

2010 WATER CONSERVATION ANNUAL REPORT

DENVER PARKS & RECREATION
Mission: As stewards of Denver's legacy, the Department of Parks and Recreation is dedicated to customer satisfaction and enhancing lives by providing innovative programs and safe, beautiful, sustainable places.
Vision: To be a nationally recognized leader providing model programs and dynamic public spaces.
Values: Accountability . Honesty . Respect . Service . Stewardship . Teamwork . Trust .
Water Conservation Mission: Coordinate sustainable water management and improved water quality for the Department through work plans driven by the DPR GamePlan, GreenPrint Denver & Executive Order 123, DW Tap + Smart Plan and DPR's Water Conservation Plan.

The following report summarizes the major costs incurred to the Water Conservation account, reports on major impacts to water use by Denver Parks and Recreation (DPR), and summarizes the 2010 work plan accomplishments.

Overall Water Summary

	2006	2007	2008	2009	2010*
Water \$	\$2,832,089.36	\$2,655,401.27	\$3,251,928.20	\$2,388,895.44	\$3,716,774.14
Sewer \$	\$71,822.30	\$93,518.04	\$80,184.78	\$86,307.42	\$ 82,939.01
Stormwater \$	\$67,189.81	\$80,782.27	\$85,311.16	\$100,390.30	\$ 101,756.19
DW Consumption for all DPR	1,834,539,000	1,875,678,000	2,005,591,000	1,192,302,000	1,754,076,000
DW Total Irrig Consumption	1,704,567,000	1,759,123,000	1,889,977,000	1,091,704,000	1,638,208,000
DW Parks Division Irrig Cons	1,457,037,000	1,529,898,000	1,639,565,000	929,294,000	1,418,953,000

The chart above shows the overall spending for three major categories covered by Water Conservation: water, sewer and stormwater costs. For 2010, the Department spent \$3,716,774 on water alone of which 98 percent of that amount was paid to Denver Water. The remaining two percent was paid to Ditch companies and water providers outside of Denver. Total consumption for all of Parks and Recreation, as billed through Denver Water main billing, totaled 1,754,076,000. Irrigation consumption totaled 1,638,208,000 with the chart below showing the specific categories of use.

Denver Water only	Potable Water	Recycled Water	Total
Parks Division	1,275,806,000	143,147,000	1,418,953,000
Golf	86,690,000	86,702,000	173,392,000
Other	45,863,000		45,863,000
Total Irrig Cons	1,408,359,000	229,849,000	1,638,208,000

*Water costs (\$) includes ~\$300,000 back bill. All consumption numbers do not include ~\$300,000 back billed consumption because consumption occurred over multiple years..

Additional billings paid by Denver Parks and Recreation are shown below:

Additional Water Vendors	
CITY OF GLENDALE	\$ 2,257.52
GOLDSMITH METROPOLITAN DISTRICT	\$10,744.92
LOOKOUT MOUNTAIN WATER DISTRICT	\$14,172.06
THE AGRICULTURAL DITCH	\$10,836.00
THE ROCKY MOUNTAIN WATER COMPANY	\$14,113.00
THE SALISBURY LATERAL DITCH COMPANY	\$11,025.00
TOWN OF MORRISON	\$ 2,131.96
DENVER WATER RAW BILLS (PARKS ONLY)	\$ 9,539.33
DENVER WATER MISCELLANEOUS BILLS	\$ 7,247.91
Total	\$82,067.70

The analysis of consumption by use shows that the primary use of water within DPR is for irrigation, therefore, the majority of this summary and the primary focus of Water Conservation is on irrigation use within the Department. The 2010 figures reflect a significant reduction of water as averaged in similar weather years which were key in limiting further significant budget cuts in the Department.

How did DPR achieve water savings?

