Course Consulting Service

ON-SITE VISIT REPORT

IRRIGATION AND WATER USE EFFICIENCY REPORT

PARK CITY GOLF CLUB

Park City, Utah

Visit Date: June 7, 2016

Present:

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USGA Green Section Mission: The USGA Green Section develops and disseminates sustainable management practices that produce better playing conditions for better golf.

The purpose of the Course Consulting Service is to collect and distribute information on the proper construction and maintenance of golf courses. Each visit is an impartial yet concerned perspective regarding turfgrass growth requirements, practical information on maintenance practices to address your specific needs, and sharing information from other courses we visit that may be helpful to your operation. This information is provided free of bias since the USGA is not affiliated with any manufacturers or suppliers. In short, we are a tool to help your superintendent and management team provide better turf for better golf.

A USGA Course Consulting Service site visit was conducted on June 7, 2016, at Park City Golf Club to study the irrigation system and water use efficiency. The purpose of this report is to benchmark and document current water management programs and offer recommendations on best management practices and practical improvements to enhance water use efficiency. The report is organized into four major sections:

- Site assessment
- Irrigation system inventory and operation
- Best management practices
- Summary of recommendations

Please contact our office if you should have any questions concerning this report or if we can contribute in other ways to your turf management programs.

SITE ASSESSMENT

Turf and landscape areas – The golf course property consists of 124 acres. 115.75 acres receive regular irrigation and the remaining eight acres comprise lakes and streams. Specific area measurements and turfgrass varieties are as follows:

Area	Grass Type	Acres	Height of Cut
Greens	Poa / Bent	3	0.135 inch
Tees	Poa / Rye	3	0.375 inch
Fairways	Poa / Rye / Blue	30	0.500 inch
Approaches	Poa / Rye / Blue	Included in Fwys	0.500 inch
Rough/Out of play	Bluegrass	75	2 inches
Driving Range	Bluegrass	4.5	2 inches
Landscape	X	¼	X
Total		**115.75 Acres**	

Water sources for irrigation – The golf course uses a combination of mine tunnel water and runoff and spring water for irrigation. The Spiro Mine supplies water to the back nine and is stored in an unlined four-acre storage pond. The Thaynes Canyon

watershed provides water to the front nine golf holes with storage in an unlined pond of approximately one acre in size.

Water features – Several small ponds are located throughout the golf course. These are used to slow the movement of water from levels of high elevation to lower elevations. The back nine has five lakes and retention basins. The ponds are ornamental in nature and only two water features directly feed the irrigation system pump stations.

Soil and water quality – Soil and water quality affect water use efficiency and the amount of water necessary for irrigation. The following comments are offered based on the water and soil analysis records:

- Water – The water entering the property is very clean and is an excellent source of irrigation water. Furthermore, it was great to learn that the water leaving the golf course is **cleaner** than the water that enters the property as indicated by the average of the 2015 samples submitted to the Brigham Young University Environmental Analytical Laboratory. The turfgrass and ponds are performing well and acting as a nutrient sink for nitrate (NO_3^-) and salts (µS/cm) as indicated in the table below.

Sample	pH	EC µS/cm	NO_3^-	P	K
Enter	7.76	456.25	0.48	0.02	1.31
Exit	7.84	408.55	0.21	0.01	1.35

- Soil – As can be expected, the greens have lower CEC (cation-exchange capacity) values due to the high amounts of topdressing sand used over the years to improve playability and conditioning. The soil on tees and fairways has a high CEC, and therefore has high levels of cations originating from the native parent material. The fairways display a dense layer of thatch at the surface that can negatively impact water infiltration. Soil salinity was low and well within the tolerance level for cool-season grasses.

Soil profile sample showing the dense layer of thatch on top of the native material on fairways.

Historical water demand – The following data provides information on estimated water demand based on historical climate information in Park City, Utah.

