nonprofit organizations, and Colorado's federally recognized Tribes to replace non-essential turf. In 2023, the program funded 50 eligible entities to install site-specific projects (e.g., enhancement of medians, parks, rights of way, etc.) and/or to develop or expand local turf replacement rebate incentive programs for their customers.[5] Colorado House Bill 24-1435[6] Section 10, also "*directed the state treasurer to transfer $2 million on July 1, 2024, from the CWCB construction fund to the turf replacement fund to finance the state turf replacement program,"* enabling CWCB to scale up its program efforts once again.

As a result of this project, pathways to turf replacements present a cost-effective long-term investment in water supply reliability. This report summarizes the methodologies used to estimate water and cost savings of large-scale turf replacement, challenges faced, key takeaways, and resources developed over the duration of the project.

The primary objectives of this multiyear project were to enable large-scale turf replacement projects that may have otherwise faced economic or other barriers to implementation. Through a multifaceted approach, the project team:

- Collaborated with three ***Partner Communities*** to develop and design turf replacement pilot projects, estimate water and cost savings based on replacement landscaping scenarios, and conduct community-wide assessments to analyze broader water savings and economic benefits of turf replacement projects.
- Developed a variety of publicly available ***Reports and Resources*** to assist communities considering or implementing turf replacement and waterwise landscaping initiatives in Colorado and beyond.

Partner Communities

WRA, WaterNow and the project team worked closely with Broomfield, Westminster, and Greeley to develop and design specific pilot projects, estimate water savings and costs based on turf replacement acreage, and conduct community-wide assessments to understand broader water savings and economic factors. Additionally, funding and financing assistance was offered to the partnering communities to further support turf conversion efforts. Below is an overview of each partner community. Details on the community-wide assessments of turf replacement potential and pilot turf conversion projects can be found in the individual community case studies, described below and on this website.

5. 2023 Turf Replacement Program Funding Summary, CWCB, 2023, https://engagecwcb.org/2023-turf-replacement-program-funding-summary
6. Colorado House Bill 24-1435, Colorado Water Conservation Board Projects, Section 10, https://leg.colorado.gov/bills/hb24-1435

Broomfield, Colorado

The consolidated City and County of Broomfield, Colorado, is located about 18 miles north of Denver. Broomfield has a population of approximately 76,976 as of 2023. The community is experiencing rapid population growth and anticipates a buildout population of 95,500 residents in 2040. Significant growth is expected in the multifamily and commercial sectors in northeastern Broomfield along the Interstate 25 (I-25) corridor. Facing climate change, drought, and rapid population growth, Broomfield's water supply and reliability is at risk. By 2050, water demand in Broomfield is projected to rise to approximately 18,100 acre-feet per year (AFY), representing an increase of about 5,000 AF from 2024 levels. With 60-70% of Broomfield's annual water supply dedicated to landscape irrigation, replacing non-essential turf with waterwise landscaping is a critical tool to ensure the community can meet growing demand in the face of climate change. Turf replacement efforts also align with Broomfield's recently adopted landscape requirements that prioritize water conservation for new development and redevelopment by limiting cool-season turf and requiring low-water plant alternatives and efficient irrigation systems.

In addition to supporting Broomfield with a community-wide assessment and its pilot turf conversion project, WaterNow and WRA developed a tailored Funding and Financing Roadmap document that outlines available grants and financing mechanisms to pay for the pilot project and future large-scale turf conversion efforts. The turf conversion multiple benefits fact sheet was developed at Broomfield's request to assist with internal discussions and decision making.

Westminster, Colorado

Westminster, Colorado, is in the Denver Metro area, located within both Jefferson and Adams counties. Westminster provides drinking water to approximately 135,000 people both inside and outside the city limits, and its population is expected to increase in the future. Westminster also faces the challenge of meeting increased water demand in the face of decreased supply due to drought. Due to high water usage for outdoor irrigation (50% of the city's annual treated drinking water in the summer), converting non-essential turf to low water use alternative landscaping offers the city an important opportunity to conserve water.

In addition to supporting Westminster with a community-wide assessment and its pilot turf conversion project, WaterNow and WRA developed the Turf Conversion Database in response to the city's request for help compiling turf conversion benefits and outreach materials to communicate the benefits to residents. Westminster's interest in materials to assist with homeowner's association (HOA) outreach also prompted the development of the HOA report and fact sheet.

