Exploratory Analysis of Potential Water Savings, Costs and Benefits of Turf Replacement in Colorado

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PREPARED FOR:

COLORADO WATER CONSERVATION BOARD

REPORT

Report

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Prepared for
Colorado Water Conservation Board

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Introduction

Turf Replacement, and removal of non-functional turf in particular, continues to be a topic of much interest across the West. Successes and water savings from the Southern Nevada Water Authority (SNWA)–a collection of municipal water providers/groups in the Las Vegas area–are often pointed to as a success story on paying for turf removal. However, significant differences between Nevada and Colorado suggest that **water savings from turf removal in Colorado could be significantly lower than Nevada and the price tag could be much higher.**

Should Colorado still pursue removing non-functional turf? Absolutely. But removing turf responsibly to achieve lasting water savings will require a broader suite of tools. **A thoughtful and Colorado-specific approach to turf removal will make all the difference for achieving the *Transformative Landscape Change* called for in the 2023 Colorado Water Plan.**

With the passage of Colorado's 2022 Turf Replacement Bill (House Bill 22-1151) and the recently signed *Memorandum of Understanding by and among Colorado River Basin Municipal and Public Water Providers* (MOU), it is increasingly important for Colorado to have a refined understanding of several questions on landscape transformation that have not been adequately evaluated to date. These include:

- How much non-functional turf exists in Colorado?
- What is the realistic water savings potential for Colorado?
- What are the realistic costs associated with turf removal in Colorado?
- What are the tools that should be employed to maximize outdoor water savings?
- What other elements must be considered when planning a turf replacement program?
- What are the data gaps and potential to refine data for future analyses?

The Colorado Water Conservation Board (CWCB) has been working with BBC Research & Consulting to conduct an analysis to identify potential water savings, benefits and costs from removing non-functional turf grass in Colorado. This report intends to provide an exploratory assessment of the complexities associated with estimating water savings from turf replacement in Colorado. While the magnitude of potential water savings, and other benefits and costs associated with incentivized turf replacement programs is one report focus, the report also highlights a range of related topics that warrant additional discussion.

To initiate these discussions CWCB hosted the November 9, 2022 Colorado Landscape Summit (Summit) which included more than 130 attendees from multiple groups (water utility staff, non-profit organization staff, landscape specialists, etc). At the Summit, CWCB shared the initial analysis from this report and invited a series of guest speakers and panelists to add to the conversation. Input from these and future discussions can inform and guide development of a suite of options that Colorado can employ to realize sustained outdoor water savings, not just from turf removal, but from a range of tools intended to achieve long-term outdoor water savings while maintaining community health.

Key Report Findings

Irrigating extensive amounts of non-native and/or cool season exacerbates Colorado's water challenges especially in combination with climate change and long-term aridification. Clearly change is needed, but the questions of how much water can be saved and how rapidly turf can be replaced through incentive-based programs require Colorado-specific data and assumptions, rather than those from another state like Nevada. The following BBC report makes some exploratory advances toward those answers by providing a better understanding of the potential range of water savings and identifying areas where more data is needed. The CWCB is also continuing to collect information and will be evaluating potential savings as part of its efforts to implement the 2022 Turf Replacement Bill. Key report findings are highlighted below:

SAVINGS FROM TURF REMOVAL MAY BE LOWER THAN PREVIOUSLY ASSUMED

- Of the total water use in the state, **municipal water accounts for just 7% of total water use in the state and about 40% of that goes to outdoor irrigation. Outdoor use accounts for approximately 2.8% of all Colorado water use but it cannot be totally eradicated fully, nor is it irrigating solely non-functional turf.** Irrigation provides water to native grasses, xeriscape, trees as well as "functional" turf - turf in places used frequently by people and pets (e.g. parks; ballfields).

- The amount of irrigated **turf in Colorado is estimated here to be approximately 100,000 acres but could be less or more - better data is needed.** Of that amount, a portion is non-functional - this report assumes about 26,000 acres and its removal is an important focus, but to realize savings, proper low-water replacement vegetation and irrigation issues need to be addressed

- **Non functional turf removal has the potential to save approximately 10,000 - 20,000 acre feet a year, or roughly 2.5-5% of annual outdoor use per year, if fully realized over time.** This could take more than a decade - it still needs to be a focus but creating locally-driven plans is key.

RATES, BUDGETS AND LAND USE POLICIES CAN BE FAST AND EFFECTIVE

- While many turf removal discussions center on a dollar per square foot estimate, removing turf is just one step toward landscape transformation. Replacing plants and addressing the underlying irrigation bumps **the costs significantly higher.**

- T**his report uses a low-end cost estimate of $5 per square foot to remove turf, but the actual cost could be much higher.** Denver Water has recently said, they estimate costs could be $10 per square foot (twice the assumption in this report). Using those numbers, total costs **for replacing 30% of the non-functional turf statewide could be $1.8 - $3.5 Billion dollars or more.**

- Water rates, water budgets and other land use policies are significantly faster and more cost effective ways to reduce outdoor water use than turf rebate programs. At the Colorado Landscape Summit, it was noted that **water budget rates could save 5 times more water at a cost 20 times lower per acre foot than turf replacement rebates.** This report estimates that in less than 10 years water savings from water-wise development codes and regulations could exceed the amount of water that may be saved by replacing a third of non-essential turf.

COLORADO SAVINGS WON'T BE THE SAME AS IN THE LAS VEGAS AREA

- Colorado's water **savings from turf replacement may be around 1/3 of the per square foot (gpsf) water savings achieved in Las Vegas**. This is due to an annual **turf watering demand in Las Vegas that is almost 4 times higher than in Colorado** due to longer watering season, higher evapotranspiration rates, and other factors. Las Vegas turf irrigation takes 72 gpsf whereas Colorado turf uses 19 gpsf.

- The **Las Vegas area requires as much as 19 gpsf of water for xeriscape** - which is the average yearly demand for Colorado turf.

- The 2022 MOU signed by cities in and outside of Colorado has a 30% target that, if applied statewide, would equal about 7,800 acres of turf replacement in Colorado - **about 1.7 times the total amount of turf that has been replaced by the Southern Nevada Water Authority in the Las Vegas area over 25 years.** The cost for SNWA to replace a lower amount of turf was about $285 million in program incentives.

MUNICIPALITIES AND WATER PROVIDERS HAVE A SUITE OF TOOLS TO ADDRESS LANDSCAPE CHANGE

- There are water providers in Colorado and the Las Vegas area that have developed strong tools to create lasting savings. Importantly, Las Vegas doesn't just have a turf program, it also uses tiered water rates, water saving development codes, and other incentives and conservation measures that combine to reduce water use. At the Colorado Landscape Summit **the top three most popular ways to reduce turf included 1st Landscape ordinances, 2nd Water rates and 3rd water budgets.**

- Inclining block rates and water budgets can drive water conservation. **The City of Boulder's 2022 water budget rate structure has inclining block rates where the highest block charges $28 per 1,000 gallons of water but just $4.22 in the lowest block rate.** These structures can create utility funding to pay for conservation rebate programs or help support lower costs in lower billing blocks that can, combined with other programs, create greater equity in supporting landscape change.

- The highest value turf removal projects may need to focus on the highest water users in commercial, multifamily HOA, institutional and other customer classes as well as high water using single family customers. The latter may also expand to shared spaces like certain parks or right of ways with non-functional turf or excessive irrigation. When public spaces are included, considering green space, trees, reduced heat island impacts and other benefits to the community will also need to be considered. While Multifamily (25%), Commercial (17%) and Single Family homes (6%) were a concern for Landscape Summit Participants, **50%** say the best place to focus is the highest water users in each category and the same amount said those using the most should pay for the costs of turf replacement.

As noted in both the report, at the summit and by the attendees, more data is needed to continue to evaluate the real and actual water savings as landscaping efforts move forward. The following report offers an understanding of what we know as of the launch of the 2023 Colorado Water Plan. It highlights why ongoing studies and updates to water conservation efforts across the state are of continued importance, supporting both actions in the Colorado Water Plan and the ongoing work to update the plan moving forward.

Exploratory Analysis of Potential Savings, Costs and Benefits of Turf Replacement in Colorado

1. Introduction

On June 8, 2022, Governor Jared Polis signed House Bill 22-1151 (HB 22-1151) into law, establishing a state turf replacement program and fund intended to accelerate turf replacement through existing turf replacement programs offered by Colorado municipal water providers (M&I providers) and to help establish and support new turf replacement programs throughout the state.