HISTORICAL WATER DEMAND								
Month	**Hi Temp**	**Lo Temp**	**Avg. Rainfall**	**ET**	**Days**	**Water Demand**	**Effective Rainfall**	**Water Balance**
				Historical Daily ET	Number of Days/Month	Historical Monthly ET	(50% of actual)	(Demand - eff. rainfall)
Jan	35	9	2.50	0	31	0	1.25	0
Feb	37	12	1.97	0	28	0	0.99	0
Mar	46	19	2.25	0	31	0	1.13	0
Apr	55	25	2.24	0.11	30	3.3	1.12	2.18
May	65	32	2.06	0.15	31	4.65	1.03	3.62
Jun	75	40	1.42	0.19	30	5.7	0.71	4.99
Jul	83	47	1.31	0.21	31	6.51	0.66	5.86
Aug	81	45	1.30	0.18	31	5.58	0.65	4.93
Sep	73	37	1.87	0.16	30	4.8	0.94	3.87
Oct	59	27	2.18	0.1	31	3.1	1.09	2.01
Nov	44	17	2.17	0.05	30	1.5	1.09	0.42
Dec	35	11	2.03	0	31	0	1.02	0
Totals					**365**	**35.14**	**11.65**	**27.87**

Actual water use – The maintenance staff has kept extensive records of actual golf course water use. The following table shows monthly water usage in gallons pumped during the 2015 season. The irrigation system is normally operated between April 20 and October 20, with peak water demand in June, July and August. In 2015, a total of 147 acre-feet of water was utilized for golf course irrigation.

GOLF COURSE IRRIGATION USAGE 2015 SEASON				
	Gallons Pumped			
	Front Nine		**Back Nine**	**Monthly Total**
	Pump 1	Pump 2		
MARCH			759,000	759,000
APRIL	0	698,800	1,223,000	1,921,800
MAY	0	274,900	463,000	737,900
JUNE	2,394,000	1,981,300	5,791,000	10,166,300
JULY	4,389,700	2,769,100	6,552,000	13,710,800
AUGUST	2,502,100	1,963,800	5,907,000	10,372,900
SEPTEMBER	2,504,300	1,907,200	4,528,000	8,939,500
OCTOBER	335,500	163,900	645,000	1,144,400
TOTALS	12,125,600	9,759,000	25,868,000	47,752,600
			Season Total	**47,752,600**
			Acre Ft.	**146.55**

These records indicate that the staff is using a **very minimum amount** of water for golf course irrigation. According to our calculations, 146.55 acre-feet (AF) of water used to irrigate 115.75 acres in 2015 equals 1.27 acre-feet per acre (AF/A), or 15.2 inches of columnar water, well below the 27.87 normally required during a normal season. What is even more astounding is that 2015 was a relatively hot and dry year with 53.99 inches of evapotranspiration (ET).

ACTUAL 2015 WATER DEMAND			
Month	Measured Rainfall	Total ET	Effective Rainfall
1/1 - 6/30	9.96	27.10	4.98
7/1 - 12/31	8.53	26.88	4.27
Totals		**53.99**	**9.25**

2015 Water Usage:
146.55 AF / 115.75 A = 1.27 AF/A
1.27 AF/A x 12 inches/foot = 15.2 inches of columnar water used

2015 Crop Coefficient:
(53.99 ET Demand x X) - 9.25 inches effective rainfall = 15.2 inches
X = 2015 Actual Crop Coefficient = 0.45

It should be noted that 0.8 is a normal irrigation crop coefficient for cool-season turfgrass species. Warm-season species that utilize the more efficient C-4 photosynthetic pathway usually are given a coefficient of 0.7. Park City is well below both of these numbers. By substituting the normal 0.8 crop coefficient into the equation above, 33.94 inches of columnar water should have been used to keep the golf course in a healthy and adequately watered state during the 2015 season.

Water Demand with 0.8 Crop Coefficient:
(53.99 ET Demand x 0.8) – 9.25 inches effective rainfall = 33.94 inches
33.94 inches columnar water / 12 inches/foot = 2.83 AF/A
2.83 AF/A x 115.75 A = 327.40 AF

The total water saved per year over the entire property is impressive. With the 0.8 Kc (crop coefficient), and 115.75 irrigated acres, the course could arguably use about 327 acre-feet of water per year. Due to excellent water management and water conservation techniques, Park City only used **147 acre-feet** of water, a savings of 180 acre-feet of water. In terms of relevance to the community, one acre-foot of water supports the water consumption of about eight people per year. Therefore, a savings of **180 acre-feet** is equivalent to the water consumption of **1,440 people** per year. Park City Golf Club is a steward and at the forefront of water conservation efforts in Park City. Congratulations should be given to the city manager, golf course superintendents and staff for their conservation efforts.