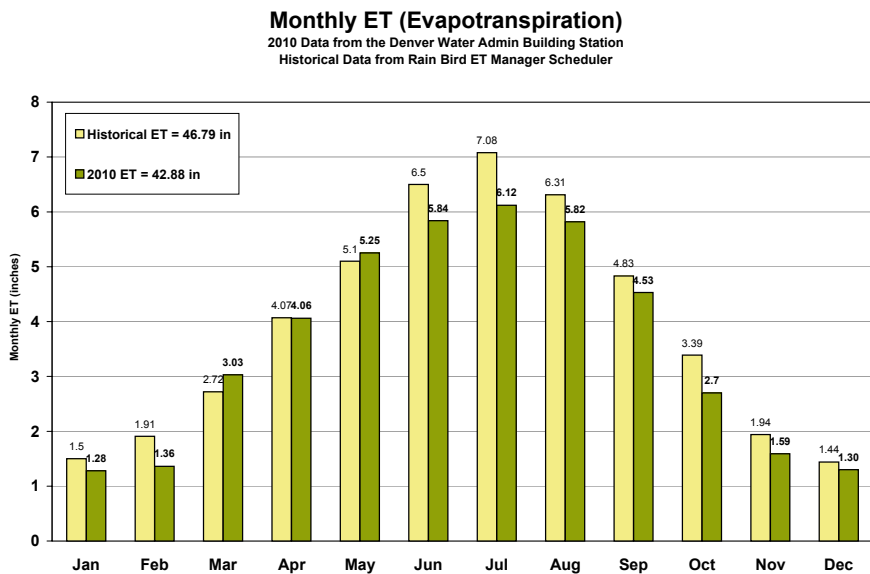
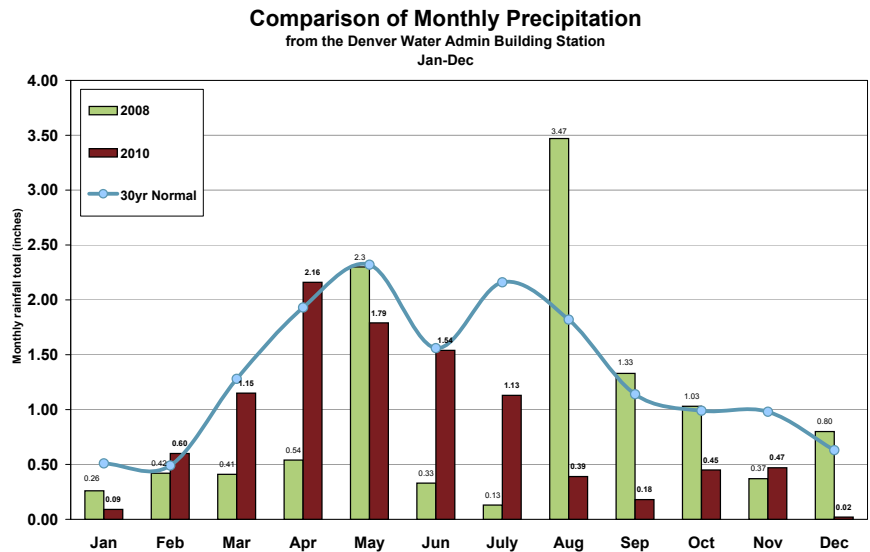
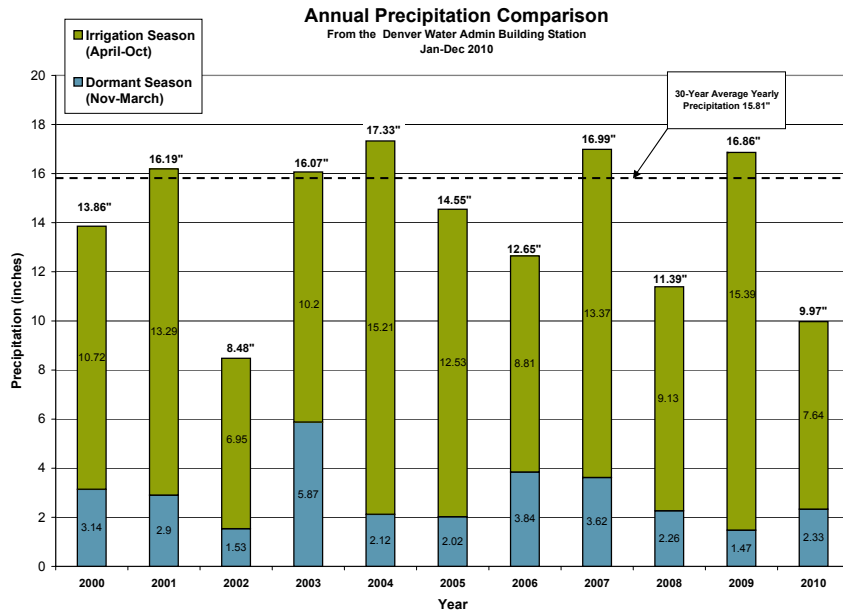
Many factors impact water savings each year including weather, water management, non-potable water expansion, water rates, additional park acreage, irrigation efficiency improvements and landscape modifications. Impacts to each of these categories is summarized for 2010 in the following text.

Weather Summary

Precipitation was variable as usual and below the 30-year normal. The year started off normal and then a short term drought occurred from July to December. The 2010 annual total (9.97") compared closely with 2008 (11.39"), however when looking at the monthly breakout a large difference in precipitation timing can be seen between 2010 and 2008. The evapotranspiration (ET) during irrigation season (Apr-Oct) was 34.32 inches, almost three inches below historical.