Reportedly as many as 22 Colorado M&I providers have existing turf replacement programs.[1] Annual Colorado 1051 water efficiency reports filed with the Colorado Water Conservation Board (CWCB) from twelve large Front Range providers[2] document a cumulative total of about 2.4 million square-feet (around 60 acres) of turf conversions since 2013.

Despite this growing body of Colorado experience, and extensive information from the longstanding turf replacement effort in Southern Nevada, many questions remain regarding turf replacement in Colorado**. Fundamental information— including current average water use per square-foot or per acre for irrigated turf, the average amount of annual water use saved by converting cool season turf to xeric plants or native grass, the total number of acres currently planted in turf, and the amount of "non-functional" turf — are not known at the statewide scale.**

This report is intended to provide a realistic assessment of the magnitude of potential water savings, costs and other benefits from turf replacement programs in Colorado — while recognizing there is considerable need for additional research. Using estimates of total outdoor M&I water use from the Technical Update to the Water Plan, we consider two scenarios to establish high-end and low-end estimates of the potential benefits and costs of incentivized turf replacement. One scenario considers high water use but low turf acres, while the other scenario considers low water use but high turf acres.

Outdoor use =
Number of irrigated acres
x
Water use per acre

Higher use per acre implies a lower number of irrigated acres and vice-versa

Both M&I providers with turf replacement programs and turf replacement service providers such as Resource Central have expressed interest in conducting the type of "before and after" analyses of changes in water use based on M&I billing records that have been undertaken for the

[1] *Financing the Future: How to Pay for Turf Replacement in Colorado.* Appendix A. Western Resource Advocates and Water Now Alliance. August 2022.

[2] Aurora, Castle Rock, Centennial, Colorado Springs, Fort Collins, Fountain, Greeley, Lafayette, Little Thompson WD, Northglenn, Thornton and Westminster.

Southern Nevada program. Such analyses will likely provide more definitive estimates of water savings from turf replacement. It would also be helpful for the State turf replacement program to be set up in a way that allows for data collection and analysis that could help better understand the full extent of associated savings. However, savings will likely have to be tracked by utilities for years as weather patterns, new xeric planting, irrigation changes and other factors may cause fluctuations from year-to-year before a clear trend can be established. Additionally, it would be helpful to have a better understanding of the total amount of turf in Colorado and the subset of total "non-functional" turf in the state.

2. Potential Benefits of Turf Replacement in Colorado

Based on data from the latest Technical Update for the Colorado Water Plan[3], as of 2020 almost 400,000 acre-feet of water per year (AFY) was used for outdoor purposes by municipal and industrial customers in Colorado. If the portion of 'non-revenue' water related to the volume of water used for outdoor purposes is included — such as water lost to treatment processes and distribution leaks — outdoor water use may require almost 450,000 AFY of water from M&I providers, about 42 percent of total M&I water use. About 70 percent of outdoor water use by M&I customers occurs in the South Platte Basin (including the Metro Sub-basin and the Republican River Basin), 18 percent occurs in the Arkansas Basin and the remaining 11 percent occurs across the rest of Colorado, as shown in Figure 1.

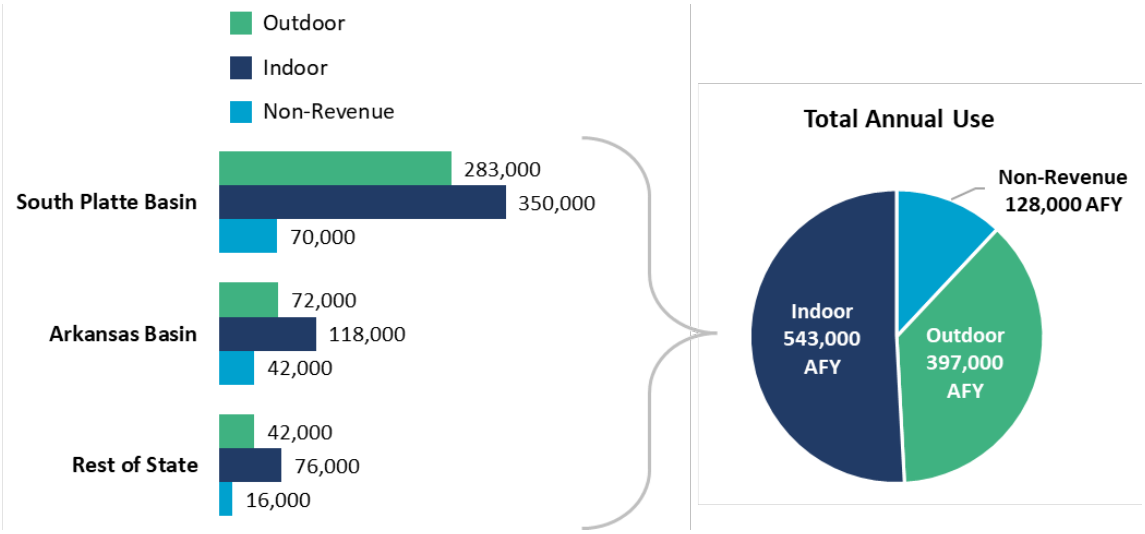
Measurements/Conversions:

1 acre = 43,560 square-feet

1 acre-foot = 325,851 gallons

1 acre-foot/acre = 7.48 gallons per square-foot

Figure 1. Estimated Current Annual Water Use in Colorado



Source: Interpolated between 2015 estimates and 2050 projections from *Current and Projected Planning Scenario Municipal and Industrial Water Demands.* Analysis and Technical Update to the Colorado Water Plan. Element Water. July 15, 2019.

[3] *Current and Projected Planning Scenario Municipal and Industrial Water Demands*, Element Water. Prepared for the Colorado Water Conservation Board. July 15, 2019.

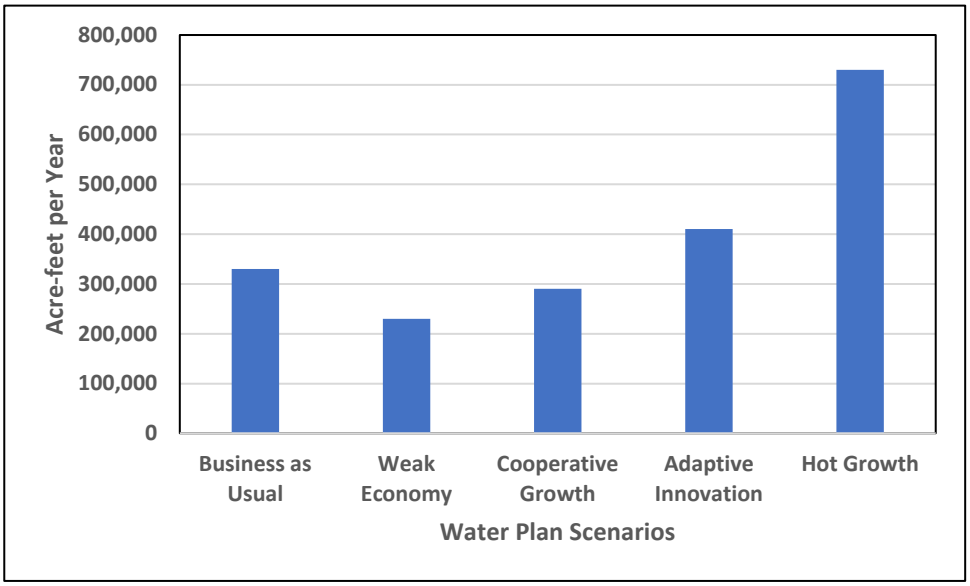
Most of the water from M&I providers used outdoors in Colorado is to grow cool season grasses, such as Kentucky bluegrass, that are not native to the state and which require substantial amounts of supplemental irrigation to thrive in Colorado's climate. There is a long history of turf grass landscaping in Colorado, and turfgrass does provide recreational and other benefits. However, using such a large proportion of Colorado's M&I water supplies for the purpose of growing a crop which is not eaten by either humans or livestock seems increasingly problematic in the face of rising average temperatures and irrigation requirements, serious issues regarding streamflows (particularly concerning the Colorado River), and increasingly scarce, costly and complex options for developing new water supplies.