IRRIGATION SYSTEM INVENTORY AND OPERATION

Item	Model	Number	Age	Longevity*
PVC pipe	X	X	31/25/42	10 -30 yrs
Control wire	X	X	31/ 25	40-50 yrs
Fittings	X	X	31/25/42	40-50 yrs
Gate valves/ isolation valves	Stockham / Nibco	3 – 8 inch 2 inch	31/ 25	20-30 yrs
Pressure relief valves	Cla-val	4" & 3"	7/ 40	20-30 yrs
Quick couplers	Buckner	1"	31/ 25	10-20 yrs
Satellite controllers	Osmac		5	10-15 yrs
Full-circle sprinklers	Toro 854	854s-5558	3	7-10 yrs
Part-circle sprinklers	Toro 855	855s-5558r	3	7-10 yrs
Central controller	Toro Lynx		5	5-15 yrs
Pumping system	Watertronics / Kesler		7/ 30	15 – 20 yrs
Pump motors	US Motor	(2)100, (2) 75. 25. 3 HP	7 / 9	

*Source: Irrigation Association/Bryant, Taylor, Gordon Golf Design/ASCGA

The irrigation system is programed and operated using a Lynx™ central controller located at the maintenance facility. (Above) One or more field satellite controllers are located on each hole that communicate with the central controller and allow field operation of specific sprinklers. Note the two wires connected to each station, 13 – 23. These stations run two sprinklers at the same time.

Sprinkler spacing and configuration:

Area	Spacing (ft.) or Drip irrigation	Configuration (triangular, square, rectangular, irregular)	Control (individual, multiple head or block)
Greens	87	*Triangular*	Individual
Tees	87	*Triangular*	Individual/ Multi
Fairways	87	*Triangular*	Individual/ Multi
Rough	87	*Triangular*	Multiple

Irrigation system notes:

- Two separate pump stations exist – one being 7 years in age and the other, 30 years.
- The front nine main line is original and installed in 1973.
- The sprinkler heads were installed in 1985 on the back nine and 1991 on the front nine. New internal drives and nozzles were installed in 2013.
- The VFD (variable frequency drive) on the back nine pump station has an air pressure tank. The front nine is regulated with a pressure regulating valve.
- The system is outfitted with a Wye and screen filter.
- Based on our discussions and a review of maintenance records, the installation of the VFD pumps has resulted in a decrease in the need for daytime watering by improving distribution uniformity. In addition, there are fewer 6-inch mainline pipe breaks with proper pressure regulation.
- Sprinkler spacing was checked on several fairways. Sprinklers are in a triangular pattern, which is the most efficient design for irrigation uniformity. The distance between sprinklers ranged from 81 – 87 feet with the majority at 83 – 85 feet.

None of the sprinklers were positioned farther than the designed 87 feet indicating good coverage. The system is subject to wind and other variables with such a wide spacing. New irrigation system designs regularly call for sprinklers at a 60-foot spacing to increase distribution uniformity during windy conditions.

- Each putting green has two quick coupler valves to allow hand watering with hoses.

- Hose connections in the fairways are done with a connection device inserted directly into a sprinkler.

Irrigation system operation and maintenance:

- The irrigation system runs a complete cycle from 8 p.m. until 6 a.m. per water department requests. The system operates at 1,100 GPM (potential max 1,760) on the back nine and 600 GPM (potential max 1,200) on the front nine.

- No watering is allowed from 10 a.m. to 7 p.m. per the City Water Conservation Ordinance.

- A visual assessment of the golf course is made each day including the examination of soil cores from tees, fairways and rough to evaluate soil moisture status. During the golf course assessment, notes are made regarding necessary repairs. Repair orders are written and posted in the maintenance facility and communicated to the irrigation technician.

- Information from the golf course assessment and regional weather station data is used to program the irrigation system each afternoon. Adjustments to the operation time for individual sprinklers are made as needed based on weather reports for the next 24-hour period.