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, etc. As the weather was monitored in 2010, water budget targets were adjusted from a normal precipitation year of 30 inches per acre (in/ac) down to 22 inches per acre to meet budget reduction targets and maintain plant health. Each park district also customized this target to reflect individual park conditions. Of note, and in alignment with the goals of DPR and Denver Water to "Use only what you need," the 2010 consumption was 13% lower (220,612,000 gal) than 2008, a similar annual precipitation year. Although short-term droughts can affect these numbers, it shows a significant effort by Park District staff to efficiently use both financial and water resources.



Approximately 1,418,953,000 gallons of water were used for park and parkway irrigation, which was approximately 98-percent of the 22" target (1,449,920,769). The districts varied in water use with the lowest using 82-percent of their target and the highest 114-percent of their target.

After analyzing the 2010 weather data with water industry budgeting models from Denver Water and the Northern Colorado Water Conservancy District (NCWCD), DPR's irrigation water requirement (IWR) called for an average of 32.5-inches. IWR uses inputs on effective rain, ET, plant material (bluegrass) and irrigation efficiency to then calculate the necessary amount of irrigation needed. This tool is a useful comparison and measurement, and overall, DPR was well below this range.

IRRIGATION WATER REQUIREMENT 2010

Location	DW Admin	City Park Zoo	Reuse Plant	Marston	Historic
NCWCD MODEL	32.71	25.97	34.48	32.80	33.25
DW MODEL	34.85	27.52	36.22	35.74	33.92
AVERAGE	33.78	26.75	35.35	34.27	33.59
Average of 4 Sites (In & GPSF): 32.5		20			

NCWCD MODEL					
April 1 - October 31					
Location	DW Admin	City Park Zoo	Reuse Plant	Marston	Historic
Eto	34.32	28.74	37.06	33.98	37.28
Kc	0.81	0.81	0.81	0.81	0.81
ET lawn	27.7992	23.2794	30.0186	27.5238	30.1968
Rain	7.64	7.93	9.55	6.43	11.92
Rain (April)	2.16	2.27	2.22	2.7	1.93
Rain (May-Oct)	5.48	5.66	7.33	3.73	9.99
Eff. Rain (50%)	4.9	5.1	5.885	4.565	6.925
Water Need	22.9	18.2	24.1	23.0	23.3
I.E.	0.7	0.7	0.7	0.7	0.7
IWR	32.7	26.0	34.5	32.8	33.2

Eto = Historical Grass reference evapotranspiration for the growing season of April 1-Oct 31
Kc = Crop coefficient for cool season turfgrass based on use and mow height
ET lawn= Calculation: Water requirement for the lawn (Eto x Kc)
Rain = Historical rainfall
Eff Rain = Effective rainfall 100% for April and 50% for all other months
Water Need = Calculation: ET lawn - Effective Rainfall
I.E. = Irrigation efficiency which includes sprinkler system performance and management
IWR = Calculation: Irrigation Water Requirement in inches (Water Need / I.E.)

http://www.ncwcd.org/ims/ims_info/HRET_NCFR.pdf

DENVER WATER SEASONAL TURF REQUIREMENT					
April 1 - October 31					
Location	DW Admin	City Park Zoo	Reuse Plant	Marston	Historic
ET	34.32	28.74	37.06	33.98	37.28
ET Water Req (Kc 0.88)	30.20	25.29	32.61	29.90	32.81
Precipitation	7.64	7.93	9.55	6.43	11.92
Effective Rain (76%)	5.81	6.03	7.26	4.89	9.06
Adjusted ET Req	24.40	19.26	25.35	25.02	23.75
System Efficiency Adj	70%	70%	70%	70%	70%
Adjusted Irr Req	34.85	27.52	36.22	35.74	33.92
GPSF	22	17	23	22	21

ET | DW Admin Bldg - DW Website
ET Water Req | PENMAN-MONTEITH Kc .88
Precipitation | DW Admin Bldg - DW Website
Effective Rain | IA HANDBOOK .76
Adjusted ET Req | Calculation (ET Water Req - Effective Rain)
System Efficiency Adj | DISTRIBUTION UNIFORMITY
Adjusted Irr Req | Calculation (Adjusted ET Req / System Efficiency)
GPSF | Gallons per square foot conversion

Non-potable Water Expansion

DPR continued to partner with Denver Water on the recycled water program, converting 15 acres at four parks. The addition of Parks brought the total irrigated acres using reuse water to 269. Planning and construction work will occur in 2011 and 2012 for parks in the Montbello area and at Cheesman and Congress. Full water conversions for these expansion areas will occur in 2013. This program continues to be a significant effort to utilize a less expensive irrigation source.