Replacing turfgrass with native grasses or other xeric plants is one obvious way to reduce current M&I water use and at least defer — if not avoid entirely — development of some of the new water supplies and other infrastructure (such as new or expanded treatment plants) that might be required to meet growing water demands. Under the Business as Usual (BAU) scenario in the Colorado Water Plan, there is a projected M&I "gap" (shortfall) between current supplies and projected demands in 2050 of about 336,000 AFY.[4] If outdoor use continues to average around 40 percent of all M&I use in Colorado, the portion of the projected "gap" due to outdoor uses under the BAU scenario will be about 135,000 AFY. Figure 2 shows the projected gaps in 2050 water supplies under each of the Water Plan scenarios.

Projects currently being considered or actively pursued to increase M&I water supplies in Colorado's Front Range typically involve costs of at least $20,000 per AF of new supply, and the costs of new supply have been increasing faster than inflation for many years. While some of the other Water Plan scenarios anticipate even larger gaps in M&I supplies (Adaptive Innovation or Hot Growth) and others somewhat smaller gaps (Weak Economy or Cooperative Growth) — using the central BAU scenario as our benchmark, **we can anticipate that filling the 2050 M&I gap could cost at least $6.7 billion — of which about $2.7 billion would be to support additional outdoor water use.**

[4] *Colorado Water Plan 2022 Draft*. Page 3-21.

Figure 2. Projected Gaps in Meeting 2050 M&I Water Demands by Water Plan Scenario



In addition to potentially reducing the investment required to meet future M&I water needs, turf replacement can also offer substantial reductions in the costs of water service for participating households. Most M&I providers in Colorado's Front Range bill customer water usage using inclining block rates or water budget-type rate structures intended to discourage excessive water use. Across some of the largest M&I water providers in the Front Range,[5] the lowest tier (a range typically reflecting indoor water use) averages about $3.41 per thousand gallons. The highest tier (a range reflecting high outdoor water use during the summer) averages almost twice as much, at about $6.52 per thousand gallons. In some communities where tiers aim to explicitly drive water conservation savings, those rates can be significantly higher. The City of Boulder's 2022 water rates have a charge of $28.14 per thousand gallons for their highest tier (Tier 5; 200% or more of their established monthly water budget).

3. Lessons from Southern Nevada's Turf Replacement Program

During the discussions regarding HB 22-1151 and turf replacement in Colorado in general, the experience of the Southern Nevada Water Authority (SNWA) with a longstanding, large-scale turf replacement program has drawn considerable attention as a potential model for Colorado. The SNWA experience (as well as experience in Southern California and other locations) demonstrates that large-scale turf replacement can be successfully achieved through incentive programs. However, differences in climate and water use between Southern Nevada and Colorado suggest that Colorado's experience with turf replacement could be different in important ways.

[5] Simple average of current inside city rates in Denver, Fort Collins, Aurora and Colorado Springs.

3.1 Overview of Turf Replacement in Southern Nevada. SNWA was formed in 1991 as a regional organization of seven M&I providers that collectively serve the Las Vegas Metropolitan Area. SNWA currently provides water to about 2.2 million people.[6] SNWA started its Water Saving Landscapes (WSL) program as a pilot in 1996 and expanded the program to be available to all of its customers in 1998.

The design of SNWA's WSL program has evolved over the past 25 years, and participation in the program has been correlated to the level of incentives offered. Variations in program design have included different rebate levels, multiple versus single tier rebate rates, and various limits on the maximum size of individual turf conversions. Some of the specific variations in structure SNWA used during the first decade of the program and the annual rate of enrollment in the program, included:

- Prior to 2003: Incentive of $0.40 per square-foot, limit of $1,000 per property. Less than 500 conversions per year.
- 2003 – 2006: Incentive increased to $1.00 per square-foot, limit of $25,000 per property. About 2,500 conversions per year.
- 2007. Tiered structure with incentive increased to $2.00 per square-foot for first 1,500 square-feet converted and $1.00 per square-foot beyond 1,500 square-feet. About 3,000 conversions.
- 2008. Flat rate of $1.50 per square-foot, no limit on area converted per property. About 4,000 conversions.[7]

SNWA's current rebate is $3 per square-foot for residential conversions. For multifamily, business and HOA conversions the rate is $3 per square-foot for the first 10,000 square-feet and $1.50 per square-foot beyond 10,000 square-feet. For all participants, the minimum conversion size is 400 square-feet.[8]

The cumulative water savings over the 25 years of the SNWA program have been estimated to be about 467,000 acre-feet (AF) and at least 4,600 acres have reportedly been converted.[9] Based on the estimated savings range of between 37 and 47 gallons per square-foot (4.9 and 6.3 AF per acre) for turf replacement in Southern Nevada[10], the SNWA program has likely reduced annual water use by between 23,000 AFY and 29,000 AFY.

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[6] SNWA website. Accessed October 26, 2022 at: https://www.snwa.com/about/mission/index.html

[7] Brelsford, Christa and Abbott, Joshua K. *How Smart are Water Smart Landscapes?* Journal of Environmental Economics and Management 106 (2021),

[8] SNWA website.

[9] *Financing the Future: How to Pay for Turf Replacement in Colorado.* Western Resource Advocates and Water Now Alliance. August 2022.

[10] *How Smart are Water Smart Landscapes?* Brelsford, Christa and Abbott, Joshua K. Journal of Environmental Economics and Management 106 (2021). Higher savings estimate based on page 11, lower savings estimate based on page 15.

Overall, the key messages we can learn from the Southern Nevada experience are that large scale turf replacement can be accomplished and that participation seems to be correlated with the level of incentive provided. Other important findings from studies of the SNWA program are that reductions in water use on participating properties do not appear to have substantially diminished over time[11] and that turf replacement does not appear to have had a substantial adverse impact on residential property values.[12]

4. How Colorado Turf Replacement May be Different

The most important distinction between turf replacement in Nevada and turf replacement in Colorado is the amount of water saved per square-foot (or per acre) of conversion. Assuming that the basic costs of conversion — which primarily consist of removal and disposal of turf, the cost of new native or xeric plant materials, and the cost of modifications to the irrigation system — are likely similar between Southern Nevada and Colorado's Front Range, the much lower water use to maintain turf in Colorado's climate (due to lower in evapotranspiration rates, seasonal irrigation versus year round irrigation, and other factors) means that the economics of turf replacement in Colorado are considerably less favorable than in Nevada.

More Definitive Data is Needed:

1) Extent of existing turf acreage in Colorado, and

2) Average water use saved by turf conversion in Colorado

4.1 Colorado Water Use and Turf Acreage Scenarios.

As far as we know, no one has estimated the total amount of turf that is being irrigated throughout Colorado or definitively determined average water use per acre (or square-foot) of turf in Colorado. This study uses the best available estimate of total outdoor water use in Colorado to develop two potential scenarios of turf water use and to roughly estimate the potential number of acres of turf in Colorado. **Treating total outdoor water use as a known quantity, we first consider a scenario with comparatively high water use per square-foot or per acre (which must also imply a relatively low number of irrigated acres, given the total outdoor water use estimate). We also consider a scenario with comparatively low water use per square-foot or per acre (which implies a relatively high number of irrigated acres given total outdoor water use).**

4.2 Approximate estimates of total turf acres and turf water use in Colorado.

A full irrigation supply for cool season turf in Colorado averages about 19 gallons per square-foot (delivered to the turf).[13] Water use efficiency for irrigating turf with sprinklers has been

[11] Brelsford and Abbot report no erosion in savings, Baker (cited below) reports savings erosion at the rate of 0.1% per month.

[12] Baker, Jonathan E. *Subsidies for Succulents: Evaluating the Las Vegas Cash for Grass Rebate Program.* Journal of the Association of Environmental and Resource Economists. March 17, 2021.

[13] Based on Denver Water and Integrated Lawn and Tree Care Colorado Springs websites as well as *Estimates of energy partitioning, evapotranspiration, and net ecosystem exchange of CO2 for an urban lawn and a tallgrass prairie in the Denver metropolitan area under contrasting conditions.* Thomas S. Theinelt and Dean E. Anderson. Urban Ecosystems (2021) 24:1201-1220.

estimated at between 50% and 70%.[14] Combining these numbers, a full irrigation supply delivered to the customers' meters is between 3.63 AF per acre (low water use/high turf acres scenario) and 5.08 AF per acre (high water use/low turf acres scenario) depending on the efficiency of the irrigation system.