- Putting green sprinklers are operated to maintain a baseline of moisture without creating excessively wet conditions. Tees and fairways are irrigated to maintain balanced moisture. The goal is to provide a baseline of soil moisture and keep the golf course slightly dry ahead of forecasted rainstorms. The rough is irrigated at a deficit in the summer months to demonstrate good stewardship and leadership in terms of water conservation.

- Lateral breaks are limited to two per month. The annual cost of parts and supplies is $2,000 to $3,000. Ten hours of labor per week is dedicated to repair.

- From June through August, one to two part-time staff members are assigned to spot water for several hours each day.

- The maintenance staff routinely trims/edges sprinklers and valve boxes to provide a clean appearance and prevent turf encroachment from interfering with the operation and repair of the system.

- The nozzle configuration on the sprinklers is the same throughout the entire golf course, which simplifies part ordering and maintenance.

- Preventive maintenance is performed on the pumping system in-house by the staff.

BEST MANAGEMENT PRACTICES

The following section of the report documents the best management practices (BMPs) that are currently implemented at Park City Golf Club, along with recommendations to further improve water use efficiency:

1. Irrigation system design and devices for efficient water use - The design of the irrigation system has a major influence on water use efficiency. An improperly designed and/or poorly installed system results in unnecessary water loss and the inability to efficiently program and maintain the system. Advances in technology now provide tools that superintendents can incorporate to monitor and adjust irrigation programs and practices for better water use efficiency.

While Park City has an aging irrigation system, it is well designed and includes the following features:

- Uniform head spacing in an equilateral triangular configuration that is consistent with manufacturer's recommendations.

- Proper hydro-zoning of sprinkler programs based on similar plants or similar environmental requirements.

- Water window of 9 to 10 hours or less to avoid interference to golfers and allow adequate infiltration into the soil prior to morning maintenance.

- Use of adjustable arc sprinklers/part-circle sprinklers to eliminate overspray onto hard surfaces and out-of-play areas.

- Isolation valves to allow sections of the system to be shut off when breaks or leaks occur without the need to shut off the entire system.

- Variable frequency drive pumping system to apply water at the quantity required in an energy efficient manner.

- Adequate number of quick-coupler valves on greens.

Recommendations:

- Upgrade the pump station on the front nine. The pump station was installed in 1987 and has exceeded its expected life expectancy. It is recommended to rebuild the pump station and put the motors and drives inside an enclosure rather than above open water.

- Replace the aging main line on the front nine and address pressure issues on upper holes. The aging main line on the front nine is due for replacement. It is recommended to work with an irrigation system design architect to address the pressure issues that exist on the upper holes. This may require adding a booster pump station or increasing the size of the main line at time of replacement.

(L) The pump station was installed in 1987 and adjusts water flow and pressure for the irrigation system. (R) The 75-hp pumps are located out over the water and susceptible to deterioration by sun and various other weathering elements.

The pressure on the front nine is low due to the change in elevation (1 foot of elevation change = 0.433 pounds of pressure).

- Consider individual sprinkler control - Individual sprinkler control will be critical as trees get taller and cast more shadows onto the turf. ET is affected by solar radiation, temperature and, to a lesser extent, wind and humidity. Decreased solar radiation will lower water use in some areas. Without individual head control, shaded areas would receive too much water and sunny areas, not enough. Precise control and placement of water to the turfgrass plants in need of that water would be possible with individual head control. Wires are already in place on the front nine. The back nine would require trenching and installation of new wire between each controller and sprinkler head.

- Install quick couplers on fairways - Quick couplers will allow for spot watering with hoses to precisely put water where it is needed most. Without hand watering, irrigation systems typically can only achieve 80 – 85 percent distribution uniformity. Hand watering can bring efficiency back into the 90 – 100 percent range.

- Better utilize the in-ground soil moisture sensors - The Turf Guard® sensors are already installed. It is suggested to work with your Green Section agronomist to develop site-specific watering schedule based on both ET AND actual soil moisture data collected from the sensors.