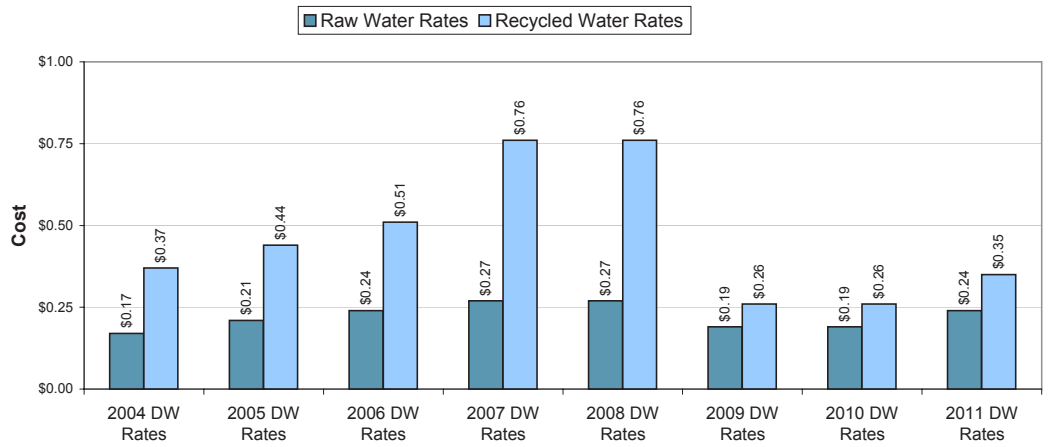
Water Rates

Summer potable water rates were maintained at 2009 rates in order to provide more notice for budgetary planning. Additionally, 2010 was the first full year to include the new monthly billing method. The intention of Denver Water to provide a more frequent reminder to keep conservation in customers' minds. DPR is now using the monthly water bills to more accurately apply and adjust consumption.

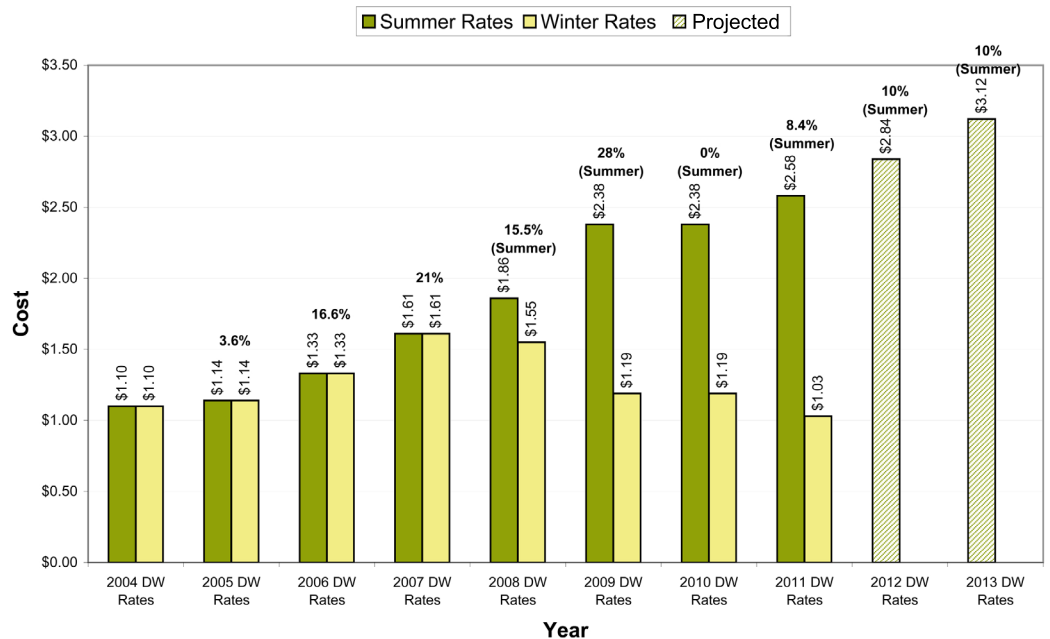
RECYCLED WATER SYSTEM

Name	Irrig Acres	2010 Cons (TG)
1 Crescent	6.3	4,868
2 Denison	2.0	1,550
3 Dunham	2.6	1,537
4 Greenway	33.8	23,187
5 Jackie Robinson Fields	17.1	12,148
6 Lowry Sports Complex	36.0	22,029
7 McNichols	3.7	2,532
8 Russell Square	2.6	2,668
9 Schafer	8.5	5,459
10 Stapleton Central	65.5	22,374
11 Swansea	7.7	4,617
12 Verbena	7.3	3,781
13 Westerly Creek	60.6	11,389
Total	253.9	118,139
2010 System Conversion - Recycled Water provided in 2011		
14 City of Ulaanbaatar	5.2	2,170
15 E 5th Ave	1.1	880
16 E 6th Ave (Roslyn to Uinta)	4.7	3,460
17 Montclair Recreation Center	3.9	2,021
Total	14.9	8,531
GRAND TOTAL	268.7	126,670

