# Environment Committee

Meeting date: January 14, 2020

For the Metropolitan Council meeting of January 22, 2020

**Subject**: Turfgrass Irrigation Efficiency Project with University of Minnesota Turfgrass Science Program

**District(s), Member(s):** All

**Policy/Legal Reference:** Minnesota Legislature, 2019 First Special Session, Chapter 2, Article 2, Section 9(a)

**Staff Prepared/Presented:** Brian Davis, 651-602-1519; Ali Elhassan, 651-602-1066

**Division/Department:** MCES c/o Leisa Thompson, 651-602-8101

## Proposed Action

That the Metropolitan Council authorize its Regional Administrator to execute the contract amendment for contract 15I103 with the University of Minnesota in Attachment A in the amount of $268,393 making the contract total $591,205.

## Background

Regionally, landscape irrigation accounts for nearly one quarter of all residential water use, totaling nearly thirty billion gallons per year. As development proceeds, more turfgrass irrigation will result in significant increases in summer water use. The Metropolitan Council is partnering with the University of Minnesota Turfgrass Science Program to investigate and promote methods for increasing turfgrass irrigation efficiency. Through research, demonstration sites, certification programs, and outreach efforts, we seek to teach residents how they can save water, improve lawn health, and help their communities save money by reducing the need for additional water infrastructure. This first contract was for $122,592 and was amended in 2017 for an additional $199,680.

## Rationale

The Water Supply Planning Unit seeks to improve water efficiency throughout the Twin Cities metropolitan area. Turfgrass irrigation has been growing significantly since the 1990s, increasing the need for water supply wells that are only used during short-term periods of peak demand. Our research has shown the need for improvement in irrigation practices: for example, over 40% of our survey respondents irrigate every other day, which far exceeds what is needed by turfgrass. Newly developed Environmental Protection Agency (EPA) WaterSense-labeled ‘Smart Controllers’ and pressure-reducing spray heads, if widely implemented, could eliminate the need for 20 additional municipal water supply wells through 2040. This would save communities millions of dollars while improving lawn health.

## Thrive Lens Analysis

This action supports the Thrive MSP 2040 stewardship and sustainability outcomes and the water sustainability goal of the Water Resources Policy Plan. Increased turfgrass irrigation efficiency will help protect our aquifers and reduce water utility rates in the long term.

## Funding

The Turfgrass Irrigation Efficiency project is funded by Clean Water, Land and Legacy Amendment funds through the Minnesota Legislature, 2019 First Special Session, Chapter 2, Article 2, Section 9(a): $1,000,000 the first year and $1,000,000 the second year are to implement projects that address

emerging threats to the drinking water supply, provide cost-effective regional solutions, leverage interjurisdictional coordination, support local implementation of water supply reliability projects, and prevent degradation of groundwater resources in the metropolitan area.

## Known Support / Opposition

No known opposition.

Metro Area Water Supply Advisory Committee supports the program.

A Contract Extension Proposal for Metropolitan Council Environmental Services
From University of Minnesota Extension Turfgrass Science Program

# Reducing Water Use on Twin Cities Lawns through Research, Education, and Outreach

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**Project funding period: January 1st, 2020 to December 31st, 2021**

**Total project funding: $268,933**

## Abstract

Lawn irrigation practices have become a concern recently due to water quantity and quality issues. Irrigation is a significant source of freshwater withdrawals in the Twin Cities Metro Area (TCMA). Our previous collaboration with the Metropolitan Council has identified opportunities for maximizing water use efficiency in the home landscape, such as conducting irrigation audits and utilizing improved technologies such as smart irrigation timers and soil moisture sensors; yet there is much more work to be done. Below we propose a series of projects that will move us further toward the goal of reducing home lawn water use in the TCMA. First, we will continue successful outreach programming from the current grant period at the Minnesota State Fair and the Minnesota Landscape Arboretum. In our second objective, we will continue and expand our research aiming to identify management practices that can reduce how much water is needed by lawns. Next, in Objective 3, we will conduct a robust online survey of homeowners in the TCMA to learn more about their knowledge of lawn watering practices and barriers that may be preventing better water conservation practices. In the fourth objective, building off of these survey results, we will work with the University of Minnesota Carlson Brand Enterprise program to identify effective communication tools and strategies that can be used to develop future

marketing materials for educating the public and help overcome some of the barriers identified in the homeowner survey. Our final two objectives will utilize the research knowledge, market research, and survey results from earlier objectives to develop comprehensive education programming. In Objective 5, we will develop in-person training for professionals, including public agency personnel. Finally, in Objective 6 we will develop a website that aims to educate the public about lawn watering best practices.