Example of a full-circle sprinkler near a green. The maintenance staff is doing an excellent job at keeping these trimmed and edged, which reduces the potential for water to hit adjacent grass blades that can lower distribution uniformity (DU). However, the greenside sprinklers are low and require leveling.

2. Maintenance of the irrigation system for optimum performance - Routine monitoring and maintenance of the irrigation system is essential for optimum performance and water use efficiency. It is recommended that specially trained personnel be assigned to check and monitor the operation of the system at regular intervals, document needed repairs, and make necessary repairs/adjustments in a timely manner. Proper follow up is necessary to insure that repairs and adjustments were done properly.

Based on our discussions and a review of current maintenance practices, the staff at Park City does an excellent job of maintaining the irrigation system for optimum performance. Routine activities include:

- Grass is trimmed around sprinklers and valve boxes.
- Operation/observation of sprinkler stations is done at routine intervals to ensure proper rotation and performance.
- Valves are periodically exercised to ensure proper operation.
- Regularly scheduled pump system maintenance.

<u>Recommendations:</u>

- Raise and level sprinklers - Sprinklers require intentional and routine checking to ensure that they are level. A sprinkler that is three degrees from level will reduce distribution uniformity by up to 20 percent.

Sprinklers that are not level around putting greens and teeing grounds require immediate raising and leveling to improve DU. It is recommended to check fairway and rough sprinkler heads during routine edging and flag low or un-level heads with a pin flag. These can then be leveled as time permits.

- Increase routine maintenance on the on-site weather station - Site-specific ET data is imperative to schedule irrigation. The weather station should be routinely checked to ensure that accurate data is available to assist with irrigation programming decisions.

- Contact the local power company. It is suggested that Park City contact the local power company, as they may offer discounts and rebates on pump efficiency tests and any recommended upgrades. The article titled Golf Course Energy Use: Pump Stations provides further information on energy efficiency.

3. Irrigation scheduling and operation - The operation and scheduling of the irrigation system is dependent on several factors:

1. The experience of the superintendent.
2. Prevailing climate and weather conditions.
3. Data from the weather station and field sensors.
4. Site characteristics (slope, sun/shade patterns).
5. Characteristics of the soil.
6. Rooting depth of the turf/plants.
7. Water-use characteristics of the turf/plants.

Careful analysis of the above factors should guide the operation and scheduling of the irrigation system. Good protocols are in place for the operation and scheduling of the irrigation system at Park City, including:

- Daily evaluation of prevailing climate and weather conditions.

- Knowledge of soil characteristics throughout the property. It was noted that the back nine has deep soil and the front nine has a shallow soil.

- Daily adjustment of irrigation programs.

- Daily, monthly and annual water use is documented to track consumption patterns.

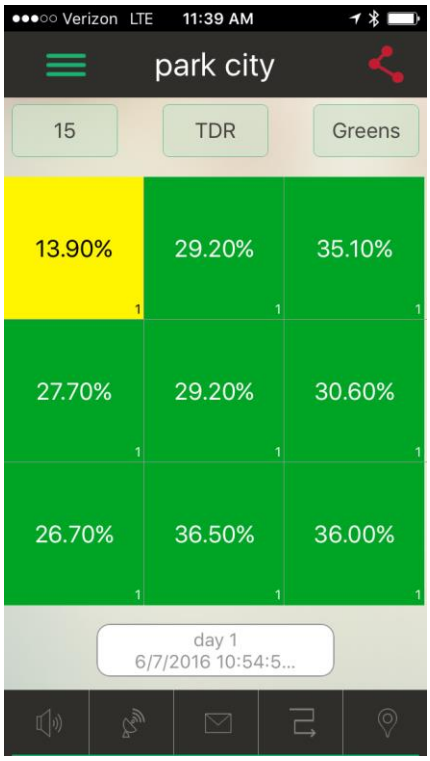
Recommendations:

- Conduct a backup of computerized irrigation schedules at frequent intervals (minimum once per month).

- Program and adjust irrigation on greens based on the *Irrigation Normalization Spreadsheet* (Appendix 1).

- Utilize the *USGA Drought Emergency Plan Spreadsheet* - The spreadsheet may be helpful when used in conjunction with your Water Reduction Program. This spreadsheet will help dial in reduction percentages and track gallons used and saved during an acute or chronic drought. This detailed analysis of water use during a drought emergency is imperative to assist with present and future decision making.