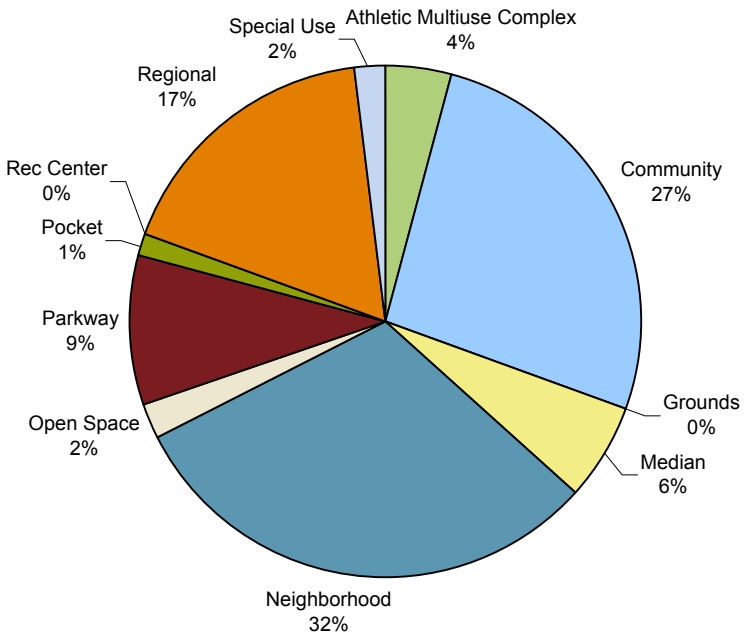
Non-Potable Irrigation Water Cost - Per Thousand Gallons



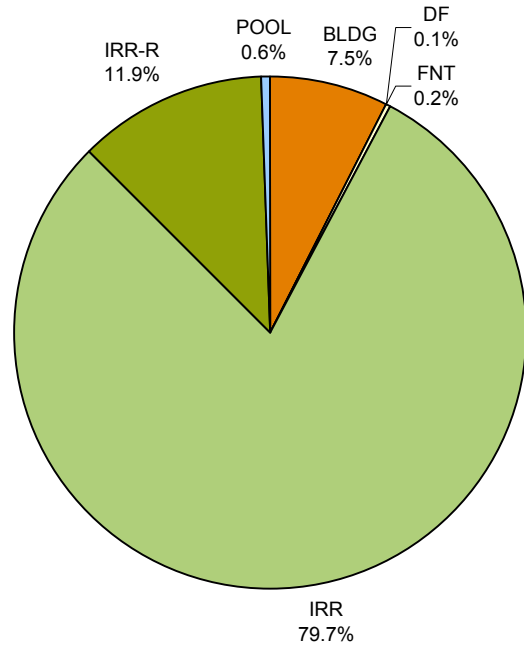
Potable Irrigation Water Cost - Per Thousand Gallons