## Background

Minnesotans cherish their land of 10,000 lakes but may not connect the dots as to the relationship between their actions at home and the impact on the state's water. Nationally, water use in the home landscape accounts for nearly one third of all residential water use, totaling nearly nine billion gallons per day (EPA, 2013). Turfgrasses provide a multitude of environmental, functional, aesthetic, and recreational benefits (Stier et al., 2013), however, lawns are estimated to be the single largest irrigated crop in the United States, accounting for over 40 million irrigated acres, or four times the irrigated acreage of corn (Milesi et al., 2005). This estimate included residential, commercial and institutional lawns, golf courses, athletic fields, and roadside turf, with home lawn turf accounting for a majority (66%) of the area (Breuninger, et al., 2013). As urbanization increases (Alig, et al., 2004), this land use estimate for turf will likely increase, posing significant implications in terms of water quality and quantity (Fender, 2008; Johnson et al., 2013). For example, monthly summer water use in the TCMA is nearly three times greater than monthly winter use (Metropolitan Council, 2014), likely attributable to outdoor watering.

Researchers have investigated the profile of home irrigation users, citing opportunities for Extension programs to improve engagement with these individuals (Ali and Warner, 2017). Yet climatic differences greatly influence homeowner irrigation practices and Extension recommendations for lawn watering. The University of Minnesota Extension recommends minimal irrigation in the spring prior to June with 1 to 1.5 inches of irrigation per week in the summer (minus rainfall), watering in the morning, and as infrequently as possible (Taylor, n.d.). However, from our findings, homeowners often schedule irrigation systems to run based on odd /even city ordinances which cause them to over irrigate lawns with rainfall levels rarely taken into account. For instance, 42% of our TCMA survey respondents with irrigation systems irrigate every other day, and many of these homeowners do not have an operable rain sensor. This is concerning because during the growing seasons of 2016 and 2017 we witnessed significant rainfall increases compared to historical averages, with 2016 being the wettest year on record in the TCMA. The fact that many homeowners did not change their irrigation practices under conditions of ample rainfall clearly suggests a need for educational programs in this area.

Our previous work with the Metropolitan Council documented homeowner irrigation practices across the TCMA, including visual assessments of over 60 residential irrigation systems. We identified the current state of lawn irrigation, as well as opportunities for improving water use efficiency. We found that:

1. Kentucky bluegrass (a high water-use species) dominates almost 75% of our lawns. This presents an opportunity for future utilization of drought-resistant species such as fine fescues and tall fescue.
2. Almost 50% of residents with irrigation systems have not audited their system. This can lead to excessive water loss due to leaking sprinklers, non-uniformity of irrigation distribution, and irrigation of / runoff onto impervious surfaces. Furthermore, the average homeowner irrigates 500 $ft^2$ of impervious surfaces (driveways, sidewalks, roadways, etc.).

3. Over 40% of irrigation system owners operate their systems on an every other day schedule.
4. Over 25% of homeowners have irrigation systems that lack sensor technology which helps prohibit unnecessary watering during periods of sufficient moisture or rainfall. This technology is currently mandated by state law (103G.298) for irrigation systems installed after 2003.
5. Over 25% of irrigation audits revealed at least 5 leaking sprinklers.
6. Over 90% of homeowners were aware of city imposed watering ordinances.
7. Many homeowners were highly likely or somewhat likely to adopt water saving strategies, such as soil moisture sensors or smart controllers.