- Invest in a moisture meter/soil probe - The Spectrum TDR 300™ moisture meter is intended for use on greens (can also be used on tees and fairways) to assess soil moisture, determine the need for hand watering, and guide irrigation programming.



The Bluetooth device that links the TDR 300 to your phone and computer can be used to visually track soil moisture on the greens, tees and fairways. The 13.90 percent in the back,left corner is the result of tree roots that are using soil moisture at a faster rate than the surrounding turfgrass.

4. Turfgrass management and cultural practices – Maintenance inputs and cultural practices promote healthy turf growth and allow plants to use water efficiently and withstand environmental stresses. It is recommended to adapt specific cultural practices based on the prevailing site conditions, soils, and types of turf to promote maximum water-use efficiency. Table 3 provides a general listing of cultural management practices and their relative importance to water-use efficiency.

Table 3. Relative importance of cultural practices on turfgrass water use efficiency*

Cultural Practice	***Relative Importance (1= most/ 4=least)***
Irrigation scheduling program	1
Soil cultivation – for water infiltration/ rooting	2
Soil modification – for water infiltration/ rooting	2
Selection of species	2
Selection of cultivar	2
Turfgrass site use and quality expectations	2
Mowing height – within the tolerance range for the grass	2
Nitrogen fertilization	2
Potassium fertilization	2
Alleviation of soil salinity	2
Alleviation of sodic soil conditions	2
Liming of acid soils	2
Mowing frequency	3
Mower blade sharpness	3
Plant growth regulators	3
Wetting agents/ surfactants	3
Insect control	3
Disease control	3
Phosphorus nutrition	4
Iron nutrition	4
Anti-transpirants	4
Other pesticides with PGR activity	4

*Carrow, R.N., R. Duncan, C. Waltz. 2007. Best Management Practices Water-use Efficiency/ Conservation Plan for Golf Courses. pp. 36-37.

The maintenance programs at Park City should be centered on the promotion of healthy turf growth and deep roots which will allow plants to use water efficiently while withstanding environmental stresses. Current practices that are especially important relative to water use efficiency include:

- Proper irrigation scheduling and programing.
- Proper nutrient management, mowing heights, and use of plant growth regulators.
- Applications of soil wetting agents to promote good water infiltration.

Recommendations:

- Increase core aeration on fairways - Focus on additional core aeration on the fairways to control excessive thatch that is limiting water infiltration.

- Increase the number of applications of wetting agents - It is suggested to utilize monthly applications on wetting agents on greens, tees and fairways.

5. Root prune trees near critical turf areas – Trees compete with turfgrass for available moisture and nutrients in the soil. The osmotic force created within a tree's root system to draw moisture out of the soil is much greater than a turfgrass root system.

Recommendations:

- Periodically cut tree roots with a root pruner - It is suggested to cut tree roots near sensitive turf areas with a trencher or root cutting device to a depth of 18 to 24 inches. Investigate the purchase of an Imants® tractor-mounted root pruner.

6. Expand native grass areas – The utilization of native grasses in out-of-play areas reduces water consumption and is a prudent water conservation strategy. This allows available water supplies to be redirected to primary playing areas and helps meet water budget goals.

Recommendations:

- Establish a native grass mixture near the front nine pump house - Several varieties of wheatgrass are being tested at Utah State University in Logan, Utah. These grasses are open and airy and allow for golfers to find and advance their golf balls. It is suggested to try a mixture of wheatgrass in an out-of-play area to see how it performs on your site. Wheatgrasses require less than 20 inches of rainfall per year, so supplemental irrigation requirements would be minimal.

7. Use of mulches in landscape beds and below trees – Installing mulch below trees and in landscape beds reduces water evaporation from the soil and helps conserve water.

Recommendations:

- Reduce turfgrass where many trees exist - Several densely populated areas of trees exist throughout the course. The trees limit sunlight and severely limit turfgrass growth. It is recommended to reduce turfgrass in these areas, turn irrigation sprinklers down and utilize a fine mulch under the trees. Install 1 to 3 inches of mulch around plants in landscape beds. Replenish mulch throughout the year as necessary. Encircle groves of trees on the golf course with this fine mulch or pine straw.

