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Auditor

SPECIAL ADVISORY REPORT

Parks & Recreation Water Conservation Program

SUMMARY OF SERVICE

Special Advisory Reports (SAR) provide information based on a limited review or time-critical assessment, investigation or evaluation as requested by City management. While not in full compliance with government audit reporting standards, SARs are non-audit services that further the accountability of the City by providing a reporting vehicle that is flexible, quickly issued, and focused on a singular issue.

PURPOSE

Denver Parks and Recreation (DPR) requested that Audit Services Department perform a peer review of DPR's Water Conservation Program and related goals. Specifically, our task was to assess the existing water conservation program metrics, and provide additional water conservation benchmarking where possible.

BACKGROUND

Water is one of our most precious natural resources. Water conservation programs play a significant role in ensuring that current and future water supplies are available by reducing the demand for water and ensure sustainability for future demand.

DPR is responsible for the daily operations and management of the City's parks, parkways, trails, natural areas, and other land and water assets. The current system includes 44 mountain parks with more than 14,000 acres and 240 urban parks with more than 3,700 acres. The agency also maintains more than 2,300 acres of natural areas, approximately 60 miles of trails and

more than 430 acres of public right-of-way or other City owned property. DPR also provides care and management for the urban forest and natural areas, the City greenhouse and the tree nursery. They oversee the planning, design, and construction of capital improvements for the department as well as providing strategic and master planning, development review, parkland policy guidance and long-range planning.¹

The primary use for water within the DPR system is for park and parkway irrigation. Recently, DPR has significantly reduced its water usage, from 1,645,915,000 gallons in 2008 to 954,725,000 gallons in 2009. This represents an almost 58% reduction over a one year period.² Savings were achieved through irrigation efficiency improvements, favorable weather conditions, landscape modifications, water management and the expansion of non-potable water usage.

DPR follows both state and local laws and regulations with regard to water conservation efforts. The Colorado Water Quality Control Act establishes requirements, prohibitions, standards and concentration limits for the use of reclaimed water to protect public health and the environment while encouraging the use of reclaimed water.³ The Colorado Water

¹ City and County of Denver 2010 Budget.

² Denver Parks and Recreation 2009 Water Conservation Annual Report.

³ Colorado Department of Public Health and Environment, Water Quality Control Commission, Regulation 84, and C.R.S. § 25-8-202 & § 25-8-205.

Conservation Board provides guidance for water conservation planning including key elements that should be part of an entity's water conservation plan.⁴ In addition, DPR adheres to Executive Orders 72 and 123, inter-governmental agreements and the Denver Revised Municipal Code with regard to water conservation efforts.⁵

There are two main areas where water is measured – water in motion and water at rest. Water in motion is measured in units of flow indicating how fast a given volume of water is moving past a fixed point. Whereas, water at rest is measured in units of volume describing how much space a given amount of water will occupy. The most common units of volume are gallons, acre-inches, acre-feet and cubic feet.

- 💧 Acre-inch—the volume of water that would cover an acre one inch deep or 27,154 gallons of water;
- 💧 Acre-foot—the volume of water that would cover an acre one foot deep or 325,851 gallons of water; and
- 💧 Cubic-foot—the amount of water that would fill a container one foot wide by one foot long by one foot deep or 7.48 gallons of water.

Measurement	Equivalent in Gallons
Acre-inch	27,154
Acre-foot	325,851
Cubic-foot	7.48

One of the key elements of water measurement is evapotranspiration. The Environmental Protection Agency explains evapotranspiration as the process through which plants secrete or transpire water through leaf-pores. As the water evaporates, it draws heat and cools the air in the process. According to the Lawrence Berkeley National Laboratory, a single

⁴ C.R.S. § 37-60-126(4)(a-e).

⁵ Executive Order 123, Greenprint Denver Office and Sustainability Policy and Executive Order 72, Utilities and Services and D.R.M.C. Subtitle B, Article X 10.1.12.

mature and properly watered tree with a crown of 30 feet can evapotranspire up to 40 gallons of water in a day.

DPR uses the acre-inch measurement in order to help citizens see the relationship between evapotranspiration and precipitation with regard to how much water is used by the Department of Parks and Recreation.

