

November 18, 2019

2019 PRM RESULTS

Eagle Hills Golf Course, Eagle ID



INTRODUCTION

Performance Resource Management is a premium agronomic service designed to deliver superior results. PRM improves playing conditions while saving water and other operational costs, which greatly benefits the business of operating a golf course.

Qualitative results that have been recorded this season include:

1. Improved turf density and color
2. Less irrigation maintenance (due to clogged sprinkler heads)
3. Reduced hand watering
4. A reduction in the severity of wet spots

PRM has monitored multiple, quantitative data points that have contributed to the qualitative results that were observed over the season.

This report highlights the agronomic improvements that have been observed at Eagle Hills Golf Course over the course of the 2019 season. Notable, quantitative improvements include:

1. Thatch Reduction
2. Root Zone Expansion
3. Drainage Improvement
4. Compaction Reduction

Charts, graphs, and tables included in the '19 PRM Results Report reference data representative of trends observed across the course since PRM was implemented in July 2019. Agronomic data has been gathered by PRM. We expect to see continued improvements throughout next year with the 2020 PRM program.

CONTROLLED TRIAL

PRM is being run on the front 9, while the back 9 serves as a control. Historically, the back 9 has is considered better in quality than the front. This is the primary reason we chose to run PRM on the front 9.

PRM

THATCH REDUCTION

Excess thatch is a problem that nearly all golf courses struggle to manage. Thatch accumulation and layering creates a perched water table, limiting drainage, the effectiveness of irrigation and the efficiency of root development. Managing organic material has posed a challenge for decades, and significant progress has been recorded this year.

The first 3 prominent layers of thatch were measured on tees and greens on July 17 and September 20 of 2019. PRM figures show the decrease in thatch due to PRM over the course of the season and compares where Control Figures show no reduction in thatch on the control site. With PRM, we made significant progress combatting thatch, layering, and managing organic material over the course of the season compared to the control.

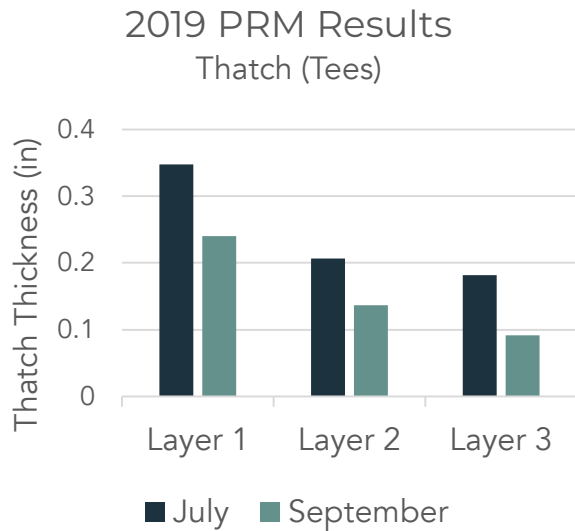


Figure 1: Thatch Reduction with PRM

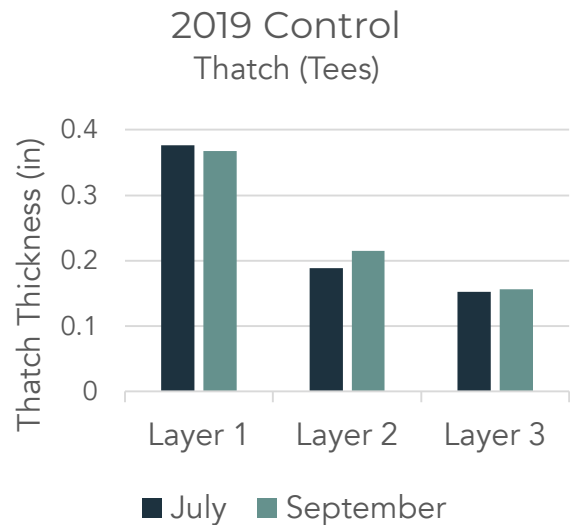
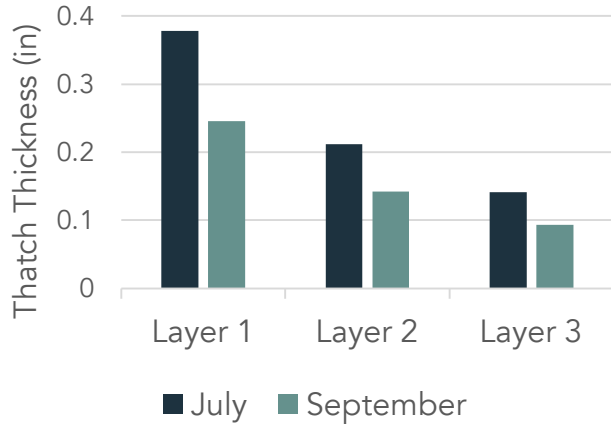


