DENVER
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DENVER PARKS & RECREATION WATER MANAGEMENT PLAN

Introduction

Denver Parks and Recreation Vision and Mission Statements:

Vision:
To be a nationally recognized leader in providing model programs & dynamic public spaces.
Mission:
As stewards of Denver's legacy, Denver Parks and Recreation is dedicated to customer satisfaction and enhancing lives by providing innovative programs & safe, beautiful sustainable places.
Denver Parks and Recreation (DPR) maintains a park system of 2,902 irrigated acres for the use of residents in the City and County of Denver. The system of traditional parks, parkways, and tree-lined streets was built with plant materials imported from humid, lush regions and built at a time when labor was less expensive and water was plentiful. We must balance our love for these places with the new paradigm for our parks, continuing to value the heritage of our parks system while accepting the realities of Colorado's semi-arid climate and available water resources.

Climate change is also putting pressures on the city's park system. Temperatures in Colorado have increased by roughly 2 degrees Fahrenheit over the past 30 years, and are forecasted to continue to rise. Water demands in our parks rise along with the increase in temperature, potentially reducing available water resources. Droughts are projected to increase in frequency, duration and severity.

The Water Management Plan is designed to improve the resiliency of DPR's parks system by preparing for future water shortages; establishing standards for new and retrofitted parks; making commitments to install new technologies; maximizing the use of non-potable water; and defining water management procedures. Safeguarding our investment in the physical resource base is a main priority.

The Water Management Plan is aligned with the values expressed by staff and the people of Denver, and are reflected in the department's strategic plan, The Game Plan: long-term sustainability of the physical system, equity, engagement, and sound economics.

Plan Products

1. A Strategic Water Shortage Response Plan

An updated, comprehensive drought response plan for DPR Parks and Golf, which includes guidelines and policies to direct decisions on the allocation of water resources, providing maximum community benefit while maintaining park health.

2. Parks Irrigation Technology

Ongoing, annual capital commitment to upgrade and replace existing, outdated irrigation systems.

3. Parks Irrigation Water Management Operations

Implement maintenance practices and standards to increase the efficient use of water throughout the park system, including:

- Report water use by park
- Define responsibilities of field operations personnel
- Implement water management training programs for park operations and planning staff

4. Parks Design Guidelines and Standards

Develop governing principles to guide Planning, Design and Construction Standards along with irrigation specifications for both new and retrofitted parks.

5. Parks Horticulture Renovation Program

The horticulture operations team will be tasked with median renovations, along with implementing a greenhouse/floral water shortage response plan.

6. Alternative Water Sources and Water Rights Portfolio

Guidelines on conversion from potable sources to reuse sources on new and suitable existing sites where Denver Water Reuse Infrastructure exists.

The Portfolio will track DPR's water rights with a goal of optimizing the use of alternative water sources.

7. DPR Facilities Operations

Efficient water use in Recreation Centers and other DPR facilities.

8. Yearly Review

DPR and Denver Water will meet to review the success and challenges of implementing this plan on an

annual basis. A written report will be created by DPR, due January 30 of each year, with updates for each category of the water plan.

Denver Parks Strategic Water Shortage Response Plan

Background

During a water shortage, whether it be a drought, catastrophic water infrastructure failure, or devastating fire in a local watershed, water availability may be impacted and a drought response may be initiated. In these situations, the availability of Public Spaces, including parks, becomes more essential to the community. Denver Water's Board of Commissioners has historically provided direction to prioritize Public Spaces over private property, but there could still be the need for Denver Parks and Recreation (DPR) to curb water use.

In time of a water shortage, minimizing impact while providing as much access to public spaces as possible, is essential. Decisions will ultimately be made on a case by case basis and are dependent upon the level of drought, using the following guidelines in the decision-making process.

Principle

In severe drought circumstances, no one will be doing "business as usual". The impact will be on every use and user of public park land. Those impacts need to be fair and equitable across the DPR system. The Game Plan identified youth and youth facilities as the priority users and uses, which is a major consideration in determining water use priorities:

Water Use Priorities

1) Recreation centers are the highest priority and in all but worst-case scenarios, will the water available to a recreation center be reduced.
2) Tree health and the health of other long-lived plant material is essential to maintain, even during water shortages. Trees will continue to be provided water either by their own separate irrigation zone (when available) or be supplemented by hand watering to maintain tree health. In extreme cases, tress may be supplemented with reuse water when available.

3) Swimming pools and play fountains (depending on the severity of drought) will operate. Season of operation may be reduced. Recirculating play features will receive preference.
4) Youth play is the priority for athletic fields. See the Denver Athletic Field Master Plan for policies and information.
5) Dependent upon their physical condition, permitted playing fields may:
   a) Be closed for a season or portion of a season
   b) Have shortened hours or days of use
   c) Have special conditions associated permits
   d) Rotated, with down time provided
6) Athletic fields and other large turf areas in parks may be closed to any access for periods of time (including informal play, dog walking, etc.)
7) Large event and festivals must plan for a "grassless" event:
   a) Event organizers must be prepared to implement a plan that minimizes crowds and/or keeps crowds off the grass
   b) The plan may require additional accommodations on streets and walks
   c) The plan must address "spill-over" activities, such as staging, parking, transit, etc.
   d) No stages or tents will be allowed on parkland during severe drought
8) Remaining parks/medians irrigation will be substantially reduced to reallocate water to higher needs
9) Flower displays and fountains will be the first amenities to receive reduced or eliminated water allotments.

Communication to Community

Denver Parks and Recreation and other city agencies will work closely with all leagues, special users, and organized events to accommodate whatever is possible during drought conditions.

An education campaign is essential, especially during drought, to help create realistic public expectations of parkland and services; to foster an understanding and appreciation of drought tolerant and water quality enhancing designs and plantings; to improve the public understanding of appropriate uses of non-potable water; to clearly communicate the department's commitment to water conservation; and to protect and monitor resources from further damage and use.

Implementation of Drought Response

1) Prior to the anticipated declaration of drought, Denver Water will work with DPR to determine the appropriate overall weather-adjusted outdoor water budget that should be implemented. In recognition that public green spaces become even more valuable as water reduction effects in the private sector may reduce opportunities for home recreation, the target budget will allow for prioritized operation of pools, athletic fields, and green spaces.
2) DPR will devise site-specific water budgets based on prioritization of uses and locations, giving parity throughout the city. Significant drought response will require strategic prioritization of some sites over others.
3) Water Conservation will send each operations district an annual water budget by site based on drought conditions status, with monthly updates on YTD water use, guidelines on expected YTD water use according to Irrigation Water Requirement (IWR), and guidelines for global seasonal adjustments for irrigation programing.

4) Peak season irrigation programs will continue to be adjusted in response to weather events, changing drought requirements, and plant health.
5) Sites with central control will be programmed by priority, activity/use, hydro-zone and microclimate, as system layout permits. Sites on Central Control will generally receive overall budgets lower than non-central control sites.
6) Superintendents will follow up on 'water waster' sites that are over consumption budgets (and investigate no/low consumption sites), sending follow up resolution reports to Administration.
7) Reuse water is generally not restricted during drought and may be trucked to other sites for irrigation for preservation of long-lived plant materials when available.
8) Fountains not in use will be started up and shut down for maintenance purposes.

Exhibit A below shows potential DPR responses to different water shortage scenarios. At the time of actual water shortage, DPR will receive a water allotment, and determine allotments for use per the water use priorities stated above.