Greeley, Colorado

Greeley, Colorado, is located on the High Plains in northern Colorado approximately 49 miles north/northeast of Denver. The population of Greeley in 2021 was 109,323. Like the other partner communities, Greeley is experiencing high rates of population growth, with up to 311,000 people projected to reside in Greeley by 2070 under a high population growth scenario. Annual water demand in Greeley is projected to increase significantly in the future (up to 70,000 AF by 2070, an increase of approximately 40,000 AF from 2021 water demand). During peak irrigation season from June through September, outdoor water use makes up approximately 70% of total use. To conserve water, replacing non-essential turf with more water efficient landscaping is a critical solution to the city's water challenges.

In addition to supporting Greeley's pilot turf conversion project, WaterNow and WRA assisted Greeley with a successful grant application to fund its pilot project and supported the drafting of a memorandum of understanding (MOU) between Greeley and University of Northern Colorado (its partner on the pilot project) to ensure future collaboration on water efficiency initiatives. With Honey Creek Resources, we also developed a modified economic analysis tool to examine the benefits and costs of replacing roadway medians and rights-of-way turf with native and water conserving grasses.

Partner Community Project Outcomes

	Broomfield	Westminster	Greeley[3]
Community-wide Irrigated Turf -all properties[1] (acres)	3,010	3,960	---
Community-wide Irrigated Turf - commercial, industrial & Institutional (CII)[2] (acres)	1,370	1,900	---
Estimated CII Turf Replacement (acres)	Up to 780	Up to 1,200	---
Potential CII Water Savings (acre-feet per year)	Up to 1,090	Up to 1,830	---
Potential CII Cost Savings ($ per year)	$7,900 - $8,500	$320,400 - $908,700	---
Pilot Parcel Turf Replacement Area (acres)	3.23	4	3.4
Estimated Annual Water Savings (acre-feet per year)	5	5	6
Estimated Annual Cost Savings ($ per year)	$35,930	$10,000	$27,557

[1] Including residential
[2] Including some HOA commons and public parks/open space
[3] A community-wide analysis was not completed for Greeley.

Key Project Takeaways

- **Significant water savings potential from large-scale turf replacement projects:** The project demonstrates that replacing turf on a large scale can lead to substantial local water savings. For example, Westminster and Broomfield may save an estimated average of 1,830 and 1,090 AFY, respectively, for changing out non-essential turf to low water landscaping across the community.
- **Cost-effective alternative to new infrastructure**: Turf replacement has proven to be a cost-effective solution, offering a viable alternative to costly investments in new water supplies, storage facilities, and infrastructure. For example, Westminster may save approximately $490,000 to $909,000 per year from reduced water demand and avoided costs of new water supplies.
- **Critical role of local data**: This project underscored the importance of having access to local spatial datasets. The availability of Denver Regional Council of Governments (DRCOG) land cover data (specifically the irrigated turf layer) was key to the success of conducting community-wide assessments in both Broomfield and Westminster. Greeley, which is outside of the DRCOG dataset, faced challenges in obtaining accurate landcover data due to unsuccessful aerial LIDAR collections, leaving them without the necessary data to complete the community-wide turf mapping analysis.
- **Need for a definition of "nonfunctional turf":** Establishing a clear, community-specific definition of what is considered functional and nonfunctional turf takes time and political will, but it is essential to conducting a spatial analysis to quantify the potential for turf removal within a community. A well-defined definition ensures that the analysis is data-driven, supporting utilities in setting precise goals and identifying specific areas for targeted removal.
- **Importance of sharing information and experiences:** There is growing momentum to shift landscaping norms in Colorado, but the transition is still in its infancy. New expertise and experience must be developed, supplies and knowledge of waterwise plants and grasses must increase, and aesthetic expectations shifted, among many other necessary changes. Sharing information and experiences between and within communities and others is critical to ensure a successful transition to more sustainable and beneficial landscapes across the state.

Reports and Resources

WRA, WaterNow, and the project team developed a variety of publicly available reports and resources aimed at disseminating key insights about this project. These materials offer valuable guidance and information to stakeholders interested in embarking on turf replacement and waterwise landscaping initiatives in Colorado and beyond.

Financing the Future: How to Pay for Turf Replacement in Colorado
This paper examines some of the more promising funding and financing pathways available to water providers to scale up turf replacement locally.