These results, along with other information from our surveys and site visits, are extremely valuable for informing education programs directed at home irrigation users. The report findings can be found at: https://metrocouncil.org/Wastewater-Water/Publications-And-Resources/WATER-SUPPLY-PLANNING/Twin-Cities-Lawn-Irrigation-System-Surveys-And-Ass.aspx

The University of Minnesota Turfgrass Science Program focuses heavily on water conservation in the home landscape. Our approach to this effort has included: 1) surveying the public about water use, 2) conducting applied research on drought-resistant grasses, and 3) public outreach-education about water conservation. Over the last decade, we have conducted research to define drought-resistant cool-season grasses for Minnesota lawns at the Turfgrass Research, Outreach and Education Center on the St. Paul campus. The results from that research have recommended utilizing turfgrass species with greater drought resistance in TCMA lawns, including fine fescues and tall fescue, over the traditionally-used, high-water-demanding species like Kentucky bluegrass and perennial ryegrass. Finally, we have worked with municipalities in Minnesota on education programs focusing on drought-resistant turfgrasses and smart irrigation systems. Taken together, we are well positioned to provide public agencies with the information necessary to reduce water use on home lawns in the TCMA.

**Objectives**

1. Continue existing research and outreach-education efforts related to this project including:
    a. Lawn Water Efficiency exhibit at 2020 and 2021 Minnesota State Fairs.
    b. Continuation of Efficient Irrigation Systems Research Project at a new location, the Minnesota Landscape Arboretum, during 2020 and 2021.
2. Conduct new field research on the mowing requirements in lawns as impacted by mowing height and smart irrigation; in addition we propose to study the effect(s) of drought-stress on cool-season turfgrass species mixture composition.
3. Conduct a survey to determine TCMA residents' irrigation knowledge, preferences and behaviors, and understand their willingness to adopt new innovative technologies and transition to drought-tolerant turfgrass varieties and identify any barriers to change.
4. Develop a marketing strategy with assistance and feedback received from the UMN Carlson Brand Enterprise program to more effectively educate the public about home lawn water conservation practices.
5. Develop and provide quality outreach-education programs for irrigation industry professionals, landscape and lawn-care operators, county and municipal officials, administrators, agencies, and regional watershed districts.
6. Develop a website for the public (e.g., homeowners, consumers, etc.) which engages consumers with responsible irrigation practices, best management practices for reducing

lawn water requirements, and features research findings, links to industry resources and tools, and includes fact sheets, online tutorials, and various learning objects.

## Project Tasks

### Objective 1: Public Outreach

Minnesota State Fair Lawn Water Efficiency Exhibit

In 2017-2019 we set up an educational exhibit at the Minnesota State Fair showcasing different irrigation systems and technologies that have been demonstrated to increase water-use efficiency. We will continue to develop and improve upon this exhibit for the 2020-2021 fairs. At the exhibit we featured low-maintenance grass species, such as fine fescues, which can serve as a more sustainable alternative to the high-input-demanding Kentucky bluegrass that is traditionally used in Minnesota lawns. Our team of graduate students, researchers, and faculty interacted with attendees educating them on the water-savings potential of these technologies and on best management practices for conserving water in lawns such as turfgrass species selection, mowing practices, and fertilization.

Efficient Irrigation Systems Demonstration Project

During 2017 and 2018 at the UMN St. Paul campus we demonstrated five sprinkler systems that represented traditional, smart-, and sensor-based irrigation, and one system that was manually irrigated. Each system was programmed to apply equivalent volumes of water at the same frequency during the week, with the exception of the manually-irrigated treatment. This schedule and application volume was representative of watering schedules utilized in the Twin Cities (municipal odd / even regulations, one inch cumulative water / week). The results of the demonstration project indicated that very little watering supplied through irrigation is required throughout the summer period (June – September) as systems that were manually irrigated or controlled using a soil moisture sensor reduced water use by greater than 80% each year. During 2019, a research trial, representative of this demonstration project, is being installed in between the Visitors' Center and Learning Center at the Minnesota Landscape Arboretum in Chaska, MN. This new study also features low-input fine fescue species (*Festuca spp.*) in the lawn. This research study will be used for multiple purposes. First, systems will be operated and monitored for cumulative water use and lawn quality for two consecutive years. Secondly, the systems will be used as a component of educational programs and field days; the study site will be utilized to inform and engage the public about improved water efficiency using smart irrigation and/or soil-moisture-based irrigation scheduling. Third, we will hold workshops and outreach-education programs at this site during 2020-2021. Finally, the irrigation systems will be utilized for producing educational content for videos, online training programs, and media interviews. An example of a media interview conducted at this site can be found here: http://minnesota.cbslocal.com/2017/09/12/u-of-m-extension-survey-lawn-irrigation/