EXHIBIT A: MATRIX OF WATER BUDGET SCENARIOS

In the event of drought declaration, DPR and Denver Water will work together to determine the most feasible water budget. From there, DPR will determine utilization throughout the system. Some possible scenarios may be:

	Inches of Water	Annual Gallons Per Acre	Irr Acres*	Annual Gallons for Site	AF
No Drought: All Sources*			2902		
Athletic fields	29	787466	400	314,986,400	967
Med/Parkway	29	787466	269	211,828,354	650
Remaining IRR (parks, grounds, open space, flower displays, etc.)	29	787466	2233	1,758,411,578	5396
Decorative fountains, interactive play fountains				10,000,000	31
Outdoor Pools				48,000,000	147
Total All Sources Water Budget No Drought				**2,343,226,332**	**7191**

Option 1: 15% overall reduction					
Athletic fields no reduction	29	787466	400	314,986,400	967
Med/Parkway 30% reduction	20.3	551226	649	357,745,804	1098
Remaining IRR 28% reduction	20.88	566976	2233	1,266,056,336	3885
Decorative fountains, play fountains; 50% reduction				5,000,000	15
Outdoor Pools-open, no reduction				48,000,000	147
Total All Sources Water Budget Option 1				**1,991,788,540**	**6113**
Option 2: 30% overall reduction					
Athletic fields 20% reduction	23.2	629973	400	251,989,120	773
Med/Parkway 45% reduction	15.95	433106	649	281,085,989	863
Remaining IRR- 40% reduction	17.4	472480	2233	1,055,046,947	3238
Decorative fountains, play fountains; 60% reduction				4,000,000	12
Outdoor Pools-open, no reduction				48,000,000	147
Total All Sources Water Budget Option 2				**1,640,122,056**	**5033**
Option 3: 35% overall reduction					
Athletic fields 20% reduction	23.2	629973	400	251,989,120	773
Med/Parkway 50% reduction	14.5	393733	649	255,532,717	784
Remaining IRR- 45% reduction	15.95	433106	2233	967,126,368	2968
Decorative fountains off, play fountains on				1,000,000	3

Outdoor Pools-open				48,000,000	147
Total All Sources Water Budget Option 3				**1,523,648,205**	**4676**
Option 4: 85% overall reduction*					
Athletic fields 35% reduction	18.85	511853	400	204,741,160	628
Med/Parkway 95% reduction	1.45	39373	649	25,553,272	78
Remaining IRR 95% reduction	1.45	39373	2233	87,920,579	270
Decorative fountains, play fountains off	0	0	0	-	0
Outdoor Pools-open 30% reduction				33,600,000	103
Total All Sources Water Budget Option 4				**351,815,011**	**1080**

Notes:

*This scenario is for outdoor use only; indoor pools and recreation center use is excluded

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EXHIBIT A CONTINUED: Possible DPR drought response based on water shortage scenarios

RESPONSE	No Drought	Option 1	Option 2	Option 3	Option 4
Water Plan Athletic Fields	Full weather-adjusted budget, no waste.	No reduction	20% reduction. May shorten season or close fields	20% reduction. May shorten season or close fields	35% reduction. May shorten season or close fields
Water Plan Flower Displays: Part of Medians and Park IRR	Full weather-adjusted budget, no waste. 100% planted.	Determined individual basis	Determined individual basis	Determined individual basis	No planting
Water Plan Medians/ Parkways	Full weather-adjusted budget, no waste.	Reduce by 30%	Reduce by 45%	Reduce by 50%	Reduce by 85% No potable water
Water Plan Remaining Parks	Full weather-adjusted budget, no waste	Reduce by 28%	Reduce by 40%	Reduce by 45%	Reduce by 85% No potable water
Trees– irrigated by Median-Parks systems	Watered by irrigation systems, full budget	Reduce per Median and Parks	Reduce Median/Parks, trucked supplement with Reuse	Reduce per Median/Parks, trucked supplement with Reuse	Manual irrigation with Reuse
Fountains: Decorative and interactive play	On normal schedule	50% red.; all play fountains on*	60% red. ; all play fountains on*	No decorative, only recirculating play*	No water
Pools (outdoor):	Open normal schedule	Open normal schedule	Open normal schedule	Open, may have shortened season or daily schedule	Open; some closed or shortened season or daily schedule
Native Areas	Water as needed	Tree Bubbler zones only per median/park schedule	No Irrigation	No Irrigation	No Irrigation
Special Use: City Center, etc.	Full weather-adjusted budget, no waste	10% weather adjusted budget, no waste	15% weather adjusted budget, no waste	20% weather adjusted budget, no waste	No Water
Establishment	Yes – Denver Water permit/signage during Summer	Yes – Denver Water permit/signage during Summer	Spring/fall turf and seed establishment only	No new establishment	No new establishment
Reuse and City Ditch	868 Acres, full budget, no waste	No reduction, per Reuse availability	No reduction, per Reuse availability	No reduction, per Reuse availability	No reduction, per Reuse availability

* Budget allowance for startup and shutdown of all fountains for maintenance purposes.

Golf Water Conservation Plan

Declaration of Policy and Purpose

Denver Parks & Recreation through Denver Golf (Denver Golf) provides an exceptional public golf experience at a fair price. Water conservation is an integral part of our culture and we strive to continually improve our efficiencies through technology and innovation. As a result, Denver Golf courses consistently use about 20% less water than a bluegrass lawn.

The purpose of the Drought Response Plan (The Plan) is to forecast and quantify additional water conservation measures to meet the mandatory reductions set by Denver Water. Denver Water through their Board of Water Commissioners is responsible for the initiation and termination of drought response stages for their customers. Denver Golf's Plan relies on Denver Water's triggering criteria set forth in Denver Water's 2016 Drought Response Plan.

Scope

Denver municipal golf course properties include seven golf facilities with 120 golf holes, encompassing about 913 acres, of which 730 are irrigated. Annually, Denver Golf places about 120 acres into conservation which are lands are set aside with minimal or no inputs from pesticides, fertilizers or water.

Denver Golf courses include City Park, Evergreen, Harvard Gulch, John F. Kennedy, Overland Park, Wellshire and Willis Case. These courses use a variety of irrigation water sources including: effluent, raw, potable, well, and ditch. Evergreen golf course's irrigation supply is not managed by Denver Water, so is excluded from The Plan in calculating drought response.

City Park Golf Course uses recycled water for its irrigation water supply and may have different conservation requirements during a drought. Recycled water is reuse water that is not treated sufficiently to be returned to the stream system. Golf courses and parkland using effluent water for irrigation act as the final treatment stage for that is otherwise unavailable for human consumption. Water developed from the Western Slope may be used to exhaustion and may positively influence the availability of recycled water during a drought. Therefore, The Plan excludes City Park's recycled irrigation water in calculating drought response.

Denver Golf employs a wide variety of sources and methods of metering. Some irrigation pump stations may show a difference in gallons pumped from what's reported by well metering systems. Without an extensive study of precipitation, evaporation and leaching, reliable data would be impossible to generate at facilities using storage ponds for irrigation water. Therefore, depending on the source of irrigation water, a combination of the following tools will be used to meter irrigation water use:

- Denver Water meters at potable water taps
- Denver Water meters at wells
- Golf Course central irrigation computer records
- Golf Course irrigation pump station records

To ensure consistency, the same measuring devices used to establish the 2016 use levels will be the same measuring standard for future conservation. Where multiple meters are available, data will be available from all sources.