Waterwise Landscapes: A Cost-Effective HOA Investment in Resilience
This report outlines strategies to help Colorado HOAs leverage funding and financing opportunities to pay for turf conversion and maximize the return on their investment. The report also includes four case studies to demonstrate how other HOAs in Colorado have successfully implemented and benefitted

from turf conversion projects. This report is accompanied by a fact sheet to assist communities in conversations about turf replacement projects with HOAs.

Turf Conversation Database
The Turf Conversion Database includes examples of turf conversion benefits, engagement options, and communications materials. These examples can serve as a resource for communities across the West to adapt to their own unique audience and goals.

Is Artificial Turf a Beneficial Water Conservation Tool in the West?
This report explores the current state of the research behind the benefits and drawbacks of artificial turf as it relates to water management, temperature impacts, lifecycle analysis, PFAS contamination, harmful chemicals, microplastic contamination, pet waste buildup, and cost.

Community-wide Assessment Water Savings Estimate Tool
This tool features a collection of interactive worksheets to assist utility staff in evaluating various turf replacement scenarios and estimating water savings for different types of replacement landscaping throughout the community.

Pilot Parcel Water Savings Estimate Tool
This data driven tool estimates water savings for turf replacement projects by considering the existing landscaping, new landscaping, and annual water savings based on local climate data (including reference evapotranspiration [ET], rainfall, and landscape water requirements). This tool was adapted and developed from Northern Water's Landscape Conversion Water Savings Calculator and the EPA WaterSense Water Budget tool.

Economic Analysis Planning Tool
Developed in collaboration with Honey Creek Resources, this tool comprises a set of interactive worksheets to help utility staff analyze the benefits and costs of turf replacements over a 30-year period. The Economic Analysis Planning Tool also supports decision making about the cost-effective price point for turf replacement incentives and helps utility staff compare the cost per acre-foot of water conserved from demand reduction due to turf replacements with the cost per acre-foot of traditional water supplies.

Transforming Non-functional Turf to Waterwise Landscapes Achieves Multiple Benefits Fact Sheet
Developed to assist communities in discussions and decision making, this fact sheet describes the qualitative benefits associated with waterwise landscapes and includes links to additional resources.

Non-Essential Turf Project Case Study Reports
These reports detail the pilot parcel projects and community-wide assessments for this project's partner communities of Broomfield, Westminster, and Greeley. The case studies include background information, methods, water savings estimates, economic analyses, and challenges and lessons learned. The case studies are intended to serve as a model for other communities looking to embark on similar efforts.

Appendices

Appendix A: Community-wide Assessment

The project team conducted community-wide analyses to estimate the non-essential turf area, potential water savings, and costs and benefits of replacing turf with waterwise landscaping in Westminster and Broomfield. The team was not able to complete an analysis in Greeley due to a lack of an existing irrigated turf landcover dataset in that region. Additional details and results from the community-wide assessment are included in detail in the Westminster and Broomfield case studies.

Mapping Irrigated Turf Area

To map irrigated turf in Broomfield and Westminster, project partners from the University of Colorado Denver Department of Urban and Regional Planning (CU Denver) compiled DRCOG 2022 land cover planimetric data[7,8] that included an irrigated turf layer. Next, CU Denver and WRA worked with Westminster and Broomfield staff to aggregate local land use data and overlay it with the DRCOG irrigated turf data to estimate existing irrigated turf area by local land use categories – such as public and private parks, commercial and industrial properties, open space, golf courses, and HOA common areas. The project team also estimated irrigated turf acreage on single-family properties but omitted these properties from the community-wide assessment as it was not the focus of this large-scale turf replacement project.

The project team's estimates of the total irrigated turf area and potential water savings estimates are expected to be lower than the actual amounts that could be realized. The DRCOG land cover layer includes a tree coverage category, and only one land cover type is assigned to any location. As a result, areas with tree coverage excluded any amounts of irrigated turf beneath the tree canopy. While additional analysis and ground-truthing could estimate the total turf area under the tree canopy at a higher confidence, the project team opted for these lower irrigated turf area results to be conservative in the water savings and cost estimates.