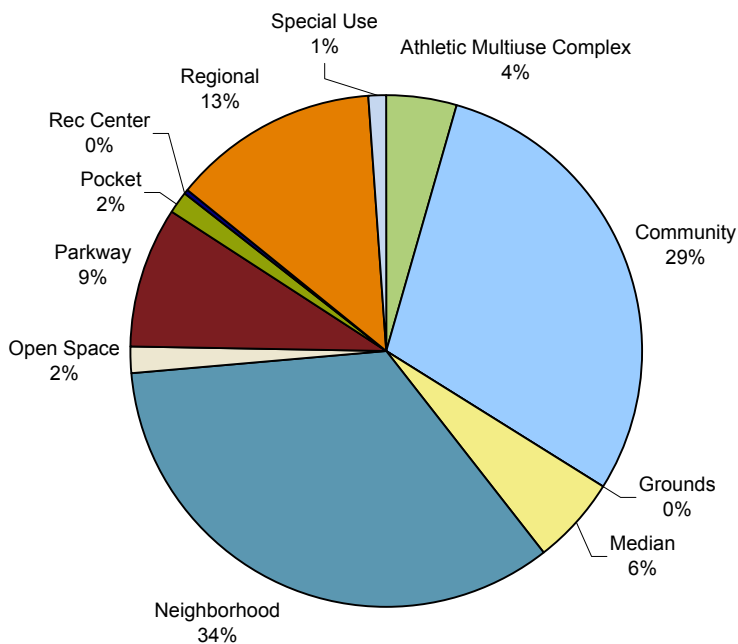
**IRRIGATION (POTABLE & RECYCLED) CONSUMPTION
BY PARK DEFINITION
2009**



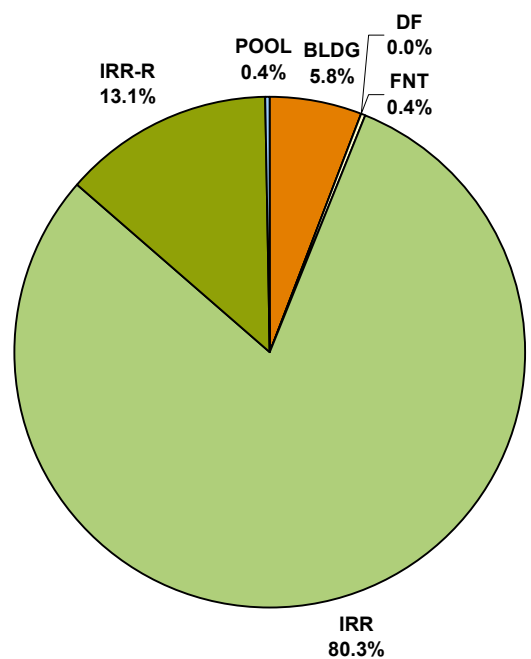
**PERCENT OF DW CONSUMPTION
BY PARKS AND RECREATION
2009**



**IRRIGATION (POTABLE & RECYCLED) CONSUMPTION
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**PERCENT OF DW CONSUMPTION
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Additional Park Acreage

Additional park acreage was added at Town Center (25.6ac Traditional Park, 2.7ac Natural Area), Parkfield-East Half (13.8ac Bluegrass, 32.1ac Natural Area), and Great Lawn (17.6ac Bluegrass, 21.6ac Natural Area).

Irrigation Efficiency Improvements & Landscape Modifications

Irrigation improvements assist with improving efficiency of water application as well as labor efficiencies in the field. The following projects highlight work performed in 2010. The Better Denver Bond Program completed the following irrigation projects in 2010: Parkfield Park Development Phase II, Cheesman Irrigation (Phases 1A & 1B), Verbena Park, Lincoln Park, Park Avenue, Highland Park, Paco Sanchez, Speer Boulevard and irrigation rehabilitations (City of Kunming, Overland, Veterans, Alamo Placita, Village Place, Garland, Pasquinels, 38th/Colorado, Ashgrove, Weir Gulch, Dailey, Richtofen, Habitat). Additional improvements outside of the bond were performed completed at Great Lawn Park, Garfield Park, Hampden Heights Park in 2010.

Irrigation standards were also updated in 2010 by the Water Conservation Division to add detailed information based on the Central Control Master Plan implementation (see work plan for additional information).

Water Conservation Work Plan for 2010

Water Conservation consists of two staff members whose work plans are driven by the DPR GamePlan, GreenPrint Denver & Executive Order 123, DW Tap + Smart Plan and DPR's Water Conservation Plan. The work plan consists of core tasks which will not vary year to year and then additional program, operations and project tasks which may have varied deadlines. With an extensive work plan but limited staff, it is essential for Water Conservation to build partnerships throughout the City and Denver Water to achieve the mission.

The typical core tasks include water usage billing and reporting, water conservation plan review and irrigation standards management, Denver Water coordination, training for staff, updates to management and citizens which can include presentations, and annual reports, budget management of operations as well as Capital Improvement Program expenditures, non-potable water coordination, and ongoing communication with various divisions within DPR, within the City of Denver and with citizens of Denver.

Major accomplishments for 2010 include the addition of the Greenhouse Program to the Water Conservation Program starting December 2009, improved training for Parks field staff on Water Conservation issues, completion of the Central Control Master Plan and continued coordination of the reuse water program. The following list highlights some of these accomplishments by detailed examples:

- Organized 12 training sessions (on 4 topics: Basic Hydraulics, Controller Programming, Renovating Irrigation Systems, Troubleshooting Irrigation Systems), 1 session on Sentinel Troubleshooting and distribution of water conservation tool kits,
- Monthly consumption reporting to field staff and preparation of the 2010 Water Target memo that provided staff with beginning of irrigation season information,
- Project Management of Sustainable Landscape Initiative sites,
- Successful completion of Water Conservation program audit