Denver Golf also looks at more than one data point to determine irrigation water requirements. This simulated use and reduction model confirms the close correlation to Denver Golf actuals and simulated plant requirement and conservation through drought restrictions.

Data is collected by golf course Superintendents daily from the pump station and central control. During non-drought times, the data is reposted to an electronic share drive monthly, but in the event of a drought and dependent on the drought stage, we would require this information to be collected daily if needed.

EXHIBIT B: GOLF WATER SHORTAGE RESPONSE PLAN

Year	Location	Propety Acreage	Conservation Acreage	Impermeable	Water body Acreage	Irr Acres	Bluegrass Est. Irrigation @ 18 gal/ft2	2016 Use	Drought Watch 10% Reduction	Drought Watch Savings	Stage 1 20% Reduction	Stage 1 Savings	Stage 2 35% Reduction	Stage 2 Savings	Stage 3 99% Reduction	Stage 3 Savings
2016	City Park	139	10	3	3	123	96,441,840	95,259,780	85,733,802	9,525,978	76,207,824	19,051,956	61,918,857	33,340,923	952,598	94,307,182
2016	Evergreen	91	22	3	1	65	50,965,200	20,162,000	18,145,800	2,016,200	16,129,600	4,032,400	13,105,300	7,056,700	201,620	19,960,380
2016	Harvard	13	0	1	1	12	9,016,920	5,630,500	5,067,450	563,050	4,504,400	1,126,100	3,659,825	1,970,675	56,305	5,574,195
2016	Kennedy	277	50	4	11	212	166,224,960	150,119,282	135,107,354	15,011,928	120,095,426	30,023,856	97,577,533	52,541,749	1,501,193	148,618,089
2016	Overland	140	23	4	1	112	87,816,960	72,348,420	65,113,578	7,234,842	57,878,736	14,469,684	47,026,473	25,321,947	723,484	71,624,936
2016	Wellshire	134	20	5	13	96	75,271,680	42,598,148	38,338,333	4,259,815	34,078,518	8,519,630	27,688,796	14,909,352	425,981	42,172,167
2016	Willis Case	119	11	2	0	106	83,112,480	69,397,392	62,457,653	6,939,739	55,517,914	13,879,478	45,108,305	24,289,087	693,974	68,703,418
	Totals	**913**	**136**	**16**	**26**	**538**	**421,443,000**	**340,093,742**	**306,084,372**	**34,009,370**	**272,074,994**	**68,018,748**	**221,060,936**	**119,032,806**	**3,400,937**	**336,692,805**

Excerpts from 2016 Design Standard Draft:

Section 5: Irrigation Design Principals

- All new irrigation design and installation must be within manufacturer performance specifications and recommendations for nozzles, flow, pressure, spacing, angle, depth, etc.
- Restrictions on narrow beds and heat islands - Typically, narrow beds are an area less than 8' wide and surrounded on two or more sides by impervious surfaces. These areas are heat islands. More factors may be used to identify a heat island which include but is not limited to: proximity to streets and other impervious surfaces, lack of shade, little or no recreational value, high risk to worker safety to maintain, subject to road salt and debris. Turf and pop-up irrigation are prohibited in heat islands. These areas may be landscaped in a xeric manner or with trees (shade) and only utilizing drip irrigation.
- Hardscapes – if irrigation heads are installed near impervious surfaces such as parking lots, building foundations, pavers, sidewalks, roads, etc., the head must be installed no closer than 4" from hardscape and irrigation directed away from any hardscape area.

- Water Pressure – In order to achieve optimal water efficiencies, the irrigation system must be designed and operated at a water pressure identified by the manufacturer that achieves optimal distribution for that head, nozzle, and spacing. Methods to achieve this include flow control valves, pressure regulators, pressure reducers (dramatic changes in elevation) etc.

Section 6: Irrigation Technology and Control Systems

- Central Control – current standard is Toro Lynx operating system and peripherals.
- Must be remotely accessible via internet
- Must provide three portable tablet type weather resistant devices for golf course use – adjustments and operations can be controlled remotely or in the field with tablets.
- Must be set up to water in inches NOT minutes.
- All new installs must provide service and support through NSN for five years. Contractor is responsible for all daily data entry during construction.
- Must be linked via radio or cellular to receive pump station data in real time. Current standard is Watertronics "Pump Log"
- Field Sensors – current standard is Toro "Turf Guard" for wireless soil moisture monitoring. New construction requirements:
    - One Turf Guard per green. Turf Guard must be GPS located on as-build and flagged/identified in the field until grow-in begins.
    - 9 other Turf Guards located throughout the course at discretion of Superintendent or may be left uninstalled if requested by Superintendent so that the Superintendent can install later.
    - Contractor must install radio repeaters as needed to ensure that any Turf Guard sensor installed on any portion of the golf course is able to communicate with central control.
    - Field Scout – all new construction requires contractor provide that facility with most recent hand-held moisture monitoring device. Current standard is Spectrum Technologies "Field Scout TDR 300".
    - Rain Sensor – all new construction must include a rain sensor to shut down the central control in the event of a rain event. Shut down parameter shall be determined by Superintendent at time of installation and set-up.
- Weather Stations – all new irrigation installations shall include a weather station (if there is one not already at location) which is installed and operational as soon as any portion of the irrigation system is operational. Weather station must communicate with central control. Data provide by weather station must be placed in an area that provides representation of irrigated turf. All new weather stations must be wireless and solar powered. Weather station must be able to report daily ET rates. Current standard is Campbell Scientific.

Excerpts from 2017 Golf Maintenance Standards

1.8 IRRIGATION SYSTEM

Includes pump station, control panels, satellites, underground wiring, connections, pipe, fittings, heads, valves, computer, and remote control devises.
Under normal growing conditions, total Gallons used per season for entire irrigated acreage shall not exceed 15 gallons per square foot.

- **Leaks –** repaired and surrounding area leveled and sod replaced to grade within 24 hours of the leak. Holes that are left open and unattended must be marked and covered so that golfers or trespassers aren't at risk.
- **Level –** heads, valves, and trenches to the surrounding grade. Heads and valves are not level if they are more than 1" below or above ¼" the surrounding grade.
- **Scheduling –** Irrigation priority is Greens, Tees, Fairways, Approaches and then Rough. Irrigation times utilize start/stop schedules for maximum soil penetration with no puddles or runoff.
- **Pump Station –** is maintained annually and repaired by a qualified outside contractor. The Superintendent is responsible for routine maintenance and oversight of proper pump station operation and can determine cause of basic faults and can identify maintenance issues requiring outside help. The Superintendent is required to operate the irrigation system within the capacity of the pump station and in a manner that does not "water hammer" or exceed pipe velocities. The pump station is operated in a manner that reduces energy consumption and minimizes the "energy ratchet". Superintendent should be aware of sediment in wet well and schedule clean out accordingly to avoid unnecessary damage to irrigation system.

- **Lightning / Storms** – Within 12 hours after a storm, systems are checked via computer, satellite, and visually for communication and grounding problems.
- **Audit** – Minimum of one yearly audit of irrigation system is required. Visual checks during daily routine of running irrigation heads are conducted to insure proper rotation, part circle adjustment, pressure, coverage, and nozzle wear or plugging.
- **Golfer experience** – moisture levels adequate on all areas to achieve healthy turf while providing a firm and fair golfing experience. Saturated soils or hardpan playing surfaces are not acceptable. We are providing a golf experience for the general public. U.S. Open conditions are not valued here. Turf health, playability, aesthetics and water conservation are all values that must coexist in the final product. A wooden golf tee should be easily placed into any playing surface.