Initially, the project team aimed to identify specific areas of non-essential turf within the case study communities. However, at the time of this analysis, the communities had not yet established a definition of non-essential turf which made it challenging to delineate between areas of essential and non-essential turf on the spatial analysis. Without these definitions, the project shifted focus to a turf removal scenario planning approach. The team worked with Broomfield and Westminster to estimate the potential turf acreage that could be replaced, and for each land use category, developed both high- and low- scenario assumptions about the percentage of turf that could be replaced. They also outlined assumptions for the types of replacement landscaping by land use category, including native grass, low water use plants, and non-irrigated options (including unirrigated vegetation and hardscapes such as walking paths) (**Table A1: Theoretical Sample Turf Replacement Scenario**).

7. Denver Regional Council of Governments regional land cover data https://data.drcog.org/
8. Greeley is outside the DRCOG region but has expressed interest in collaborating with neighboring communities to develop irrigated turf mapping in the future. During this project, two attempts to collect aerial imagery were made to collect the necessary data. However, the first attempt occurred too early in the season before turf had fully greened, and the second was unsuccessful due to turbulence during the flight, which rendered the data inaccurate.

Table A1: Theoretical Sample Turf Replacement Scenario

Irrigated Turf		Scenario Percent Turf Replaced				Replacement Landscaping		
Example Land Use Categories	Acres	High Replacement	High Acres Replaced	Low Replacement	Low Acres Replaced	Native Grass	Low Water Use Plants	No Irrigation
Open space	100	80%	80	30%	30	90%	5%	5%
Public parks & recreation	100	60%	60	20%	20	85%	5%	10%
Golf course	100	20%	20	5%	5	100%	0%	0%
Private park	100	70%	70	25%	25	90%	5%	5%
Commericial, Industrial	100	80%	80	30%	30	70%	10%	20%
HOA common property	100	70%	70	25%	25	70%	10%	20%
Single family	100	70%	70	20%	20	40%	40%	20%
TOTAL	700		450		155			

Water Savings Estimates

The project team collaborated with the partner communities to estimate the potential water savings from the various turf replacement scenarios. The team calculated savings by comparing the estimated average annual supplemental irrigation needs of existing turf to those of the replacement landscaping. They applied the following annual irrigation requirements to the respective acreages of turf and replacement scenarios to determine water use and savings (**Table A2: Assumed Landscaping Irrigation Needs**).

Table A2: Assumed Landscaping Irrigation Needs

	Annual supplemental irrigation needs			
	Westminster		Broomfield	
Landscaping	Inches (in^3/in^2)	AF/acre	Inches (in^3/in^2)	AF/acrez
Cool season turfgrass[1,2]	26	2.17	25	2.08
Native grass[3]	9	0.75	9	0.75
Regional plants (low water use)[4]	7	0.58	7	0.58
Not irrigated	0	0.00	0	0.00

[1] Westminster: Approximate mid-point of irrigation needs per city conservation staff. Westminster assumes 15 gal/ft2 to 18 gal/ft2 (24 – 29") annual supplement irrigation needs for turf.
[2] Broomfield: Mid-point of Kentucky Bluegrass annual supplemental irrigation needs of 24 to 26" per Broomfield's https://www.broomfieldvoice.com/landscape-code-rewrite.
[3] Mid-point of the Colorado Native Grass Guide low water use grass options 8 to 10" annual watering needs.
[4] Mid-point of low water use plant estimated annual required irrigation application of 5 - 9 gal/ft^2 from Table 1 in Green Industry Best Management Practices (BMP) for the Conservation and Protection of Water Resources in Colorado: Moving Toward Sustainability, Appendices, 3rd Release, May 2008.

Economics Analysis

The project team (led by Honey Creek Resources and WaterNow) completed a scenario benefit-cost and return on investment (ROI) analyses to evaluate investments in turf replacement as a source of water supply. Westminster and Broomfield have unique water supply portfolios and future water supply needs, so the project team conducted customized economics analyses for each community using an Economic Analysis Planning Tool developed specifically for the project. For example, Westminster's alternative water supply is the purchase of Colorado-Big Thompson (CBT) shares at an assumed cost of $40,000 per AF. Avoiding this high-cost alternative supply drives the economics of conservation in Westminster. In Broomfield, the economic driver was avoided costs for distribution and treatment of water, as well as the value of leased water.