Mobile Education Trailer

During the fall of 2019, we will be converting a teardrop-style camping trailer for conducting mobile outreach education in communities across the TCMA. This mobile education trailer will include the following interactive display items: smart irrigation controllers, soil moisture sensors, irrigation heads / nozzles, valves and piping systems, auditing tools, and low maintenance grass examples. We will utilize this trailer for conducting outreach education in several locations across the TCMA, to include but not limited to: Metropolitan Council Regional Parks, farmers markets, field days, environmental fairs, and the educational programming for professionals (Objective 5).

**Objective 2: Field Research**

Smart irrigation systems and their environmental and economic impacts on the mowing requirements of Kentucky bluegrass lawns

In 2019 we initiated this new study at the previous site used for the water efficient irrigation systems demonstration project at the UMN St. Paul campus. Those results clearly showed that significant water savings are achieved through the use of smart irrigation controllers. We also know that turfgrass water-use efficiency can also be impacted by other cultural management factors such as mowing. Previous research has recommended increasing mowing heights during periods of drought stress to improve water-use efficiency and overall aesthetic quality in cool-season lawns. The purpose of this study will be to determine additional benefits from utilizing smart irrigation, beyond overall water savings, such as reducing mowing requirements. Other benefits could include reduction in $CO_2$ emissions and financial savings from reduced water use and less mowing events required. This research project will continue during the next two summers (June-Sept. of both 2020 and 2021). Findings will be included in local outreach-education programs (Objectives 5 and 6 below) and presented at professional and scientific meetings.

Effect of drought on cool-season turfgrass species composition

During our previous research in 2017 and 2018, we evaluated the drought resistance of 28 different consumer-available turfgrass seed mixtures under 60 days of acute drought stress (i.e., irrigation and precipitation eliminated) and during a 4-week recovery period (irrigation / precipitation allowed). As a next step, we will conduct both growth chamber and field studies to determine how turfgrass species composition changes in a mixture over time and over multiple drought and recovery periods. This information will help inform the design of optimal cool-season turfgrass mixtures that can be recommended for homeowners in the TCMA.

As the first component of this effort we have established a growth chamber experiment consisting of nine different treatments comprised of various combinations of Kentucky bluegrass, hard fescue, and perennial ryegrass (monocultures and various 2-way mixtures at a 2:1 ratio). These species were chosen based on their prevalence in typical consumer mixes (Kentucky bluegrass and perennial ryegrass are common while hard fescue is not) and their performance in our earlier research. We will subject all mixtures and blends to two drought periods of 28 days separated by a recovery period of the same length. During the different drought and recovery periods, weekly data will be collected on visual turf quality, NDVI (turf color), digital image analysis (objective assessment turf coverage), and chlorophyll fluorescence analysis (plant stress). The species composition will be estimated at the beginning of the experiment, and the end of each of the drought and recovery periods.

To determine if these results translate to field conditions, we are proposing a second experiment using the same mixtures under the rainout shelter at the UMN St. Paul campus. This experiment will be seeded in late fall 2019 (as a dormant seeding) with two drought periods each year beginning after full establishment (mid to late summer 2020 and then again on the same approximate dates in 2021). Each drought period will be followed by a recovery period, much as in the growth chamber experiment. Turf quality, NDVI and digital images will be recorded weekly during both drought and recovery. Similar to the growth chamber experiment, chlorophyll fluorescence and species composition will be monitored at different time points throughout the experiment.