For additional information refer to:
Golf's 2016 Design Standards and 2017 Golf Maintenance Standards

Parks Irrigation Technology

Denver Parks and Recreation (DPR) manages irrigation systems that provide water to nearly 3,000 acres of parks, medians and parkways. DPR added an additional 400 acres in 2017 and in recent years, has received approx. $700,000 in annual funding through the Capital Improvement Program (CIP). As of 2017, funding levels were at $965,000 which is insufficient to maintain sustainable infrastructure.

According to the City and County of Denver Infrastructure Analysis (Jacobs, Feb 2017) the present value (PrV) of the entire system is $169,390,000 and a 20-year life replacement cycle was recommended. The study found 18% of the systems were in poor condition with an additional 5% in very poor condition. It should be noted that irrigation system data was based on a 2012 assessment with some updates between 2013 and 2015, and did not include whether systems are following standards. DPR would need to increase annual CIP funding to $8,067,150 annually to allow the Department to achieve total compliance with irrigation standards. The study also recommended:

- Install central control with all new and renovated systems
- Assess all mainlines more than 25-30 years old, planning to replace all non-PVC piping with PVC composition
- All systems should use best design practices and avoid pump stations when possible
- Continue to partner with Denver Water and strive toward water conservation and sustainability
- Devise a rating system that accounts for system condition and compliance to standards
    - Current irrigation condition rating system does not consider whether the system is meeting standards

DPR standards and specifications require water conservation irrigation equipment for new and upgraded parks. In 2010, the Central Control Master Plan (CCMP) selected Toro Sentinel Controllers with flow sensing as the DPR standard and outlined a five-year implementation plan to bring all systems on central control. Funding constraints have not allowed DPR to meet the 5-year schedule—as of April 2017, approx. 35-40% of DPR irrigation is on central control. Central control systems installed prior to 2010 do not have flow-sensing capabilities.

Bonds can provide additional funds for irrigation improvements. The Better Denver Bond passed by Denver voters in 2007 provided $17+ million in irrigation improvements for systems and infrastructure components that were past their useful life. Denver voters again chose to invest in the city's infrastructure (including irrigation systems) with the 2017 Go Bond ballot initiative which includes more than $5 million for irrigation improvements.

DPR and Denver Water will explore other methods to gain the support for necessary upgrades, including an update to the irrigation infrastructure assessment to provide a more accurate estimate of irrigation needs and priorities.

Parks Water Management Operations

GIS Data

Approximately 58% (2,902 acres) of Denver's parkland (including parkways, medians, right-of-way, etc. but excluding mountain parks) are irrigated. The exact irrigated area for every site is known through GIS data analysis and staff's input of irrigation boundaries. Additional data related to water conservation is available for staff's use in the Parks GIS Irrigation layer: controller, meter, pump and backflow data; water budget and past annual consumptions; park type, class, service level and water type.

Water Use and Water Cost Reporting

Denver Parks and Recreation (DPR) and Denver Water have worked together to sync GIS data layers. DPR provides park boundary, irrigated areas and backflow data to Denver Water, enabling them to accurately generate a monthly water use and cost report. Denver Water has committed to produce these reports monthly and send them directly to DPR staff. By combining park boundary information with tap and meter data, the reports will show two levels of resolution:

- Level 1 – Water use and water charges per connection point (tap/meter)
- Level 2 – Rolled up water use and water charges per park boundary

DPR and Denver Water will update GIS data each year to maintain report accuracy. A future goal is to report water use by landscape typology. See Exhibit B: 2016 Water Use and Water Cost report.

DPR Water Budgeting and Reporting

Fiscal annual water budgeting is based on a full 29-inch (18 GPSF) water budget for irrigated acres. The irrigation season is generally April 15-October 15, but weather conditions may require irrigation outside that window, especially on permitted playing fields and other high-use areas.

In April each year, Parks Water Conservation and Parks Administration determine water budgets for irrigation of those areas that are managed by DPR. The primary focus throughout the season is to irrigate to IWR (irrigation water requirement), maintaining plant health with water as needed. Throughout the season, water budgets may be adjusted based on weather conditions such as drought or extended irrigation season.

Water Conservation provides water targets to all staff involved with water management, indicating annual budgets by district and location. Central control sites with flow sensing capabilities receive a maximum water budget of 25.5 inches (15.9 gal/sf) per Denver Water/Parks IGA, and sites without flow sensing receive a maximum budget of 30 inches.

Water Management Consumption Reporting is provided to district staff monthly using the consumption provided for billing by Denver Water. The reports include YTD consumption by location (LOC) in inches used, and the current percentage of the budget target used. A chart is also provided, with graphics showing the YTD irrigation consumption by LOC and color-coded by month. The current IWR is calculated and shown on the chart below as a guideline. The report also includes a summary of general irrigation for Operations and Superintendent Districts.

Currently, consumption is provided at the time of billing, but meters are read in batches during the prior month, up to four weeks prior to billing. There is additional delay of 3-5 days to receive and process the report. These delays can be critical for irrigation management during summer and fall. A future goal is to work with Denver Water to shorten delays in consumption reporting, especially during drought periods, by sending consumption reports in batches as they are read, so that DPR can report consumption to staff quicker.

Below is an example of Water Management Consumption Reporting. Segments show YTD consumption data compared to the original s water budget target. The corresponding chart indicates the current Irrigation Water Requirement (IRW, purple bar) and the year to date consumption, coded by the month of use.

Name	District	Class	YTD Cons	IrrigAc	28 In/ac Target	Inches Used	% of Target Used	Park Type	Water Type	Shop	LOC
Babi-Yar	East	Community	5174	9.3	4740	30.5	109.2%	Park	Potable	Yale	601
Ash Grove	East	Neighborhood	3407	7.5	5737	16.7	59.4%	Park	Potable	Crestmoor	751
Alamo Placita	East	Neighborhood	3023	5.2	3941	21.5	76.7%	Park	Potable	Congress	301
6th & Josephine	East	Median	169	0.1	96	49.6	176.8%	Median	Potable	Congress	344
Cheesman	East	Regional	49489	77.5	58998	23.5	83.9%	Park	Reuse	Congress	312
Denison	East	Neighborhood	1604	2.4	1826	24.6	87.8%	Park	Reuse	Crestmoor	458
Congress	East	Community	9202	14.5	11030	23.4	83.4%	Park	Reuse	Congress	314
Garland	East	Community	20026	47.5	36207	15.5	55.3%	Park	Raw-Well	Crestmoor	728
Cherry Creek	East	Neighborhood	8925	6.4	3777	51.0	236.3%	Park	Raw-Well	Congress	330
Burns	East	Neighborhood	9866	13.0	9887	28.0	99.8%	Park	Raw-Well	Crestmoor	418

Follow-Up on Consumption Issues

Excessive consumption or low-no consumption is apparent with this method of reporting, so operations staff can investigate if a problem occurs. For sites without flow sensing capability, staff can use handheld meter readers or observe the “tattle tale” register on the meter to determine if flow occurs when systems are scheduled to be off. Causes may be irrigation scheduling or field equipment issues, but consumption anomalies can also be related to meter reading errors. “Catch up” billings or credits and billing errors may also skew consumption numbers. Investigation of no-consumption reports is vital to avoid unexpected bills and scheduling problems which may result in plant loss. Water Conservation may ask staff to report back on significant consumption issues.