Many factors that influence water supplies and usage include: location, total number of acreage, drought, climate changes, population growth, technology and resources. Some benefits of water conservation include: saving money; protecting drinking water resources; minimizing water pollution; and saving energy used to pump, heat, and treat water.

Outdated irrigation standards were updated in 2009 by DPR Water Conservation Division to better reflect current irrigation practices and materials and better align with water conservation goals through hydrozone and water budget requirements.⁶

In order to meet the current and future water needs, DPR is making efforts to conserve their water supply. Some areas where DPR is making efforts to achieve water-saving includes, but is not limited to the following programs: Water Management & Consumption, Non-potable Water Expansion, and Irrigation Efficiency Improvements & Landscape Modifications.

Water Management & Consumption:

Water management is a balance between responding to weather conditions and understanding specific park conditions including irrigation efficiency, plant material, soils, slopes and microclimates. As the weather was monitored in 2009, water budget targets were adjusted from a normal

⁶ Denver Parks and Recreation 2009 Water Conservation Annual Report.

precipitation year of 30 inches per acre down to an 18 inch per acre water budget. Each park district also customized this target to reflect individual park conditions.⁷

Non-potable Water Expansion:

DPR continues to partner with Denver Water and the reclaimed water program, converting 19 acres at four parks in 2009, making a total of 13 parks converted to reclaimed water. The addition of Verbena, McNichols, Crescent and Denison Parks brought the total irrigated acres using reclaimed water (piped in) to 254. Three additional parks are planned for conversion in 2010.⁸

Irrigation Efficiency Improvements & Landscape Modifications:

The Better Denver Bond Program completed the following irrigation projects in late 2008 and 2009: Auraria Parkway, Berkeley Irrigation Automation, Cranmer Park, Green Valley Ranch East, Washington Park, E. 6th Avenue, Magna Carta-In House, Frontier West, Lincoln Park, Valverde Park, City Park Museum, Zoo and Deboer Garden areas. The 2009 DPR Capital Improvement Program completed the Barnum Park irrigation project in 2009.⁹ The completion of these projects resulted in irrigation efficiency improvements that allow DPR to reduce the use of potable water and increase savings.

METHODOLOGY

Auditors utilized the following methods as part of their review:

- 💧 Reviewed DPR 2003 Water Conservation Program and Denver Water Conservation Program;
- 💧 Interviewed DPR water conservation staff;

- 💧 Researched water conservation measurements and practices;
- 💧 Conducted a survey of other cities considering the following attributes:
 - Similar size;
 - Environmental considerations;
 - Geographic location;
 - Arid/semi-arid regions; and
 - Drought criteria.
- 💧 Surveyed and reviewed the following cities: Aurora, CO; Austin, TX; Salt Lake City; Tucson, AZ; and Las Vegas, NV;
- 💧 Compared survey results with Denver Parks and Recreation Water Conservation Division;
- 💧 Identified best practices of other cities/industries; and
- 💧 Conducted research and reviewed sustainable water conservation methods/practices.

REVIEW RESULTS

Our survey and review of other cities water conservation plans was not specific to parks and recreation departments, rather water conservation programs reviewed were for entire cities. This was done primarily due to the fact that water conservation programs are tracked, monitored, and performed at a city level and are not broken out by a specific department. However, tracking on a city-wide basis did not limit our ability to evaluate and compare on the following key elements: measurement methods, infrastructure, water loss controls, water reclamation, and public education programs.

Measurement Methods

The cities contacted for the survey identified various methodologies for water usage measurement. The processes ranged from using a master valve programmed by a computer, meter readings, water audits, and a “rough estimate” comparison between winter and summer water volume use.

⁷ Denver Parks and Recreation 2009 Water Conservation Annual Report, p. 1-2.

⁸ *Ibid.*, p. 1-4.

⁹ *Ibid.*

Based on the review of selected cities, the standard water usage measurement is acre-foot. Although, DPR is using acre-inch, this is considered a good measurement for parks and recreation and acre-foot is considered a good measurement for a city.

Infrastructure

DPR has standardized specifications to promote installation of master valves, flow sensors and central control systems to improve water management.