Two other factors that are not fully known are the extent of deficit irrigation and the proportion of all irrigated landscape acres that are planted in turf. Regarding the former, Colorado Springs Utilities has estimated that as much as 30 percent of the irrigated landscapes in their service area are no longer being watered and Denver Water also reports that deficit irrigation or landscape abandonment is a substantial phenomenon in portions of their service area. Regarding the share of irrigated landscape planted in turf, we've assumed it may be between two-thirds of all irrigated acres (for the high water use/low turf acres scenario) and 100 percent of irrigated acres (for the low water use/high turf acres scenario).

Based on current M&I outdoor water use of about 397,000 AFY per year across Colorado shown previously in Figure 1, these data and assumptions imply that the likely extent of turf in Colorado is between about 52,000 acres (high water use/low turf scenario) and about 156,000 acres (low water use/high turf scenario). This range could also be thought of in terms of a midpoint estimate of about 104,000 turf acres with a range of uncertainty of +/– 50%.

The corresponding water use scenarios are between 2.54 AF per acre (low water use/high turf scenario) and 5.08 AF per acre (high water use/low turf scenario). Or, a midpoint estimate of about 3.8 AF per acre with a range of uncertainty of +/- 33%. The typical assumption is that converting turf to native plants in Colorado cuts water use in half, meaning that the central estimate of water savings from turf conversion is about 1.9 AF/acre — again with a range of uncertainty of +/- 33%.

These turf water use and acreage scenarios are illustrated in Figure 3.

[14] *Efficient Landscape Irrigation during Drought and with Limited Water Availability in Colorado.* Colorado State University Extension.

Figure 3. Colorado Turf Water Use and Acreage Scenarios

	High Water/ Low Turf	Low Water/ High Turf
Full Irrigation Supply	19 gallons/SF 2.54 AF/acre	19 gallons/SF 2.54 AF/acre
Efficiency	50%	70%
Water Use/Acre	5.08 AF	3.63 AF
Adjustment for Turf Abandonment/Deficit Irrigation	0%	30%
Adjusted Water Use/Acre	5.08 AF	2.54 AF
Turf Proportion	67%	100%
Turf Acres	52,362	156,303
Mid-point Turf Estimate	104,332 Acres (+/-50% range of uncertainty)	
Savings per Acre Converted	2.54 AF	1.27 AF
Mid-point Savings Estimate	1.90 AF (+/-33% range of uncertainty)	

Based on the breakdown between residential and non-residential outdoor use from the Technical Update to the Water Plan, about 57 percent of Colorado's turf (potentially around 30,000 to 90,000 acres) is likely to be on residential properties and about 43 percent is likely to be on non-residential land (potentially 22,000 to 67,000 acres).

The lower water savings from turf conversion in Colorado than in Southern Nevada (under either scenario) mean that homeowners participating in a Colorado turf conversion program will likely not experience as much financial benefit from the conversion. Converting 500 square-feet of turf to a xeric landscape using one-half as much irrigation can save a homeowner in the Las Vegas Water District up to $121 per year, based on the midpoint of the SWNA savings estimates and the current top tier in the District's rate structure. The same conversion in Colorado's Front Range could save a participating homeowner between $31 and $62 per year, based on typical top tier water rates in the Front Range. However, the financial savings could be larger in cities with higher top tier rates like Aurora and Colorado Springs, or smaller in those with lower top tier rates like Denver and Fort Collins.[15]

A more extensive discussion of the potential costs and benefits of turf reduction for Colorado homeowners is provided later in this report.

[15] Based on current top tier water rates in Aurora, Colorado Springs, Denver and Fort Collins.

5. Potential Scale of Turf Replacement in Colorado

5.1 Existing turf replacement programs in Colorado. According to a recent report from Western Resource Advocates and Water Now Alliance (Water Now Report), 22 water providers in Colorado currently have turf replacement programs.[16] Nineteen of those providers have filed recent Water Efficiency Reports (HB-10-1051 reports) that are available from CWCB's Water Efficiency Portal.[17] Although these reports are not always as comprehensive as intended, they provide some insight into the current scale of turf replacement in Colorado.

Fourteen of the 19 M&I providers identified in the Water Now Report as having turf replacement programs identified those programs as one of their conservation measures in their most recent HB-10-1051 report, an annual accounting of water use and conservation required of retail water providers that produce over 2,000 AF/year of water.[18] While not all of the 19 M&I providers included any quantitative information, 12 of the providers included information on the number of acres of turf replacement in their most recent report.[19] Some of those providers also included turf replacement acreage in 1051 reports for prior years, dating back as far as 2014.

Based on the 1051 data, about 1 million square-feet of turf (just over 23 acres) was replaced during the most recent reporting year (generally 2020 or 2021 depending on the provider). Earlier 1051 reports document an additional 1.4 million square-feet of turf replacement in previous years (about 32 acres). Based on the 1051 data, about two-thirds of turf replacement to date has occurred on non-residential properties. In some cases, the 1051 reports also describe the incentives provided for turf replacement. The most common incentive appears to be free or reduced-price xeric planting materials (e.g., Garden-in-a-Box kits), though some providers offer a cash incentive (usually $1 per square-foot) or subsidized lawn removal.

While it is very likely that the cumulative total of less than 60 acres of turf replacement to date documented in the Water Efficiency Reports is a substantial underestimate due to gaps in the reported data, compared to the earlier midpoint estimate of at about 104,000 acres of irrigated turf in Colorado it seems clear that there is substantial room for growth in the overall turf replacement effort.

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[16] *Financing the Future: How to Pay for Turf Replacement in Colorado*. Western Resource Advocates and Water Now Alliance. August 22. Page 17.

[17] Available at: http://www.cowaterefficiency.com/report/public_access.

[18] Wholesale water providers such as Northern Water are not required to file these reports.

[19] Aurora, Castle Rock, Centennial, Colorado Springs, Fort Collins, Fountain, Greeley, Lafayette, Little Thompson WD, Northglenn, Thornton and Westminster.

5.2 Non-functional turf. At the other end of the turf replacement scale, Denver Water, Aurora Water, Pueblo Water and other large Western water providers have recently signed a memorandum of understanding calling for a 30 percent reduction in "non-functional turf", or — as some prefer to refer to it — "non-recreational turf." Colorado Springs Utilities has reportedly agreed with the goal, though it has not signed the MOU.[20] HB 22-1151 provides examples of such turf areas which include medians; areas adjacent to open spaces or transportation corridors; areas with greater than a 25-degree slope; stormwater detention basins; commercial, institutional or industrial landscape areas; areas irrigated by HOAs and portions of residential yards.

Denver Water has estimated that its service area contains approximately 6,000 acres of non-functional turf, and has committed to replacing 2,000 acres — a little more than 30 percent. As is the case with the total amount of turf in Colorado, the total amount of non-functional turf in Colorado is also unknown. However, if Denver's service area is representative of other M&I providers (at least in the Front Range), there could be approximately 26,000 acres of non-functional turf across the state — which is about 25 percent of our mid-point estimate of the total turf acres in Colorado.

Replacing around 30 percent of non-functional turf in Colorado — potentially around 7,800 acres — is an ambitious goal, representing about 1.7 times the total amount of turf that Southern Nevada has replaced over the 25 years of their program. Based on the turf water use scenarios described previously, 7,800 acres of turf replacement in Colorado could save 10,000 to 20,000 AF of water per year.

Non-functional Turf

Potentially 26,000 acres of non-functional turf across the state (25 percent of total estimated turf acres)

Replacing around 30 percent of non-functional turf in Colorado – potentially around 7,800 acres – is an ambitious goal (1.7 times the total amount of turf that Southern Nevada has replaced) over 25 years

Will likely require multiple approaches to achieve this goal

This ambitious goal is likely to be even more challenging given the smaller water savings per square-foot in Colorado than in Nevada, and correspondingly smaller economic benefits. While incentivized turf replacement programs can help encourage individual property owners to contribute their share to help reduce turf in Colorado, achieving the level of reductions envisioned in an effort to reduce 30 percent of non-functional turf will also likely require more targeted efforts to identify and replace turf in larger landscape settings such as parks, open spaces, medians, large commercial office parks and large HOAs. The data available to M&I providers from their billing systems can help identify properties that may have the greatest potential to reduce water use through turf replacement and M&I providers with large scale conservation programs are also likely to have access to the expertise needed to make these conversions successful.