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311 Calls and After-Hours Irrigation Complaint Resolution Process

The City of Denver provides online mobile site, Pocketgov.com, and phone access to the 311 Call Center for citizen reporting of water conservation issues such as irrigation leaks. Once received, the report is logged into the 311 data base and routed to the appropriate District for resolution. For afterhours reports, the Parks after-hours water emergency line (manned by Parks staff) is called, and the Operations District is then notified. Extreme water loss (such as a broken mainline) and issues of high visibility or safety (such as a geyser on a median flowing into traffic) are attended to immediately. All other water-related complaints are assigned to staff for investigation during the work shift. After resolution, the District Staff logs resolution with the 311 Call Center. Reports can be made regarding complaints, and included in annual follow-up on the Water Plan. It is DPR's goal to resolve irrigation related issues within the following timeframe 98% of the time:

- **Mainline and high visibility/safety issues:** Water shutdown 24 hours; repair before reactivation
- **Broken heads, puddling:** investigation within 24 hours; repair within three (3) business days.
- **Issues related to scheduling/daytime watering/rain/establishment:** investigation within 48 hours; repairs/modifications as needed within 72 hours.

Denver Water will route all concerns directly to DPR through the 311 system.

Water Management and Scheduling

DPR schedules irrigation to adequately and completely irrigate all sites within a three-day, eight-hour water window. Sites with undersized taps or under establishment are exceptions. Normally, DPR does not activate systems until May (athletic fields frequently begin operation earlier). Staff are instructed to program controller run times based on a peak season, with seasonal adjustments based on historic ET. The program is fine-tuned based on observed site conditions and weather so that sites are irrigated to IWR and plant health requirements. Rain shutdown is required. Heavily used sites such as playing fields will often require longer run times. Multiple start times are programmed to control runoff.

Seasonal Adjustment of System Run Time		
Month	Hist. ET/WK	% of Peak Season
May	1.30	79%
June	1.55	94%
July	1.64	100%
Aug	1.33	81%
Sept	1.04	63%
Oct*	0.72	44%

Central Control is a significant water management tool, with industry estimates of water savings at 15 – 30%. Savings from central control are more significant when installed in conjunction with new and improved irrigation technologies, and operated by trained personnel.

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DPR's Central Control Master Plan (CCMP) guides DPR's buildout of the Central Control system. It has been a DPR standard since 2011 to install central control with flow-sensing, and to upgrade irrigation on all sites where projects involve a significant area of work. This requirement stands not only for parks planning projects, but also for projects by other city agencies such as Public Works, Urban Drainage, Wastewater, etc. DPR has a Standard Operating Procedure identifying protocol for using Central Control.

Field Operations Maintenance

See also, Parks Maintenance Standards:

- Prior to the start of the season, a preventive maintenance check is performed on controllers
- Ohms testing of field wiring is performed/compared to previous readings to detect developing wiring problems
- Visual inspections are performed at the time of startup, and periodically thereafter
- Routine repairs are made to eliminate water waste
- Audits for system efficiency should be performed once every 5 years, but staffing levels do not allow this function to happen routinely

Water Management Training

DPR's Water Conservation group provides a minimum of three training sessions per year for Central Control programming and trouble-shooting, customized to the level of user experience. Training topics also cover electrical and system trouble-shooting, scheduling, preventive maintenance, system hydraulics, city GIS, and other topics. Water Conservation also provides on-site training, programming help, and trouble-shooting assistance with emphasis on staff involvement and self-sufficiency.

Training related to water management is also provided for Planning and Superintendents on topics such as establishment watering, water budgeting, and water tap applications. DPR field staff are cross-trained in maintenance tasks, including irrigation. This helps to keep all available eyes alert to irrigation problems. Training for all new employees, on-call and seasonal employees is presented during orientation presentations each spring, with emphasis on educating staff to identify potential irrigation problems and reporting them to supervisors.

Weather and IWR Reporting

Water Conservation provides weather data including year-to-date precipitation and ET, along with comparison to 30-Year normal and previous years, and IRW during the season. DPR relies heavily on Denver Water for ET and precipitation data to provide staff with current IWR. Water Conservation supplies staff with intermittent reports from the Urban Drainage Flood Control District after significant rain events showing precipitation in various locations of the City. These reports help staff make scheduling decisions about the sites they manage.

Water Conservation Design Guidelines for New and Retrofitted Parks, Parkways and Medians

Intent

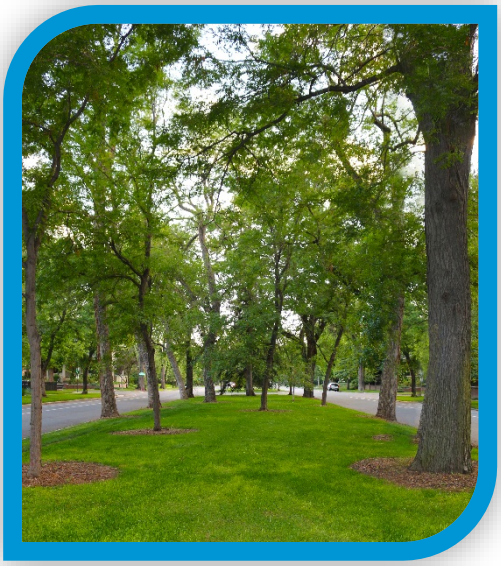
Create new and retrofitted park design standards and horticulture renovation standards geared toward water efficient design that will better respond to drought conditions, preserving natural resources and park assets. Guidelines include:

- Environmental sustainability will govern the planning, management, design and maintenance of public spaces within the City of Denver, as stated in The Game Plan.
- Changes in operations and design are intended to improve water conservation, water quality, and broaden park landscapes in existing parks. They will affirm the mission/goals of The Game Plan while respecting traditional Denver park design and natural history. Operational and design changes in our parks will be an opportunity for DPR to be an example to Denver residents.

Concept Design

The master planning process for new parkland and renovation of existing parks is a multi-step process that begins with concept design. Site Assessments first collect important data about a site and drive the concept design:

- Water availability and type: Non-potable water (reuse or raw water) is used where possible to ease the strain on potable water supply. If a site does not have access to non-potable water but the possibility of future build-out of exists, consideration is made for inclusion of non-potable infrastructure.
- Water supply: When reuse, greywater or storm water will be used as a water sources, it will be essential to consider how adaptable existing plants and new plants are for landscape sustainability. Additional site assessment factors for reuse water must also be considered. See: Parks Reuse Site Evaluation Checklist.
- Existing Conditions: verified with onsite visits and surveyed with minimal requirements including:
    - Existing topography
    - Current use (play fields, passive recreation, etc.)
    - Location of utilities
    - Location and protection of remnant native plant communities and wildlife habitat
    - Plant inventory and protection
    - Identify potential planting locations based on site features.
    - Property protection
    - Trail protection/detour
    - Erosion control
    - Site layout
    - Contamination



- Soil conditions: Soil plays a significant role in plant health and water conservation. Composition, percolation rate and nutrient levels affect root depth, which factors into the plant's ability to withstand variable conditions and can reduce the need for frequent irrigation. Pre-construction testing and analysis is required on the existing soil on-site along with imported topsoil and pre-amended imported soil, and is done with the following guidelines:
    - Collect a minimum of five (5) soil test samples from areas that will receive similar soil preparation (including sod, native seeding, planting beds and gardens) for projects up to one (1) acre, and one (1) additional sample for each additional acre of project size
    - Soil testing must identify the soil texture and classification. Fertility testing needs to include at a minimum percentage of organic matter, PH, and existing level of salts in the soils and any other tests that will assist in creating a beneficial environment for plants in which to thrive
    - Soil tests should also determine if there are any deleterious materials on site that could be harmful to plant growth
    - The design documents shall include recommendations for soil treatments, fertilization, amendments, and conditioners to be incorporated to produce a healthy soil for plant growth. See also DPR Specifications Seed and Turf

Intended Site Use

Intended use of a site is an important factor in determining design. Active, Passive, Active Xeric or Passive Xeric areas require differing plant palettes and have differing irrigation needs. Planted areas should utilize plant palettes that require the least amount of water for the specific use. Athletic fields and permitted open turf require the highest use of water to maintain health and vigor.
Passive areas should be designed to require the least amount of water possible.