- Ongoing Bond irrigation coordination with Denver Water on the 10% Match,
- Compliance with Regulation 84 for reuse water and participation in the CDPHE Water Quality Forum Reuse Work Group for updating Regulation 84,
- Conversion of 4 Parks to reuse water and coordination of future reuse park conversions in conjunction with irrigation projects,
- Ongoing work on DPR Water Rights throughout the system,
- Updates to the public through emails, newsletter articles and improved information content on the Water Conservation web page
- Authored Denver Parks Conservation in CSU Colorado Water Newsletter (http://www.cwi.colostate.edu/newsletters/2010/ColoradoWater_27_4.pdf)
- Co-authored for City and County of Denver 'Aesthetically Enhanced Detention and Water Quality Ponds' (http://www.denvergov.org/Portals/696/documents/detention_pond_guide_screen.pdf)

Central Control Master Plan - In Depth Summary:

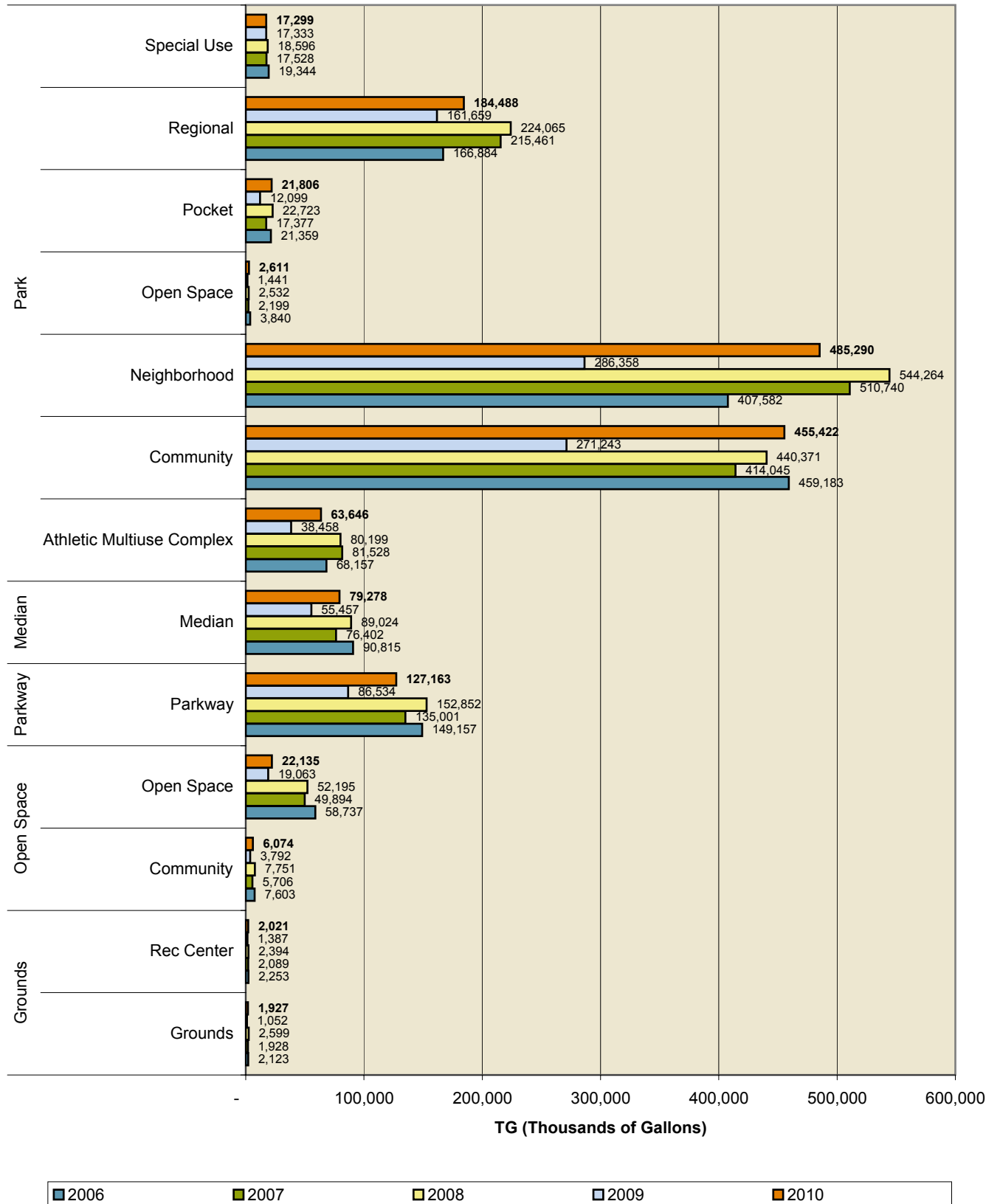
The 2010 Central Control Master Plan (CCMP) provides a five-year plan for complete build out of irrigation central control systems. Central control provides the greatest water management capabilities with the most efficient use of labor when used in tandem with flow sensing and a master valve. Parks is comprised of many large independent sites, with limited personnel to individually manage each site with stand-alone controllers. Central control allows necessary seasonal and weather related schedule adjustments of multiple sites quickly from a centrally located computer instead of requiring staff to make multiple trips to adjust each controller on site. Flow sensing with a reliable master valve allows the control system to sense mainline and lateral pipe breaks or broken heads, and shut the system down within minutes. Flow sensing also provides Parks with the capability to monitor and analyze water use through consumption reporting, which allows the opportunity to maximize the efficient use of water. In addition to labor and fuel savings, Parks anticipates a 15-percent water savings from improved water management when central control build-out is complete, providing a short four year return on investment.