[20] Scott Winter, Colorado Springs Utilities. Personal communication. October 6, 2022.

6. Benefits and Costs of Turf Replacement in Colorado

Incentivized turf replacement can offer a number of financial benefits and non-monetary benefits for participating property owners, water utilities and Colorado as a whole — but it is not inexpensive, particularly in regard to the upfront costs of conversion. Figure 4 highlights the conceptual benefits and costs of incentivized turf replacement in Colorado. Note that the potential non-monetary costs of turf conversion shown in the "Overall" category reflect some of the important environmental benefits currently being provided by turf in sequestering carbon, cooling urban temperatures and assisting with stormwater and erosion control. Most, if not all of those environmental benefits should be able to be maintained with well-conceived native planting strategies.

Most of the costs of turf conversion for the property owner are incurred upfront, but the financial benefits occur over the years following turf replacement. With this in mind, the analyses that follow are based on the benefits and costs over a ten year period beginning with the turf conversion.

Figure 4. Conceptual Benefits and Costs of Incentivized Turf Replacement: One Acre of Turf Conversion over the Following 10 Years

Conceptual Benefit-Cost Matrix for Incentivized Turf Replacement Programs

Water User		Water Provider		Overall	
Benefits	**Costs**	**Benefits**	**Costs**	**Benefits**	**Costs**
Incentive Payments	Lawn Demolition & Disposal	Reduced Demand in Irrigation Season	Incentive Payments	Reduced Water Use	State Incentive Payment
Reduced Water Bills	New Plants and Planting Costs	Avoided Capital Costs of New Supplies	Reduced Water Sales Revenue	Increased Streamflow	Carbon Storage*
Lower Maintenance?	Changes to Irrigation System	Avoided Costs of Chemicals/Utilities and Supplies	Technical Assistance/Program Administration	Fewer New Projects	Urban Cooling*
Environmental Stewardship		Avoided Costs for Treatment Capacity		Reduced Use of Chemicals	Stormwater and Erosion Control*
				Reduced Emissions from Mowing	

6.1 High water use/low turf acres scenario benefits and costs. Figure 4 provides approximate estimates of the potential financial and economic benefits and costs for the high-water use/low turf acres scenario. The numbers shown in Figure 4 are based on an acre of incentivized turf conversion at the scale of less than one thousand square-feet per conversion and reflect substantial do-it -yourself (DIY) participation by the homeowner, which Resource Central — one of the largest, if not the largest turf replacement service provider in Colorado — reports is typical for their projects. The estimated unit values for benefits and costs are shown in Figure 5 and were developed based on interviews with Resource Central and conservation staff at Colorado Springs Utilities, current rate schedules and financial reports from large Front Range utilities and transferrable results from the economic analyses of the SNWA program. Like many other aspects of turf replacement in Colorado, there is considerable uncertainty around these values and they could differ substantially depending on choices regarding replacement plant materials and other factors.

With the property owner contributing much of the labor, and using inexpensive kits available to convert existing sprinkler heads to drip irrigation, we estimate the total, upfront conversion costs to be around $5 per square-foot. If a professional landscaping firm undertakes the conversion, the costs would be considerably higher (though the results might also be better). **It is notable that at $5 per square-foot to replace turf, the cost of replacing 30 percent of non-functional turf in Colorado (estimated to be about 7,800 turf acres in Section 5.2) would be about $1.7 billion. At $10 per square-foot for turf replacement, which may be a better estimate assuming professional removal and installation, the total cost would be about $3.4 billion.**

Many of the key variables in this benefit-cost analysis are likely to vary depending on the water provider and the approach taken to replace turf and modify the irrigation system. With that in mind, Figure 5 and Figure 6 also show the underlying assumptions used to make the cost and benefit calculations (such as $3.50 per square-foot for new plants and planting costs, or $6.52 per thousand gallons for reduced water bills). With this information, readers can infer how the analysis and results might change given their specific circumstances.

Figure 5. Estimated Benefits and Costs Under the High Water Use/Low Turf Acres Scenario: One Acre of Turf Conversion over the Following 10 Years

10 Year Benefit Cost Estimates per Acre Replaced - High Water Use/Low Turf Acres Scenario					
Water User		Water Provider		Overall	
Benefits	Costs	Benefits	Costs	Benefits	Costs
Incentive Payments	Lawn Demolition & Disposal	Reduced Demand in Irrigation Season	Incentive Payments	Reduced Water Use	State Incentive Payment
$87,120 ($2/SF)	-$43,560 ($1/SF)	25.4 AF 2.54 AFY	-$43,560 ($1/SF)	25.4 AF 2.54 AFY	-$43,560 ($1/SF)
Reduced Water Bills	New Plants and Planting Costs	Avoided Capital Costs of New Supplies	Reduced Water Sales Revenue	Increased Streamflow	Carbon Storage*
$53,964 ($6.52/K gals)	-$152,460 ($3.50/SF)	$63,500 ($25K/AF)	-$53,964	???	???
Lower Maintenance?	Changes to Irrigation System	Avoided Costs of Chemicals/Utilities and Supplies	Technical Assistance/Program Administration	Fewer New Projects	Urban Cooling*
$26,136 ($0.06/SF/year)	-$21,780 ($0.50/SF)	$16,553 ($2/K gallons)	-$54,450 ($1.25/SF)	???	???
Environmental Stewardship		Avoided Costs for Treatment Capacity		Reduced Use of Chemicals	Stormwater and Erosion Control*
???		$2,235 ($2.70/K gallons)		???	???
				Reduced Emissions from Mowing	
				???	
Total 10-Year Quantitative Estimate per Acre Replaced					
$167,220	-$217,800	$82,288	-$151,974	$249,507	-$413,334
Costs/Benefits per AFY of Water					
$65,834	-$85,748	$32,397	-$59,832	$98,231	-$162,730

Since most of the property owner costs are incurred upfront, while most of the benefits are ongoing, this benefit-cost analysis reflects a ten-year post-conversion perspective. Under the high water use/low turf acres scenario, we estimate the total costs to the water user to exceed the total benefits by about 30 percent — implying that the full payback period could be around 13 years.

From the perspective of the water provider, benefits and costs are estimated on a financial basis. The estimated costs of turf conversion exceed the financial benefits — though this is largely due to the decrease in revenue from water sales (which is a corresponding benefit to the water user). The total cost to the water provider is estimated to be around $60,000 per AFY with offsetting benefits of around $32,000 per year in avoided costs for new water projects and additional treatment capacity, as well as annual operating savings in terms of energy, chemicals and other variable costs. It is worth noting that if (or perhaps when) the costs of developing new supplies exceeds $50,000 per AFY, the benefits to the water provider from turf conversion could offset their total costs.

The overall benefits and costs are summarized in the right-hand columns. The only additional monetary cost — beyond the costs borne by either the property owner or the water provider — is the matching state incentive payment created under HB22 - 1151. As noted previously the non-quantified costs of the lost environmental benefits from turf shown in Figure 4 serve primarily to point out the importance of choosing replacement vegetation that can offer similar benefits.

6.2 Low water use/high turf acres scenario benefits and costs. Figure 6 provides the same analysis for the Low Water Use/High Turf Acres scenario. As would be expected, the benefit-cost comparison is less favorable if the water savings from turf conversion are smaller. Under this scenario, the costs for the property owner are about 55 percent greater than the projected benefits over the following 10 years — suggesting a payback period of around 15 to 16 years. Both the benefits and costs are smaller from the standpoint of the water provider than under the high water use/low turf acres scenario.