Active use includes:

- Athletic fields
- Planting beds/community gardens
- Play features
- Facilities (buildings, parking, etc.)
- Open turf – permittable
- Trail/hardscape

Passive use includes:

- Open turf non-permitted – acceptable quality can be maintained with less water.
    - New or redeveloped sites should be designed with reduced water turf types.
- Native area – dryland species should be used with little or no irrigation after establishment.
- Medians/Right-Of-Way – see Median/Horticulture Guidelines

In existing parks identify future areas to be converted to native grass, those areas should not be under planted with trees.

Identifying Proposed Typologies/Habitat Types

See definitions in Glossary of Terms:

- Upland
- Riparian
- Hydrologic
- Traditional park spaces
- Developed areas

Site Grading and Drainage:

- Provide water to meet irrigation demands
- Provide for opportunities to keep water on site where possible to implement water quality and green infrastructure
- Maintain existing on-site topsoil and to be reused
- All park projects shall direct drainage away from buildings, electrical
- Enclosures and parks structures and comply with ADA requirements

Plant selection considerations are based on the following:

- Hydro-zones
- Micro-climates
- Solar Aspects
- Soil types
- Landscape typology
- Water source
- Education – Identify opportunities for education using interpretive signs

Design Process and Guidelines

The design process develops the Concept Plan into a detailed document for implementation.

1) Hardscape/Gathering Areas/Non-Permeable Areas
   a) Divert water to water quality areas
   b) Courts, plazas, synthetic turf fields, playgrounds – drain to low lying areas to be used for green infrastructure and water quality needs
   c) Roads and parking areas– drain park roads and parking areas to water quality and green infrastructure

d) Spray pads/pools– where possible, plan recirculating systems; for non-recirculating systems, divert water into water quality and green infrastructure areas to be used for plants

2) Turf Areas
   a) Turf areas should be a minimum of 8' wide, anything less should be evaluated for consideration of a moderate or low hydro-zone
   b) Active areas to be bluegrass turf
   c) Passive areas need to consider the use of low water turf alternatives
   d) Parks being considered for conversion to non-potable water should reference the Denver Parks and Recreation Reuse Conversion Site Evaluation
3) Plantings (Trees, Shrubs, Groundcovers)
   a) Layout - group by hydro-zone and landscape features should be used to make irrigation more efficient and protect plant assets
      i) Plant locations and spacing shall permit normal plant development without undue crowding or trimming
      ii) Conversions around high value trees should be avoided or a mitigation plan should be developed to protect the plantings
   b) Selection – Utilize appropriate hydro-zone for specific site use and conditions
      i) Plants should be selected based on specific hydro-zones and water budgets
   c) Consult with DPR horticulture and forestry staff for appropriate plant selections
      i) Utilize native plant materials and lowest water hydro-zone whenever possible
   d) Water source considerations– consult with DPR Horticulture and Forestry staff for appropriate plant selections based on the water source
      i) Non-potable water can have detrimental effects on some plants due to higher salt content in the water
      ii) When a conversion to non-potable water is being considered or being implemented, care needs to be taken to avoid spray onto trees that are susceptible to salts

HYDRO-ZONE CHART			
WATER USE CATEGORY	ANNUAL IRRIGATION REQUIREMENT		PLANTING EXAMPLE
High	> 25"	> 16 Gal/SF	Bluegrass/Fescue Turf
Moderate	15" - 25"	10 - 16 Gal/SF	Many trees/shrubs/perennials
Low	7" - 15"	5 - 10 Gal/SF	Xeric, many shrubs/trees/grasses
Very Low	0" TO 7"	0 - G/SF	Xeric, native grasses, shrubs, trees

4) Native Areas

5) Medians
   a) Planting beds shall be a minimum width of 5'. Anything less shall not be planted
   b) Design should be low-water or moderate hydro-zone requirements, or as required to protect existing plants that will remain

c) Provide opportunities for water quality and green infrastructures in medians

6) ROW Landscapes
   a) Design to be a minimum of 8' wide landscape areas when possible
   b) Design to be low water or moderate hydro-zone requirements where possible
   c) Provide opportunities for water quality and green infrastructures in ROW landscapes

7) Soil Preparation
   a) Per Parks Specifications and soil test reports

8) Irrigation Design – See Specifications and Details
   a) Potable water
   b) Non-potable water

9) Maintenance Considerations
   a) Install high-maintenance/need plant materials close to maintenance access to minimize labor requirements
   b) Group plants by hydro-zones and maintenance needs to allow for efficient irrigation zoning

10) Existing – High value existing planting shall be preserved whenever possible
   a) With Operations and Forestry, evaluate the value and lifespan of the existing plant
   b) Develop a watering schedule based on preservation of existing plants and establishment of new plantings

Irrigation Design for Water Conservation and Drought Management

Intent

Parks Irrigation System Standards are developed and updated annually. Standards will:

- Embrace new irrigation technologies that are cost-effective, maintainable, and reduce current water usage
- Respect long-held irrigation design integrity principles regarding tap sizing, system hydraulics, velocities, etc.
- Reduce man-hours of irrigation renovation of existing systems for maintenance personnel who are already over-taxed
- Be based upon cutting-edge, proven irrigation technologies to reduce possibility of short-lived technologies
- Support creation of water-efficient design to better respond to drought conditions and preserve natural resources and park assets

Supporting Planning Documents (See Also):

- DPR Planning Design & construction Standards
- DPR Specifications for Irrigation (Sec 328000)
- DPR Specifications for Irrigation Controllers (Sec328433)

Design Strategies

- Hydro-zone map drives the irrigation design
    - Plan can help identify possible future conversion areas
    - System is zoned to separate hydro-zones and future conversion areas
    - The system should also be zoned by uses so that active areas can be irrigated separately from passive areas which will also facilitate drought prioritization of water use
- Water budgets required with new planning by tap area, indicating water needs based on DPR' water window, hydro-zones, acreages, and historical ET
- Taps must be sized to accommodate an 8-hour/3-day a week water window. Reuse sites may require a shorter water window
- Irrigation Equipment Schedule charting zone#, type and size of valve, head and nozzle, zone GPM and PSI is to be provided with planning. It is then compared to actual installation GPM for controller programming purposes
- Pressure loss calculations are provided at design to analyze system losses and guarantee hydraulic performance
- Base the irrigation design on the mature landscape
- Zones separate from seed irrigation must be provided for trees in native seed areas.
- Central Control with flow sensing is Parks' standard
- Use of 2-wire systems is Parks' standard for new or renovated systems
- A site must be brought up to Parks irrigation standards if construction involves 30% or more of irrigated areas