The Denver Better Bond has been the most significant source of funding for central control improvements. Parks Capital Improvement Projects, other agencies (Public Works, Urban Drainage, Waste Water) and Parks Water Conservation have provided funding for central control on additional projects. The following table highlights work performed since the initial inventory of the system took place in 2009.

Total Number of Controllers	Central Control Units	Standalone Units
785 existing	217 existing	568 existing
	117 new*	177 removed
* New central control units includes replacements to standalone controllers and 22 new units at sites previously without any form of controller or newly acquired sites		

In addition to controller installations, Water Conservation has also focused on additional priorities established in the CCMP. Water Conservation has strengthened standards for installation of central control, flow sensing equipment, master valves, controllers and grounding. An optimization process and a Controller Certification Checklist have also been developed to verify that all equipment is functioning as intended at project turnover. Additionally, improved communications standards have been developed along with an antenna build out plan so that any site can be accessed and controlled through the City network. To date, 11 new or upgraded antennas have been installed or are slated for installation in the next few months. Training was also identified by the CCMP as an essential element for success. Along with formalized training previously mentioned, Water Conservation also formed a Central Control User Group for staff to share information and solutions to common problems.

2006-2010 Consumption Comparison by Park Classification & Type



City Park Greenhouse

The addition of the Greenhouse Program to the Water Conservation Program began in December 2009 as part of an overall Department reorganization. The current greenhouse mission is to support the Park's horticultural program by growing and distributing landscape flowers, shrubs, and other ornamental plants for Denver Park Districts and other City Agencies and Facilities.

The City Park Greenhouse serves the four major park districts of Denver and is located on 23rd and York Street. It consists of sixteen greenhouses comprising 54,000 square feet of growing area. Fourteen greenhouses are for use by Parks and two houses are, by agreement, for use by the Denver Zoo and to a lesser extent, the Denver Botanic Gardens. Directly outside of the houses is a trial garden to showcase new and interesting flowers. Every park plant gets its start at the Denver Parks and Recreation's City Park Greenhouse. All of the annuals for Denver's park system plus some perennials and blooming decorative plants are grown there, most from seeds or cuttings.

Core tasks at the Greenhouse consist of supporting plant production and include general Greenhouse maintenance, coordination with Parks Horticultural staff and plant purchasing, stock plants maintenance and propagation, seed plant propagation, planting and maintenance of the Greenhouse trial and stock gardens, poinsettia program and assisting Parks Horticultural staff with assigned flower beds.

Beyond meeting plant production goals this year, as illustrated on the table to the right, the following additional items have occurred to help enhance the Greenhouse Program:

- Coordination of the new Greenhouse website that allowed citizens to view planting plans for specialty gardens
- Creation of Greenhouse Work Plan and new Time Card
- Assessment and participation in Facility Improvements study for Greenhouse
- Coordination with Greenhouse and CSU on water conservation garden at the City and County of Denver building.
- In coordination with staff, inventoried planting areas through GIS and added flower bed categories to assist with defining different types of flower beds
- Coordinated 3 horticultural quarterly meetings with Parks staff
- Renovation of 7 greenhouses and shared office/meeting spaces as part of the Better Denver Bond
- Initiation of Department Horticultural Standards



Greenhouse Elevation Looking South

Current Flower Bed Inventory 2010		
Type	Number of Beds	Square Feet
Park Bed	36	22,416
Park Garden	97	56,242
Specialty Garden	296	106,940
Parkway Bed	45	18,227
Parkway Garden	41	15,563
Sign Bed	16	4,721
Building Entry Bed	15	3,967
Grand Total	546	228,077 (5.24 ac)

Flower beds are divided by scale, but can generally be categorized as either beds or gardens. Beds are typically one or two small size areas meant to be viewed individually. Gardens typically consist of many beds meant to be viewed together and designed with a consistent theme.

Year	Plant Production Number	Poinsettia Production
2004	129,500	
2005	175,000	
2006	191,800	1,900
2007	205,400	1,914
2008	212,900	1,379
2009	250,000	1,178
2010	228,900	880