Park planners utilize hydrozone mapping in the planning process to plan for water usage. Additionally, DPR utilizes Geographic Information System (GIS), Microsoft Office including Excel and Access, and AutoCAD to monitor water usage through annual and monthly reporting. Water accounts, irrigated acres and controller locations are tracked through GIS layers. Information tracked includes but is not limited to annual water use, water targets, and water sources.

Similar to DPR, many cities surveyed utilized GIS and other similar technology such as Motorola irrigation hardware and software with Arad master valves. Based on our survey results with five different locations, DPR is using a comparable central control system to monitor water usage.

Water Loss Controls

DPR uses a review of irrigation accounts to see if flow is detected and field staff to verify the information at a specific site. Monthly consumption reports are prepared based on billing which highlight high water usage parks by normalizing the data on inches per acre. This allows staff to compare the data against their known water usage and detect leaks. Field staff can verify small leaks through the use of leak indicators. In the long term, recently updated irrigation standards will help detect leaks and prevent water loss.

All cities surveyed including DPR, report a variety of water loss controls and processes, which include the following:

- 💧 Use of master valves programmed by irrigation software and hardware;
- 💧 Leak detection teams to listen for leaks;
- 💧 Implementation of aggressive pipe replacement programs;
- 💧 Complete water loss audits; and
- 💧 A comprehensive water loss control program.

Reclaim Water Consumption

Reclaimed water is an important component of wise water management. Water is reclaimed from domestic wastewater and small amounts of industrial process water or storm water that is treated to restore water quality to acceptable levels in accordance with Regulation 84. The process provides a high-level of disinfection and reliability to ensure that only water meeting the requirements of Regulation 84 leaves the treatment facility. It is intended for non-potable uses, such as irrigation, parks, dust control, fountains and fire suppression.

Approximately 19% of the 2,900 irrigated acres maintained by DPR are irrigated using reclaimed water and 8.7% (254 acres) of the acres are irrigated using reclaimed water that is piped in. While 10.1% (291 acres) of the reclaimed water irrigation is accomplished by water fed through the City Ditch. An additional 7% of the irrigated acres are irrigated by raw water sources.¹⁰ Other cities reviewed consumed approximately 3% to 40% of reclaimed water. The more arid and drought prone cities such as Tucson and Las Vegas use a higher percentage of reclaimed water in order to conserve their potable water for residential consumption.

¹⁰ Water Conservation Survey.

City	Reclamation Consumption %
Salt Lake City, UT	<3%
Austin, TX	3%
Tucson, AZ	12%
Aurora, CO	15%
Denver Parks & Recreation Denver, CO	19%
Las Vegas, NV	40%

DPR reclaim water usage is comparable to entire citywide usage for the cities surveyed. In fact, DPR has a better rate of reclaim consumption than Salt Lake City, Austin and Tucson and Denver's rate is comparable to Aurora.

Public Education Programs

Public awareness and community buy-in are key components that drive the success of water conservation programs. Public education appears to be an important element in all cities surveyed, including DPR, and all have extensive information and resources for individuals and organizations that include:

- 💧 Advertising, community events and publications;
- 💧 Indoor and outdoor water reduction tips, soil analysis, types of water-wise plants;
- 💧 Sprinkler and home water saving products, rebates, water saving calculations; and
- 💧 Links to several federal and local water-sites including the Environmental Protection Agency.

SUMMARY

Each city throughout the nation has a unique set of challenges relating to reducing water usage, controlling water loss, and implementing a water conservation program that will preserve water supplies for future generations.

Our review consisted of surveying five cities with regard to size, environmental conditions, geographic location, arid/semi-arid region, and drought criteria and compared elements of their water conservation programs to DPR water conservation program. The elements compared were measurement methodology, infrastructure, water loss controls, water consumption reclamation and public education programs.

Based on our examination, DPR's water conservation program is comparable to the citywide programs reviewed. In some areas, including Reclaim Water Consumption, DPR does significantly better than the surveyed cities.

One area where DPR can improve its water conservation program is by updating and including a long-term plan for future conservation efforts.¹¹ Each of the five cities reviewed incorporated a long-term plan that included an additional ten to fifty year plan. DPR's water conservation plan was released in 2003 and does not contain a long-term plan.

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¹¹ C.R.S. § 37-60-126(4)(d) provides that a covered entity must review and update its adopted plan at least every seven years.