IRRIGATION DESIGN & EFFICIENCY		
Irrigation Application by Type of Zone	Distribution Uniformity (DU)	Scheduling Coefficient (SC)
Fixed Spray	65%	1.4 or less
General Rotor Zone	70%	1.3 or less
Athletic Field Rotor Zone	75%	1.2 or less
Drip/Micro	80%	1.2 or less
Dist. Uniformity (DU_{LQ}: Measure of how evenly water is applied across the lowest quarter of catch-cans in an irrigated area		
Scheduling Coefficient (SC): Defines how big the critical dry area will be and irrigation run time required to alleviate the dry area		

Irrigation Design and Efficiency Practices

- Systems may not be looped between two taps
- Use gear rotors when possible (best DU)
- Use heads with check valves to keep water in lateral lines and stop low-head drainage, using in-line check valves where elevations vary beyond 10 ft. This will reduce end-of-run water seepage
- Use pressure-reducing valves on mainline or PRV features on automatic valves and/or heads as required (when line pressure exceeds manufacturers recommended pressure at head by 10 PSI)
- Avoid placing mainline valves and wiring within ROW and easements when possible
- Avoid placement of mainlines and valve boxes adjacent to trails, swales, or areas maintenance vehicles may travel
- Use applications with low precipitation rates on slopes and in native areas where erosion is a significant problem
- Zone crowns and upper slopes separate from the lower slope drainage areas
- Zone Athletic fields with areas of high wear-and-tear separately from other zones
- Do not place mainlines below field playing areas, playgrounds, or within community gardens
  Do not place valve boxes within the footprint of these areas
- Reduce head spacing: maximum should equal no more than 100% of recommended radius throw in bluegrass turf areas. Head spacing may be greater in areas with native seeding
- Sub-surface irrigation is required for planting beds or medians with dimensions of less than 8 ft.
  In such small areas, low precipitation nozzles may be utilized
  No irrigation is allowed if dimension of area is less than 5'
- All irrigation installation and repair must adhere to (IPC) International Plumbing Code and (ASSE) American Society of Sanitary Engineering Standards or (ABPA) American Backflow Prevention Association Standards, per the State of Colorado
- Central control field unit locations must be signal tested and model specified prior to 90% irrigation planning.

Plan Review

Irrigation plan review at all phases of design will help reduce costs, improve system efficiency, and reduce water. In addition to Planning review of systems, Water Conservation will provide review for water conservation equipment, approved product review, water budgets, tap sizing and other water conservation related factors. Planning and Water Conservation should update the Parks approved product list annually.

Staff Training and Construction Oversight

In addition to well-planned design, ensuring expert installation and use of water conservation equipment is essential. DPR plans to:

- Educate staff on new irrigation standards and details
- Establish staff buy-in for new irrigation technology through use of product trials, audits, and product demonstrations
- Help develop in-house expertise in understanding good irrigation design and maintenance
- Provide contractor management to assure standards and specifications are met
- Establish Central Control set up and use protocols to standardize use, to best use product water conservation features, and so that movement of staff between districts requires less training.

Goals:

1. Develop improved contractor guidance and oversight of scheduling during the establishment process to reduce water waste and improve plant survival rates.

2. Planning and Water Conservation should update the DPR approved product list annually.

3. New irrigation products and technologies that may improve water conservation should be evaluated through product trials.

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Horticulture Renovation & Greenhouse

Traditional annual flower displays in Denver Parks and Recreation (DPR) parks and medians are highly valued by Denver residents. Many horticulture areas also provide shrub beds. Approximately 11.5 irrigated acres of parkland in Denver are planted as horticultural displays. DPR recognizes these areas provide an opportunity to reduce water demand and provides examples of attractive and practical reduced-water plantings. A continued emphasis is placed on planting water-conserving perennials and shrubs rather than annuals in appropriate locations, with water systems that are zoned and programmed independently of turf areas. See also: Parks Horticulture Standards.

DPR faces challenges when replacing traditional plants with low-water plant materials:

- Protection of the urban forest is a high priority and many horticulture areas have existing trees with higher water demand which may be damaged by reduced irrigation
- Some historical displays (ex. rose gardens) would not be suitable for conversion to reduced water
- Several parkways are designated as City/National Historic Parkways, making their landscapes highly protected from change
- Renovation is expensive—demolition of existing mature landscape in medians or right-of-way locations require additional traffic control expenses
- Current standards require separate irrigation zones for flower displays/shrub beds from turf—most areas added/renovated in the last 8-10 years comply, but many older horticulture areas do not, and wiring/controller space required for separate zones is often not available
- Continuing staff education on maintenance and irrigation of Xeric plantings is needed— reduced-water planting maintenance is different than conventional landscapes

Median Renovation Program

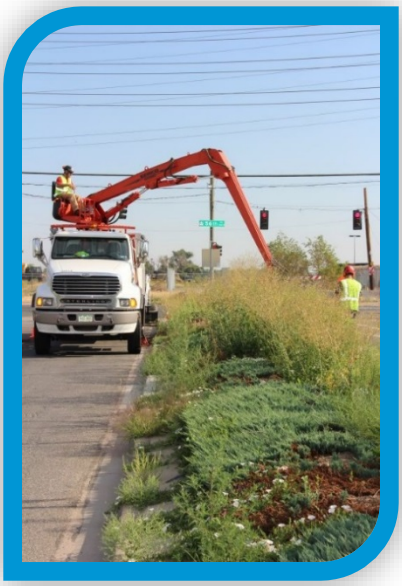
Median renovations are currently the focus of horticulture renovation. Budget Management Office (BMO) reports estimated that 70% of medians need renovation. As funding permits, medians are evaluated and renovated to reduced-water plantings and more efficient irrigation. DPR has approximately 72 miles of medians and parkways; 269 acres are irrigated.

The Median Renovation program is in its fourth year. Although $250,000 CIP funding is allocated to medians, approximately $200,000 is historically used for median maintenance (DPR has contracted maintenance on many medians) The remainder of that CIP funding varies; $50,000 to $100,000 has been allocated annually for median renovation. That amount may be increased to $200,000 to $250,000 in 2018. Suitable site renovations use a plant palette with a low or moderate hydro-zone, 16 GPSF or less. Water consumption reductions are shown in the table below:

MEDIAN AND HORTICULTURE RENOVATION WATER SAVINGS EXAMPLE Landscape Area: Median, 7 Acres						
Landscape type/ Water Use	Annual Plant Water Requirements	Replacement/ Perennials, grasses	New Plant Water Requirements	Water requirement reduction	Gallons Saved:	Total A/F reduction

Bluegrass turf/ High	30", 18.7 gal/sf	Xeric/ Mod Low	15", 9.3 gal/sf	15", 9.4 gal/sf	2,851,170	8.75
Shrubs/						

Peoria Street Median Renovation—overgrown thistle and bindweed converted to Xeric Plantings



Mayoral 2020 Sustainability Goals

A commitment for the Mayor's Office Sustainable Goals was made in 2015, to be completed by 2020:

1. Create Median Horticulture and Renovation standards based on reduced-water landscaping guidelines, Xeric plant palettes, irrigation, soil improvements, and mulch. DPR's Planning division is currently working on these standards.