The area inside the dotted line was discussed as a possible location to connect tree basins and remove turfgrass in an effort to reduce mowing in and around individual trees.

8. Indoor and other landscape water conservation practices – In addition to the golf course, the entire facility should be evaluated for water use efficiency including the clubhouse, maintenance facility, course rest rooms, other buildings and landscape areas.

Recommendations:

- Perform an indoor audit - Hire a consultant or contact water district personnel to perform an indoor water audit.

9. Education – Continuing education for turf managers and the maintenance staff is an important component of water conservation efforts. Ongoing training should be incorporated into daily maintenance practices to build awareness of the commitment to water conservation and make adjustments to current practices when necessary. Superintendents should take an active role in educating golfers, course officials, policy makers, water district officials and others in the community on the programs and practices directed toward water conservation at their facility.

Recommendations:

- Attend continuing education seminars - Seminars and classes related to water conservation and improving water use efficiency are available through the GCSAA and other organizations.

- Develop a staff training program - It is suggested to develop a written training program for staff on proper hand watering techniques, washing of equipment, and other maintenance activities that impact water conservation efforts. In addition, one-on-one staff training for irrigators and annual training for irrigation programming can help the course maximize its water use efficiency.

- Publish articles - Publish articles in the club newsletter or website highlighting water conservation projects at the golf course and how readers can implement similar programs at their homes and in their gardens.

- Post updates - Post articles and updates on the bulletin board in the clubhouse and locker rooms regarding efforts to conserve water.

- Demonstrate the new native area to the public - Invite policy makers and water district authorities to visit the golf course and learn about the water conservation measures that are in place. Tours can include and explanation of the irrigation system, tools that are used to conserve water, and viewing of demonstration areas and recent projects.

- Continue water conservation demonstration areas on the driving range - It is suggested to continue with the irrigation trials that were started on the driving range. These areas will demonstrate water conservation techniques to the golfing public as water is applied at varying levels of conservation. They can also be used to demonstrate possible drought emergency situations.

SUMMARY OF RECOMMENDATIONS

Recommended routine programs:

- Raise and level sprinklers.
- Better utilize the in-ground soil moisture sensors.
- Increase routine maintenance on the on-site weather station.
- Conduct a backup of computerized irrigation schedules at frequent intervals (minimum once per month).
- Increase core aeration on fairways.
- Increase the number of applications of wetting agents.

Recommended short-term programs:

- Install quick couplers on fairways.
- Program and adjust irrigation on greens based on the *Irrigation Normalization Spreadsheet.* (Appendix 1)
- Utilize the *USGA Drought Emergency Plan Spreadsheet*.
- Invest in a moisture meter / soil probe.
- Periodically cut tree roots with a root pruner.
- Perform an indoor audit.

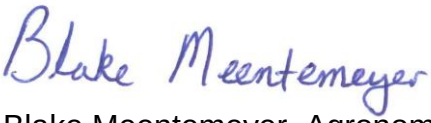
Recommended long-range programs:

- Upgrade the pump station on the front nine.
- Replace the aging front nine main line/address pressure issues on upper holes.
- Consider individual sprinkler control.
- Demonstrate a native grass mixture near the front nine pump house and other locations.
- Reduce turfgrass where many trees exist and install drip line to trees.

CONCLUSION

Thank you for the opportunity to visit Park City Golf Club to discuss irrigation and water management programs. The USGA has identified water as the single biggest issue facing the game of golf, and the organization is fully committed to encouraging efficient water use and protecting water quality at all golf courses. A comprehensive archive of information is available at The USGA Water Resource Center that we hope you will use as a further reference. Again, thank you the opportunity to serve you and I trust the suggestions and recommendations offered in this report will assist your efforts to improve irrigation system performance and water use efficiency.

Respectfully submitted,



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Distribution:

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Attachments:

Irrigation System Preventive Maintenance Checklist (USGA)
Appendix 1: Irrigation Normalization Spreadsheet for Greens
USGA Drought Emergency Plan Spreadsheet