Figure 6. Estimated Benefits and Costs Under the Low Water Use/High Turf Acres Scenario: One Acre of Turf Conversion over the Following 10 Years

10 Year Benefit Cost Estimates per Acre Replaced - Low Water Use/High Turf Acres Scenario

Water User		Water Provider		Overall	
Benefits	**Costs**	**Benefits**	**Costs**	**Benefits**	**Costs**
Incentive Payments	**Lawn Demolition & Disposal**	**Reduced Demand in Irrigation Season**	**Incentive Payments**	**Reduced Water Use**	**State Incentive Payment**
$87,120 ($2/SF)	-$43,560 ($1/SF)	12.7 AF 1.27 AFY	-$43,560 ($1/SF)	12.7 AF 1.27 AFY	-$43,560 ($1/SF)
Reduced Water Bills	**New Plants and Planting Costs**	**Avoided Capital Costs of New Supplies**	**Reduced Water Sales Revenue**	**Increased Streamflow**	**Carbon Storage***
$26,982 ($6.52/K gals)	-$152,460 ($3.5/SF)	$31,750 ($25K/AF)	-$26,982	???	???
Lower Maintenance?	**Changes to Irrigation System**	**Avoided Costs of Chemicals/Utilities and Supplies**	**Technical Assistance/Program Administration**	**Fewer New Projects**	**Urban Cooling***
$26,136 ($0.06/SF/year)	-$21,780 ($0.50/SF)	$8,277 ($2/K gallons)	-$54,450 ($1.25/SF)	???	???
Environmental Stewardship		**Avoided Costs for Treatment Capacity**		**Reduced Use of Chemicals**	**Stormwater and Erosion Control***
???		$1,117 ($2.70/K gallons)		???	???
				Reduced Emissions from Mowing	
				???	
Total 10-Year Quantitative Estimate per Acre Replaced					
$140,238	-$217,800	$82,288	-$124,992	$222,526	-$386,352
Costs/Benefits per AFY of Water					
$110,423	-$171,496	$64,794	-$98,419	$175,217	-$304,214

6.3 Return on State investment. Another metric that is worthy of consideration is the return on the State investment in providing an additional dollar per square-foot to increase the incentives for turf replacement. This is a bit tricky to estimate, since some proportion of the water users who opt into turf replacement over the next two years[21] — and receive the additional incentive payment provided by the State — would have converted their turf even without that extra benefit (presumably everyone who converts turf will seek the additional incentive). But, if we assume that one-half of the participants in turf replacement programs during the next two years would not have done so without the additional State-provided incentive payment, that incentive payment (expected to be about $550,000 per year) will increase turf replacement by about 550,000 square-feet (13 acres) per year, or 1.1 million square-feet (25 acres) in total over two years. Using our central estimate of the annual water savings from turf replacement of 1.9 AF per acre, the additional, State-provided incentive

[21] Note that the CWCB funding projections cover two funding "cycles", which could be longer or shorter than two years.

payment provided over the next two years could save about 48 AFY of water use on an ongoing basis (+/- 33 percent). This estimate implies a cost to the State of about $23,000 per AFY saved — counting only the additional, direct incentive payment passed on to participants in turf replacement programs.

7. Other Important Considerations

Apart from the financial and economic benefits and costs of incentivized turf replacement, there are a number of other important considerations regarding these types of programs.

7.1 Sustainability of water savings. How long the water savings from turf replacement continue to occur in the future is an important issue in terms of the benefits and economics of incentivized turf replacement programs. The benefits and costs shown previously in Figures 4 and 5 reflect ten years of continuous water savings relative to conditions prior to relandscaping. If those water savings continue beyond 10 years, the economics become more favorable as the one-time, upfront costs of relandscaping are diluted relative to the water savings. On the other hand, if the savings persist for fewer than 10 years, the economics would be less favorable than shown in Figures 4 and 5.

One consideration in terms of the sustainability of water savings from turf replacement is home ownership turnover. On average, the median duration of homeownership in the U.S. is about 13 years. However, homes in the West tend to turn over more frequently. Colorado Springs, for example, has one of the shortest average homeownership durations among large U.S. cities at about 8 years.[22]

Homes in the City of Las Vegas turn over even more frequently, averaging every 7 years.[23] Despite frequent homeownership turnover, both of the published economic studies of the SNWA program found no evidence that water savings have substantially deteriorated over time, using longitudinal data spanning 15 years or more for some program participants.

Some of this durability may be due to the evolution in the rules of the SNWA program. Initially, there was no required minimum duration for the conversion. Beginning in 2003, new participants were required to maintain the xeric landscape for at least five years, which was increased in 2004 to the shorter of 10 years or until sale of the property. Finally, in 2009, the program began requiring the conversion to last in perpetuity, although there reportedly has been little or no effort to ensure compliance with these requirements.[24] During this time, the Las Vegas Valley Water District (the largest retail water provider within the SNWA) also instituted numerous other measures to reduce water use, including restrictions on turf in new

[22] National Association of Realtors, 2020. Downloaded from: https://www.nar.realtor/blogs/economists-outlook/how-long-do-homeowners-stay-in-their-homes

[23] Ibid.

[24] Brelsford and Abbot, page 3.

construction, indoor conservation programs, strict restrictions on water features and increased fines for water waste.[25]

One of the two economic studies of the SNWA program also looked at the effects on home values from participating in the turf replacement program. The study found a small, but statistically significant *increase* in value from participation of around 1 percent. This could be an indication that the Las Vegas market has come to prefer xeriscaped landscapes and/or that the annual financial benefits to the owners from decreased water use are being capitalized into home prices.

While the water savings from the SNWA program appear to have been durable over time, it still seems prudent to require participants to sign an agreement to not return their landscape to turf — at least for the duration of their ownership. It would be even better to establish a covenant with participants that would transfer with the title to their home, though the benefits of that approach would have to be weighed against its potential impacts on participation in the program.

7.2 Funding and infrastructure. As discussed previously, HB 22-1151 appropriated $2 million to the CWCB for the 2022-2023 fiscal year to help expand incentivized turf replacement in Colorado. After accounting for additional staffing and administrative costs for this effort, CWCB expects to have approximately $750,000 available for each of two funding cycles. CWCB expects to use $1.1 million of these dollars ($550,000 per cycle) to help leverage incentives provided by water providers within existing turf replacement programs, and $400,000 ($200,000 per cycle) to help establish and support additional turf replacement programs across the state.[26]

While our previously described estimate that the additional State incentive could save around 48 AFY by incentivizing about 550,000 square-feet of conversion *that would not otherwise have occurred*, this level of additional turf replacement is more than one-half of the turf replaced in the latest year that is documented in the 1051 reports described earlier in this report (though we know those reports do not capture all of the turf replacement programs in Colorado).

The increased level of turf replacement supported by HB 22-1151 funding should be feasible to achieve, although current turf replacement providers report that availability of native, xeric plants can already be challenging.[27] The much larger turf replacement goals under the non-functional turf replacement MOU will likely require considerable expansion in the supply of appropriate plant material if that goal is intended to be met within the next couple of decades.

7.3 Equity. Not everyone is a candidate to participate in an incentivized turf replacement project and receive public funds to help change their landscape. As discussed in one of the

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[25] *Empirical Strategies for Coupling the Analysis for Social and Physical Systems.* Presentation by Christa Brelsford, U.S. Department of Energy. Undated.

[26] September 21, 2022 Board Meeting Turf Agenda #20 Power Point presentation. CWCB.

[27] Kate Larsen, Resource Central. Personal communication April 2022.

economic studies of the SNWA program, one of the key differences between participants and non-participants is home ownership. "When a home is owner occupied, the benefits and costs of [program] participation all accrue to the same decision-maker." Further, participants in the SNWA program typically had larger homes with greater than average values (about 14 percent higher than non-participants, on average).[28]

The argument can certainly be made that incentivized turf replacement creates public benefits — such as increased stream flows and reduced need for new water projects or water transfers. Critics of the program, however, may raise concerns about the transfer of taxpayer funds to recipients who are likely to generally be wealthier than average. The program could also be seen as providing a reward to large residential water users using public funds.

These issues — along with the desire to make the program available to a large number of property owners — may be one of the reasons why the SNWA turf replacement program has typically included either limitations on the size of individual turf replacement projects or a tiered incentive structure that favors smaller projects. **Using funding generated by water budgets with high rates for excess use, or by steeply inclining block rates, to provide the incentive payments for landscape conversion could also alleviate some of these potential equity concerns by raising the funds for the program from property owners who are using the most water.**

8. Conclusions

Climate change and population growth are placing increasing stress on water supplies throughout the West, which is particularly obvious from the dire situation currently confronting the Colorado River Basin and potentially the transbasin M&I water users in Colorado's Front Range and elsewhere that depend on it. Current outdoor M&I water use in Colorado is about 400,000 AF per year, most of which is presumably used to grow turf. The five scenarios in the latest update to the Water Plan anticipate that M&I outdoor use could grow by 234,000 (Weak Economy scenario) to 733,000 more AFY (Hot Growth scenario) by 2050.