**Objective 3: Survey on Consumer Lawn Water-Use Behaviors and Preferences**

Our previous work with the Metropolitan Council included a survey related to homeowners' irrigation practices and lawn preferences. We are proposing to refine the inquiries of that survey and to include new inquiries such as consumer's willingness-to-pay for renovations to their sprinkler system such as upgrading to a smart controller or adding on a soil moisture sensor, and / or transitions to their lawn such as converting to low-maintenance turfgrasses which require less mowing, irrigation, and fertility. We will also aim to identify any barriers that might be preventing water-saving decision making by consumers, including attitudes about even-odd watering restrictions, or lack of knowledge about turfgrass water needs. As part of our participation in the Brand Enterprise program (Objective 4), the professors in that program will consult with us on survey development to maximize the combined effect of the two objectives. This survey will have a large sample size (over 1500 respondents), to allow us to better understand current water-use behaviors and consumers' willingness to adopt smart irrigation technologies and implement more water-conserving turfgrass practices. Furthermore, we would be able to utilize this information to develop on-target messaging and awareness in our marketing research (Objective 4) and educational content in face-to-face education (Objective 5) and the website (Objective 6).

**Objective 4: Marketing Strategy Development**

To maximize our outreach-education efforts and form dynamic, high-impact messaging for consumers we will work with the University of Minnesota Carlson Brand Enterprise program (CBE) of the UMN Carlson School of Management to learn how to best reach the general public with important information about reducing outdoor water use on lawns. University researchers have employed similar strategies to effectively conduct outreach-education efforts in water conservation (Squeeze Every Drop, 2019; VI Marketing and Branding, 2019). The objectives of the marketing strategy efforts will be to discover how to create effective conservation branding and messaging to reduce outdoor water use in TCMA lawns. During the spring 2020 semester (13 weeks) CBE students (a team of 4-5 students, mostly at the graduate MBA level) will develop a wide scope of findings containing feedback received from various consumer testing models and approaches (A/B testing, consumer intercepts, factor analytics of lawn attributes, ... etc.). These end-products delivered from CBE will provide us with the knowledge we will need to effectively communicate the value proposition of water-efficient lawns. We, along with the Met Council, will then have the information needed to effectively create marketing and educational materials that optimize our limited resources to target our audience so we can spur a real change in behavior. This partnership will be cost effective as well as synergistic (in fact, the Metropolitan Council has collaborated with this program in the past for other projects). Beyond the grant period, the end products can be utilized in enhancing our outreach-education programming through face-to-face education events, online education, and through opportunities in public advertising (e.g., Met Council-owned facilities such as the Metro Transit system), with local media, and in other end products such as the homeowner website (Objective 6).

**Objective 5: Educational Programming for Professionals**

With our initial project studying lawn irrigation in the TCMA, we have a clear understanding of how irrigation systems are being installed and operated. From this work, we will develop and offer face-to-face education programs for water efficient lawn and irrigation practices. These programs (i.e., workshops) will include speakers from the University of Minnesota, Metropolitan

Council, irrigation contractors, government agencies, and personnel from local utilities and watershed districts. The target audience for this program will be lawn / landscape / irrigation professionals involved with residential and/or commercial irrigation, and municipal/county administrators and decision-makers. These educational efforts will include a full day of classroom training and hands-on education, followed by an exam in order to receive continuing education units. There will be a small fee charged for this class to cover meals and hospitality expenses. During 2020 and 2021, a total of four outreach-education workshops will be held to reach all interested participants across the TCMA. Providing proper education and training to these individuals, specifically the decision-makers, will empower them to enact smart-irrigation regulations for citizens and stakeholders in their communities.

**Objective 6: Online Homeowner Education Website**

We will develop an all-inclusive educational water conservation website in 2021. This website will serve as a one-stop shop of water conservation resources primarily for homeowners and the general public. This website will be modeled similar to UMN extension and outreach websites (bedbugs.umn.edu, extension.umn.edu/home-and-financial-management, septic.umn.edu, and roadsideturf.umn.edu) and will provide consumers with educational content similar to other university websites (e.g., CWEL; Squeeze Every Drop; Water University), such as lawn irrigation information, industry links and resources, and various water conservation modules and engaging multimedia tools. The website will be fully developed and made available January 1st, 2022, with the intention that this will supplement and / or replace the face-to-face education program and outreach efforts with the mobile-education trailer in subsequent years. We will use results from survey (Objective 3) and brand management efforts (Objective 4) to inform website design to maximize the effectiveness of outreach.