To conduct these economics analyses, the project team worked with the communities to compile data inputs including utility annual revenue requirements, utility growth rate, cost of supply (e.g., water rights purchases), treatment and distribution costs, the retail cost of water, and ongoing operation and maintenance costs. The economics analysis also relied on the estimated water savings and replacement landscaping from the low and high planning scenarios. In addition, the economics analysis used several assumptions about annual acres of turf replaced, dollar amount of subsidy provided by the water provider, inflation, annual maintenance of replacement landscapes, and expected annual increase in water use. The analysis for Broomfield also includes two additional factors. First, potential grant funds the city can use to support turf removal investments. Second, analysis of the impact of foregone utility revenues due to decreased water usage from turf replacements on the benefit cost ratio. These two additional inputs help Broomfield make its unique case based on its community-specific circumstances.

Based on inputs and assumptions, the Economic Analysis Planning Tool estimated the present value of turf replacement benefits and costs over a 30-year period for both communities. These results provide information about the benefits and costs of turf replacements for property owners as well as for the water provider. The Economic Analysis Planning Tool is a decision-support resource that communities can use to model different levels of investment in turf replacements. With this tool, water providers can right-size a turf replacement program to achieve desired water savings goals while ensuring the investment is cost-effective with benefits outweighing costs for both the utility and property owners.

Using the Economic Analysis Planning Tool to develop a cost-effective turf replacement program gives water providers a data-driven turf replacement budget. For example, the economics analysis for Westminster demonstrated that an investment of $74 million in turf replacements would be cost-effective and save 36,358 AF of water saved over 30 years. Westminster can now use this information to build its turf replacement program budget and identify funding and financing pathways to make this large-scale investment.

Appendix B: Pilot Parcels

Parcel Selection and Design

The project team worked with the partner communities and with local stakeholders to identify larger-scale pilot turf replacement projects in highly visible areas of the communities. Westminster selected a 4-acre parcel adjacent to City Hall. Greeley collaborated with the University of Northern Colorado to select a 3.4-acre parcel adjacent to the University Center. Broomfield identified two parcels in neighboring parks, totaling 3.2 acres. All projects will have multiple co-benefits in addition to saving water. Details on the pilot projects and their selection are provided in the Westminster, Broomfield, and Greeley project case studies.

The initial goal of the pilot projects was to reduce outdoor water use by replacing high-water turf with waterwise landscaping. During the parcel site design process, however, the communities chose to use the opportunity to increase public use and create new educational opportunities at the selected sites. Some of the features included in the new landscape designs are improved access, walking paths, seating areas, recreational spaces, demonstration gardens, waterwise plantings, shade trees, hammock areas, and educational signage. These amenities offer significant community benefits, but also led to higher project costs, as compared to projects that are solely focused on water savings from replacing cool-season turf with native grasses, for example.

Water Savings Estimates

The project team calculated annual water savings for the pilot parcels using methods tailored to each community's preferences.

A modified version of Northern Water's Water Savings Estimate Calculator,[9] based on the EPA's WaterSense Water Budget Tool,[10] was used across all communities. This tool incorporates detailed local monthly ET and precipitation data. Northern Water shared its Excel-based tool with the project team, allowing WRA to customize it for each community and the pilot projects. Modifications included the ability to evaluate multiple retrofit landscape types and incorporating community-specific ET and precipitation data for Westminster and Broomfield (Greeley's data was already included in the original tool). The updated Landscape Conversion Project Water Savings Estimate Tool is available for download to calculate water savings from similar projects.

Water savings estimates for Broomfield were averaged across three methods: calculations by Norris Design (the firm responsible for the new landscape designs), results from the modified tool, and estimates based on landscaping irrigation needs in **Table A2: Assumed Landscaping Irrigation Needs**. For Westminster, water savings were calculated by averaging results from the modified tool and the high-level irrigation estimates. Greeley relied solely on the modified tool, rounding results to the nearest AF.

Funding Assistance and Status

Replacing large areas of turf with new waterwise landscaping can be costly, so a key focus of the project was securing funding for the pilot projects. WRA and WaterNow supported the partner communities in applying for grants, including a CWCB Water Plan Grant for Westminster and a City of Greeley grant for the University of Northern Colorado that provided the matching funds for implementation. Broomfield, which is planning to pursue external project funds in 2025, received a detailed funding and financing roadmap from the project team.

Greeley's project at the University of Northern Colorado broke ground in late 2024, and Westminster plans to begin contracting and construction in 2025.

9. Northern Water's Landscape Conversion Water Savings Calculator can be requested at https://www.northernwater.org/environmental/efficient-water-use/landscape-resources
10. https://www.epa.gov/watersense/water-budget-tool