2. Convert five to seven (5-7) existing medians with historically high consumptions. Create an in-house irrigation auditing team to identify and provide follow-up data on improvements. 3.53 acres have been completed to date. The locations of these sites are:
    a. Peoria Street (7 median islands | .39 acres): mainly Plant Select upgrades, some irrigation upgrades completed 2015
    b. Quincy Islands (6 median islands | .68 acres): mainly shrub/perennials Plant Select upgrades, some irrigation upgrades completed 2016
    c. E 23rd Ave (York to Colorado Blvd | .4 acres): native grass conversion, upgraded irrigation and plantings completed 2016
    d. Alameda & Colorado Blvd. (2 median islands | .14 acres): irrigation and planting upgrades completed 2017
    e. Colfax & Kalamath (.39 acres): irrigation upgrades completed 2017
    f. S Logan St. (5 medians islands | .6 acres), irrigation upgrades, planting of end caps completed 2017

g. Whittier/Downing St Islands (.93 acres): irrigation and planting upgrades completed 2017

Staff are currently working on taking inventory of all median and parkway sites, with a proposed list of sites scheduled to be available by the end of 2017.

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Greenhouse and Floral Display Drought Management

Below are guidelines intended for water conservation management during times of extended drought while providing some floral displays across the city (as sufficient irrigation exists). If floral displays are reduced or not planted, a contingency plan is to donate plants already grown so they will not go to waste.

Greenhouse

During a declared drought, DPR will make decisions to plant the approximately 11.5 acres of floral displays based on available water. Some beds are zoned separately from turf irrigation, and some are not, which will factor into decisions. No new flowerbeds will be created during a drought, and no special requests will be honored from other agencies.

Planted Park Beds

The level of drought and water available will determine if any or some flower displays will be planted. If some water is available, the beds that are planted will parallel the overall water budget strategy for DPR, with priorities being:

- Public view/access: Regional/Specialty Parks, historical public interest displays, specialty gardens (rose gardens/monument plantings)
- Displays with water systems zoned and programmed independently
- Drought tolerant and Xeric Demonstration Beds
- Perennial gardens determined individually
- Annuals evaluated as drought tolerant
- Direct seeding of native wildflowers
- Mulch used where applicable to retain moisture

Unplanted Beds

These beds will be:

- Mulched with woodchips/kept free of vegetation
- Treated to control soil problems (fungus/bacteria/weeds)
- Kept as future beds/not eliminated until further review

Staff and public education

Consistency across the city will be a standard:

Staff training is provided to District Horticulturists annually including on drought tolerant design and maintenance, including proper watering and mulching techniques.
See also Parks Horticulture Standards:

- Denver Botanic Gardens and CSU Extension may be involved in staff training and Xeric Demonstration Beds
- Xeric Demonstration Beds will provide signage and information for the public

- Accurate records regarding acreage and water use will be mandatory (irrigated acres)

Alternative Water Sources

Denver Parks and Recreation (DPR) recognizes that alternate sources of water provide a more sustainable, low cost water supply to irrigate parkland, and that use of alternate water resources will help reduce the city's water costs; reduce pressures on potable water, helping ensure a sustainable supply for Denver residents. DPR is committed to evaluating future potential connections to alternative sources, including raw water (ditches, lakes and wells), reclaimed water and other sources as regulations allow.

Reuse Water

Since 2003, 581 acres of DPR parkland have been converted to reuse water, and an additional 287 acres utilize the City Ditch for irrigation, which is charged with reuse. Thirty-two (32) park locations have been converted to reuse as of January 1, 2017. Veterans Park is slated for conversion in 2018. Stapleton North, currently under construction by a developer, will be converted to reuse and conveyed to DPR in the future. Recycled water will be the preferred water source for newly developed parks and golf courses that are within the Board's recycled water service area.

DPR uses an evaluation checklist of potential conversion sites to identify site conditions, evaluate trees, system layout, and provide consumption data useful for cost-benefit analysis.

Recycled water expansion in Denver's park system has some challenges which affect the current expansion of the reuse system. DPR and Denver Water have learned that the treatment process required to bring reuse water up to quality standards can stress trees and other plant species. Specifically, salinity levels are a concern for conifer species.

Recycled water use in the parks system can be managed to mitigate salinity buildup in soils and plant tissue. In 2016, Denver Water and DPR convened an advisory committee of community members, technical experts and on-staff subject matter experts to review the use of recycled water in Denver parks. The intent was to monitor how recycled water is currently used to better understand impacts on tree and plant health; and to advise on possible improvements, monitoring and testing sites; and explore mitigation and remediation options to protect tree and plant health moving forward.

Another challenge is making the irrigation system modifications and connections necessary to prepare for conversion while mitigating the effects of spray on conifer species. Through the recent IGA between Parks and Denver Water, a three-year funding mechanism for system retrofits is utilized.

DPR is also dependent on Denver Water's infrastructure expansion for future conversions. DPR has identified several sites in the Central Platte Valley, plus new sites currently being developed, but the eventual determination of reuse conversions will be dependent on the outcome of Denver Water's Integrated Resource Plan.

Raw Water

Denver Water has helped DPR identify potential water rights ownership and interests, which were compiled as an inventory. The information contained in the inventory will be used to better understand and maintain water rights. The inventory will continue to be updated as water rights are acquired, sold, changed and decreed, or as additional information becomes available. As required, staff from Denver Water and DPR will evaluate and make recommendations on best use of existing DPR water rights, determining if additional water rights acquisitions or interests would benefit the long-term vision of Denver Parks and Recreation.

DPR and Denver Water have partnered in securing reliable raw water sources for many parks through augmentation plans. Currently, the agencies are cooperating in converting the Harvard Gulch Complex (Harvard Gulch Park, Harvard Gulch North, and Harvard Gulch Golf Course) to raw water from the City Ditch. The agencies are also working together to resolve water rights issues related to storage in Harvey Park Lake and future conversion to raw water for irrigation.

Parks and Recreation Facilities

Facility Operations

To use water efficiently in the operation of all Denver Parks and Recreation facilities, the department will:

1. Construct new recreation centers with the highest efficiency products on the market, such as Water Sense Label, and ensure any fixtures replaced in existing sites meet these same standards.

2. In water shortage situations, Recreation will engage customers to educate about the shortage and how to help conserve water.

Previous Work Complete

1. In Partnership with Denver Water, through the Tap Smart Water Conservation Plan, detailed facility audits were performed at 36 Recreation and Pool sites in the summer of 2007. Aggregate water savings were estimated at 3,028,000 gallons per year, equivalent to 9.3 acre-feet annually. Denver Water provided parts, and Denver Parks and Recreation Facilities Department provided the repairs.

2. Retrofits on low flow shower heads, faucet seat repairs, aerators, sticking flush and float valves, plumbing, and irrigation leaks we completed December 2008. Pool shower heads were not retrofitted as Denver Pool Regulations require a 3 GPM flow, but all leaks were repaired.

3. Pool Vacuums that require discharge of water to the sewer have been replaced with vacuums that have the capability to recycle instead of discharge to the storm drain.

Future Goals

1. Monthly Recreation Center water use reports—identify and follow up on unusual water usage

2. Annual audit of water usage at DPR facilities; monthly checks for leaks throughout the facilities

3. DPR and Denver Water working together to identify water use history, annual visitor numbers and annual water use reports

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