**Project Deliverables**

- Final reports of the field research projects on lawn irrigation systems, impacts of smart irrigation on the lawn mowing requirements, and turfgrass species persistence in consumer-available seed mixtures as well as findings from the survey regarding lawn-watering knowledge, preferences and behaviors (Objectives 1, 2, and 3).

- The marketing strategy developed in Objective 4 will be available for use by the Met Council for outreach and education. The strategy will be used by UMN to guide outreach-education efforts including the face-to-face education programs (Objective 5), and the education website (Objective 6)

- We will provide a list of participants from the face-to-face education programs (Objective 5).

- All educational content developed as part of this project will be freely available to the public and the Met Council will be acknowledged on all content.

- Research findings, from both field and survey work, will be prepared for publication in scientific peer-reviewed journal in order to broaden our impact beyond. A press release will be prepared for each published manuscript so that the Met Council can promote their contributions to reducing water use in urban landscapes.

Schedule
All tasks will be completed from January 1st, 2020 to December 31st, 2021.

- Objective 1: January 1st, 2020 to December 31st, 2021
- Objective 2: January 1st, 2020 to December 31st, 2021
- Objective 3: January 1st, 2020 to December 31st, 2020
- Objective 4: January 1st, 2020 to December 31st, 2020
- Objective 5: January 1st, 2020 to December 31st, 2021
- Objective 6: January 1st, 2020 to December 31st, 2021

**Budget narrative**

Budget includes salaries for this two-year extension for a Postdoctoral Research Associate (Dr. Daniel Sandor), UMN faculty member (Dr. Eric Watkins), support from Scientists (Kristine Moncada and Florence Sessoms), a graduate student to analyze the survey data in Objective 3, and an undergraduate student worker. Additionally, estimates for supplies, travel, and printing are included. Funding for the consumer survey will come from current funding that has not yet been used.

**Budget overview**

| Budget Item | Description | Budget | | |
|---|---|---|---|---|
| **Salary** | | 2020 | 2021 | Total |
| Daniel Sandor, Postdoctoral Associate | 100% Effort | $50,011 | $51,011 | $101,022 |
| Eric Watkins, Professor | 1 week summer salary | $2,055 | $2,096 | $4,151 |
| Kris Moncada, Scientist | 15% Effort | $9,138 | $9,321 | $18,459 |
| Florence Sessoms, Scientist | 10% Effort | $5,267 | $5,372 | $10,639 |
| Graduate student, TBA (*survey analysis*) | | $24,422 | ----- | $24,422 |
| Undergraduate Research Assistant | 700 hr / year | $7,000 | $7,000 | $14,000 |
| **Fringe Benefits** | | | | |
| Daniel Sandor | 24.3% | $12,153 | $12,396 | $24,549 |
| Eric Watkins | 36.0% | $740 | $754 | $1,494 |
| Kris Moncada | 29.5% | $2,695 | $2,750 | $5,445 |
| Florence Sessoms | 36.0% | $1,896 | $1,934 | $3,830 |
| Graduate student | 36.1% (tuition)<br>16.1% (fringe) | $19,922 | ----- | $19,922 |

| | | | | |
|---|---|---|---|---|
| **Non-salary** | | | | |
| Marketing Strategy Development | UMN Carlson School of Management Brand Enterprise Program fees and services (2020 Spring semester ~13 weeks with an average of 60-80 hours of week student time devoted to the project; equivalent to almost 250 hours of consulting) | $25,000 | ----- | $25,000 |
| Website | IT consultant fee for interactive element development on homeowner website with educational and engaging lawn water-conservation information, tools, and resources | ----- | $5000 | $5000 |
| Outreach Supplies | Promotional / leave-behind materials, printed materials (signs, brochures, flyers ..., etc.), supplies for mobile educational trailer, state fair exhibit, and face-to-face outreach-education events. | $1,000 | $1,000 | $2,000 |
| Laboratory Supplies | Turfgrass seed, maintenance of data collection equipment used in field research, field maintenance equipment (paint, mowing, irrigation system components / maintenance, growth chamber rental). | $1,500 | $1,500 | $3,000 |
| Local / Regional Travel | Fuel, Mileage..., etc. used for local / regional travel to outreach-education events. | $3,000 | $3,000 | $6,000 |
| **Total** | | $165,799 | $103,134 | $268,933 |

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