Given the situation, there is a clear need to reduce outdoor M&I water use in Colorado. Put simply, less turf is better than more turf, although it will be important to try to retain the benefits that turf currently provides in terms of sequestering carbon, reducing urban temperatures and helping to manage stormwater and erosion.

One of the most visible ways to reduce turf in Colorado is through incentivized turf replacement. Numerous Colorado M&I providers already have turf replacement programs, though the scale of those programs is relatively small compared to the size of the best-known turf replacement effort in Southern Nevada. New statewide legislation passed in 2022 (HB 22-1151) is intended to help expand these efforts by expanding the Colorado Water Conservation Board's role in supporting new and existing turf replacement programs and by providing State funds to match existing incentives from M&I providers.

[28] Brelsford and Abbot, pages 6-7.

The Southern Nevada experience illustrates that incentivized turf replacement can save a substantial amount of water and, perhaps more importantly help change landscape preferences and expectations. However, conditions in Southern Nevada are different than in Colorado—particularly due to much higher water use to grow turf in Nevada than in Colorado. Because water use per square-foot (or per acre) to grow turf is lower in Colorado, the economics of turf replacement are also substantially less favorable. It will likely be very challenging to replicate the Southern Nevada turf replacement success without much higher levels of incentives for homeowners to participate.

While there is clearly a place for incentivized turf replacement programs at the residential or small commercial scale in Colorado — particularly in helping change landscaping preferences, these programs are not an inexpensive way to reduce turf. Achieving large scale turf replacement will also likely require more targeted efforts focused on public properties and large outdoor water users such as office parks and homeowners' associations. Larger scale turf replacement is generally likely to be more economical than small scale residential and commercial landscape conversions.[29]

As illustrated in this report, there is a need for more information regarding the actual water savings from turf replacement in Colorado, as well as the total amount of turf that currently exists. As more data become available regarding pre- and post-conversion water use by turf replacement participants, we are likely to obtain a more refined estimate of the savings potential from incentivized turf replacement programs.

The most cost-effective way to reduce turf in Colorado is to also focus on the future. This is perhaps the best example of the importance of the water and land use nexus often discussed in the water community. Changing the rules for new development, as has recently been done in Aurora and Castle Rock, is far cheaper than incentivized turf replacement and can achieve much greater reductions in water use. Even the water savings from the ambitious goal of replacing 30% of non-functional turf, previously estimated to potentially save between 10,000 and 20,000 AFY of water use per year, could be matched within approximately 4 to 8 years if all of Colorado's M&I providers were able to prohibit new turf grass lawns in their service areas.[30]

The most cost-effective way to reduce turf in Colorado is to also focus on the future

Changing the rules for new development is far cheaper than incentivized turf replacement and can achieve greater reductions in water use

If all of Colorado's M&I providers were able to prohibit new turf grass lawns in their service areas, water savings could reach up to 20,000 AF per year within about 8 years

Of course, incentivized turf replacement to reduce *existing* water use and new development regulations to discourage or prohibit or limit turf for new homes and businesses to

[29] Cost estimates provided by Julia Gallucci, Colorado Springs Utilities, for larger scale projects indicate substantially lower costs per square-foot of conversion than the incentivized residential turf replacement analysis in this report.

[30] Based on the Business-as-Usual Water Plan Scenario and assuming 37% outdoor water use.

reduce *increases* in future outdoor water use from growth are not mutually exclusive. As other providers serving high growth areas follow the example being set by Aurora and Castle Rock, it is likely that many providers will feature both incentivized turf replacement programs and development codes designed to reduce increases in the number of turf acres in Colorado.

The results of this study were presented at the ***Landscape Summit*** in Denver convened by CWCB involving water providers, water-focused non-profit organizations, and other water, landscaping and conservation experts on November 9, 2022. The Summit generated ideas and feedback on incentivized turf replacement and other approaches to reducing outdoor water use in Colorado – and is summarized in Attachment A.

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Attachment A

Colorado Landscape Summit

Event Summary

Background

During the lead-up to the release of the 2023 Colorado Water Plan and amidst significant statewide drought conditions, many conversations began coalescing around how Colorado can functionally reshape its municipal landscapes including the removal of non-functional turf. In the summer of 2022, the Colorado Legislature passed HB 22-1151 which aimed to incentivize non-functional turf removal by requiring the Colorado Water Conservation Board (CWCB) to develop a one-time statewide program to provide approximately $2 million in financial incentives for eligible entities to support the voluntary replacement of irrigated turf with water-wise landscapes. Adding to this, the cities of Aurora Water and Castle Rock both announced new ordinances to limit installation of turf grass in new construction, and Denver Water and several other water providers including Aurora and Castle Rock signed a Memorandum of Understanding by and among Colorado River Basin Municipal and Public Water Providers (MOU) aimed at identifying and removing 30% of the nonessential turf in their service areas. Throughout all these innovative responses to conditions there was limited discussion around the actual water savings that can realistically be achieved through turf reductions in Colorado, what the potential data gaps might be, and what other tools might be available to advance these efforts.

In an effort to unify the chorus of ongoing conversations and actions about landscape transformation the CWCB hosted the November 9, 2022 Colorado Landscape Summit (Summit) which included more than 130 attendees from multiple groups (water utility staff, non-profit organization staff, landscape specialists, etc.). At the Summit, CWCB shared an exploratory initial analysis conducted by BBC Research & Consulting (BBC) on the potential water savings, costs, and other benefits associated with a statewide turf replacement program in Colorado. CWCB also invited more than 20 guest speakers and panelists to add to the conversation on transformational landscape change in Colorado, and conducted an 11-question survey asking participants to share their opinions on a range of questions related to landscape transformation. These results are included as an attachment to the BBC report to help provide additional context that can help inform and guide development of a suite of options that Colorado can employ to realize sustained outdoor water savings, not just from turf removal, but from a range of tools intended to achieve long-term outdoor water savings while still maintaining community health.

Preliminary Insights and Summit Survey

The insights below combine survey response data and summaries of presentations and content shared at the Colorado Landscape Summit. Doug Jeavons from BBC noted in his presentation that non-functional turf removal savings in Colorado may represent a smaller water savings (10,000 - 20,000 acre-feet per year) than anticipated. Some of the reasons for this are the meaningful differences between Las Vegas, where much of the existing data comes from, and Colorado - where data on turf removal is scant. Las Vegas' irrigation season is year-round and it is a warmer and drier climate, leading to annual turf water requirements that are nearly 4 times higher than turf water requirements in Colorado. As a result, water savings from reducing turf in Colorado will be smaller and more costly to achieve - potentially $1.7B-$34B or more to remove 30% of the assumed quantity of non-functional irrigated turf in the state. While more data is needed, the Colorado Landscape Summit presenters and attendees helped provide additional support for and potential direction for an ongoing and expanding conversation about transformative landscape change to save water in Colorado. Survey data from the Colorado Landscape Summit further supports this. Including demonstrating:

- Strong support for municipality and water provider-led approaches such as using rates, water budgets and land use codes to drive change.
- Preference to put the burden of paying for turf removal on those using the most water outdoors rather than all ratepayers, tax payers, etc.
- Recognition that residential turf replacement efforts (through rebate or other) will have a smaller impact than other avenues.
- Continued interest in an ongoing workgroup to explore these issues.
- Concern over data collection that leads to better understanding of use and savings.

While not a specific survey question, equity was another topic which came-up in several ways that touched on broader community issues, communications and low-income water users. Greenspaces that support community health, reduce heat island, allow for people and pets to play are often areas where both functional and non-functional turf exists. Saving water but also providing enough water to support such community spaces was noted as important. Low income and some other water users have sometimes stopped watering their turf or may have any turf at all, let alone non-functional turf. In those cases, supporting landscape change may not actually reduce water use, and could even increase it. Utility programs that may provide rate solutions or other rebate programs (e.g., xeriscape gardens) may need consideration. Rates have the potential to create more equitable solutions if designed to support both low-income and water-conserving community members as well as penalizing water waste.

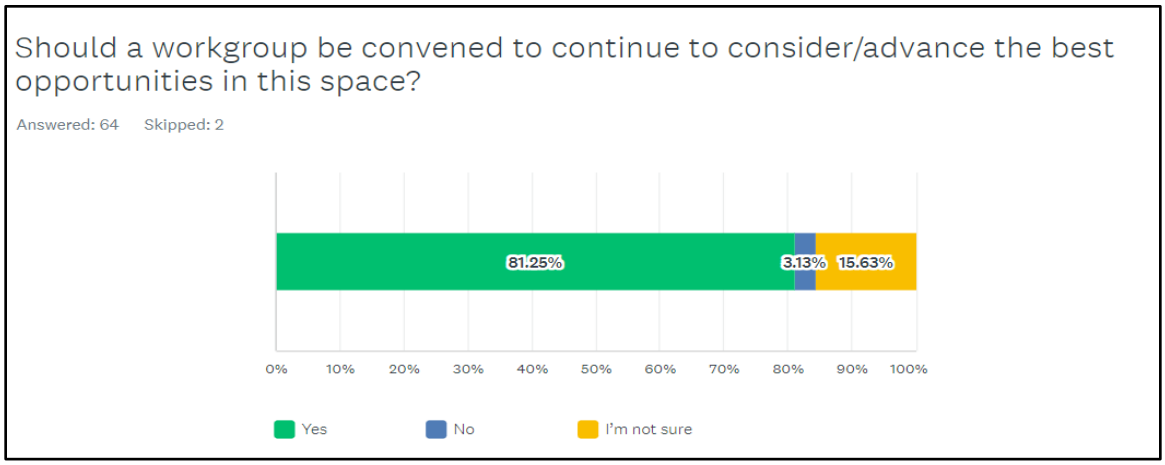
Eleven specific questions were asked to attendees. Survey responses and discussion follows.

Colorado Landscape Survey

During the Colorado Landscape Summit a web-based survey was shared with both online and in-person attendees throughout the day via a QR code in order to gather their input on several important questions that may inform the conversation on turf replacement programs and landscape transformation.

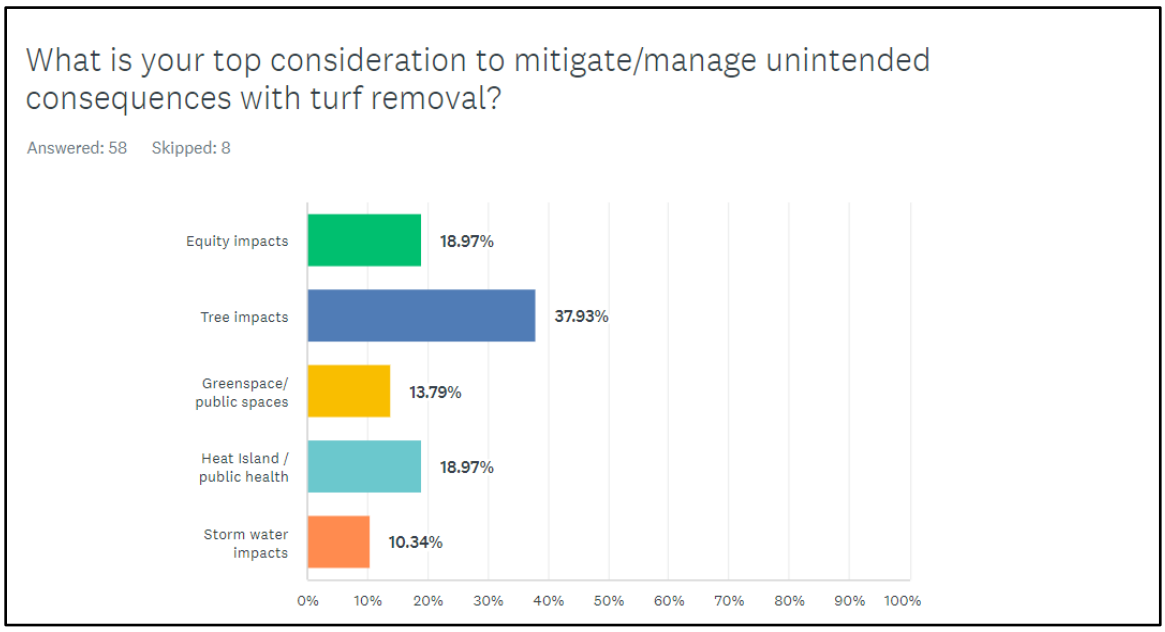
A total of 66 respondents representing water utilities (28.79%), local government (30.30%), NGO (10.61%), private industry (1.52%), Academia (4.55%), Private Citizens(9.09%) and Other(15.15%) including water conservancy districts, planning consultants, state government and commercial landscapers took the survey and **the Landscape Summit survey results are presented visually in an online dashboard.**

Survey respondents weighed in on a number of important questions related to policy and implementation for landscape transformation. Some key findings include that respondents wanted to continue the nuanced and important conversation about landscape transformation. **Respondents overwhelmingly (81.25%) would like to see landscape transformation conversations continue via a workgroup.** To that end, CWCB has secured funding to support a facilitated conversation on landscape transformation that could begin as early as mid-2023.

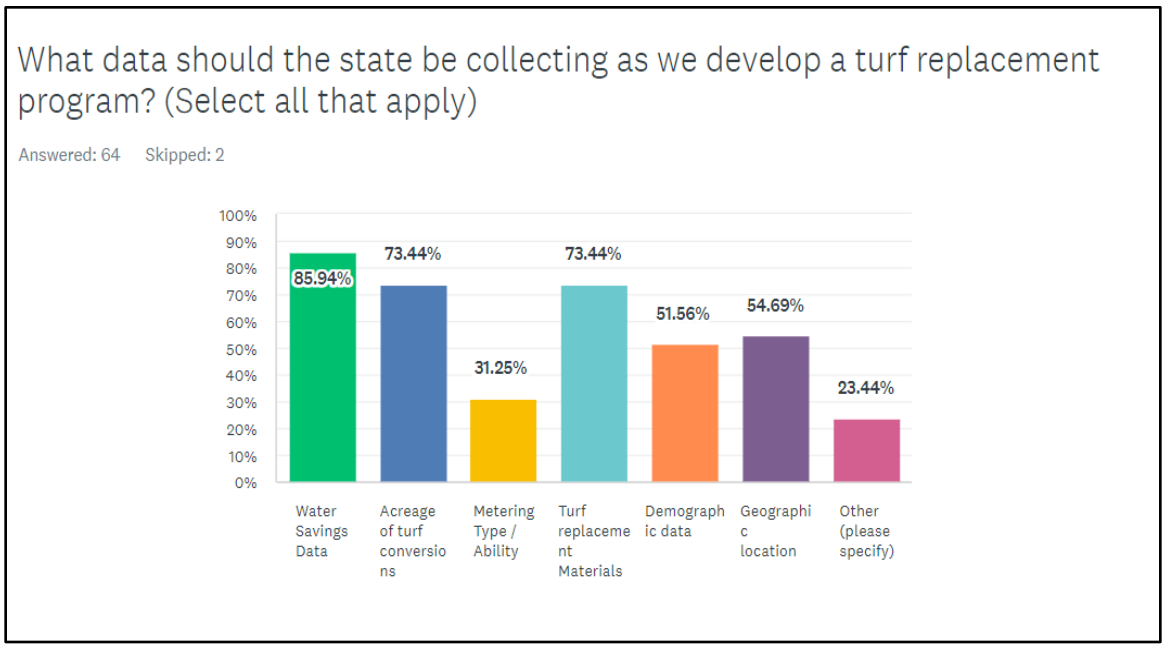


Additionally, stakeholders identified specific concerns about how turf removal and landscape transformation would be implemented, who would be impacted, and who needed to be part of ongoing conversations on the topic.

Respondents felt that there were important considerations that should be evaluated to avoid negative outcomes associated with turf removal. **The impacts to consider include equity impacts, tree impacts, the impact to green spaces and other public spaces, the heat island consequences for public health, and negative effects on stormwater management.**



Stakeholders selected several data categories they felt would be valuable for the state to measure via a turf replacement program. These include water savings data, acreage of turf conversion, turf replacement materials, geographic location, demographic data, and metering type.



Based on their knowledge and the presentations at the summit, CWCB asked stakeholders to weigh in on the best mechanisms to drive landscape transformation going forward and their answers indicate that **stakeholders overwhelmingly (78.13%) see Codes and Rules for New Construction to be the most effective opportunity to address the amount of turf present in Colorado**. In comparison, only 7.81% of respondents felt that retrofitting existing properties (i.e., turf replacement) was the best strategy to manage turf acreage in the state.