Figure 2: Thatch Control

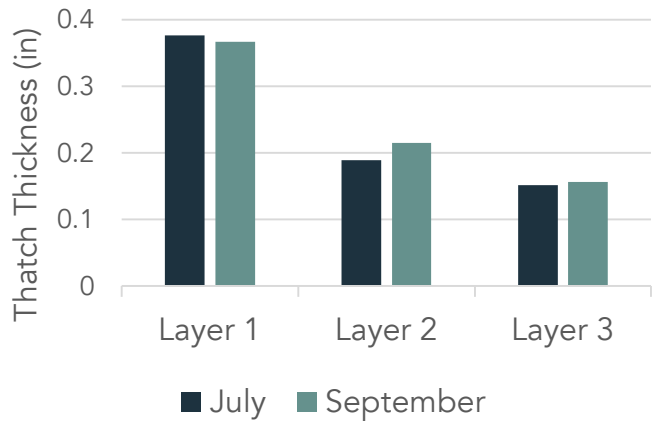
Average Thatch Reduction on Tees (in)				Average Thatch Reduction on Tees (in)			
PRM	July	September	% reduction	Control	July	September	% reduction
Layer 1	0.348	0.240	31%	Layer 1	0.377	0.367	2%
Layer 2	0.206	0.136	34%	Layer 2	0.189	0.215	-14%
Layer 3	0.181	0.092	49%	Layer 3	0.152	0.157	-3%
Average			38%	Average			-5%

THATCH REDUCTION

2019 PRM Results
Thatch (Greens)



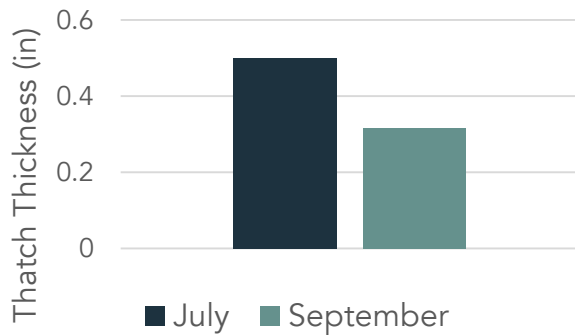
2019 Control
Thatch (Greens)



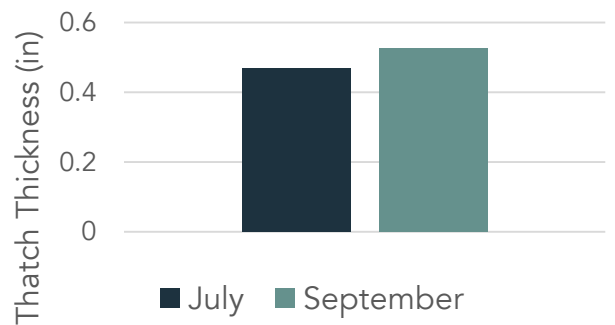
Average Thatch Reduction on Greens (in)			
PRM	July	September	% reduction
Layer 1	0.378	0.246	35%
Layer 2	0.212	0.142	33%
Layer 3	0.142	0.093	34%
Average			34%

Average Thatch Reduction on Greens (in)			
Control	July	September	% reduction
Layer 1	0.377	0.367	2%
Layer 2	0.189	0.215	-14%
Layer 3	0.152	0.157	-3%
Average			-5%

2019 PRM Results
Thatch (Fairways)



2019 Control
Thatch (Fairways)



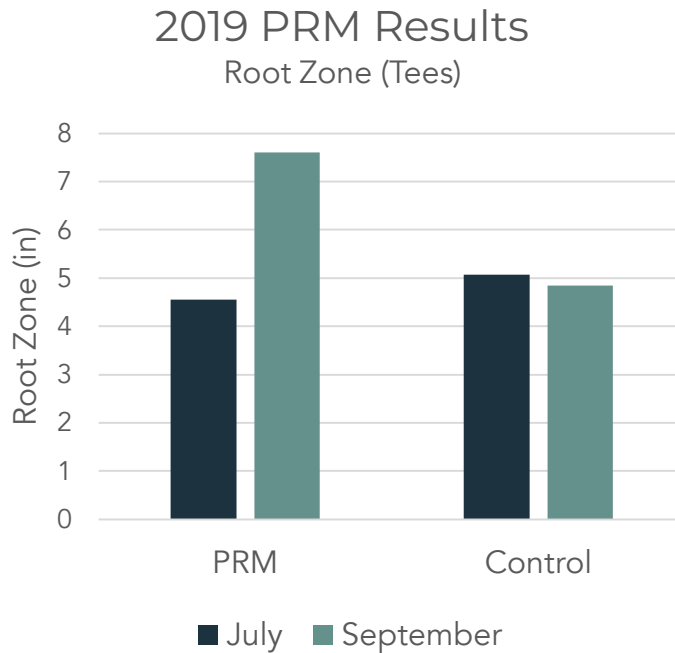
Average Thatch Reduction on Fairways (in)			
PRM	July	September	% reduction
Thatch	0.500	0.316	37%

Average Thatch Reduction on Fairways (in)			
Control	July	September	% reduction
Thatch	0.471	0.527	-12%

PRM

ROOT ZONE

The deeper roots can go into the soil, the more efficient the plant is in transporting nutrients and surviving extreme temperature and drought. Running PRM causes the root zone to expand course wide, on greens, tees, and fairways. Root zone expansion was observed across all playing surfaces under the PRM program. For the control surfaces, the root zone did not expand.



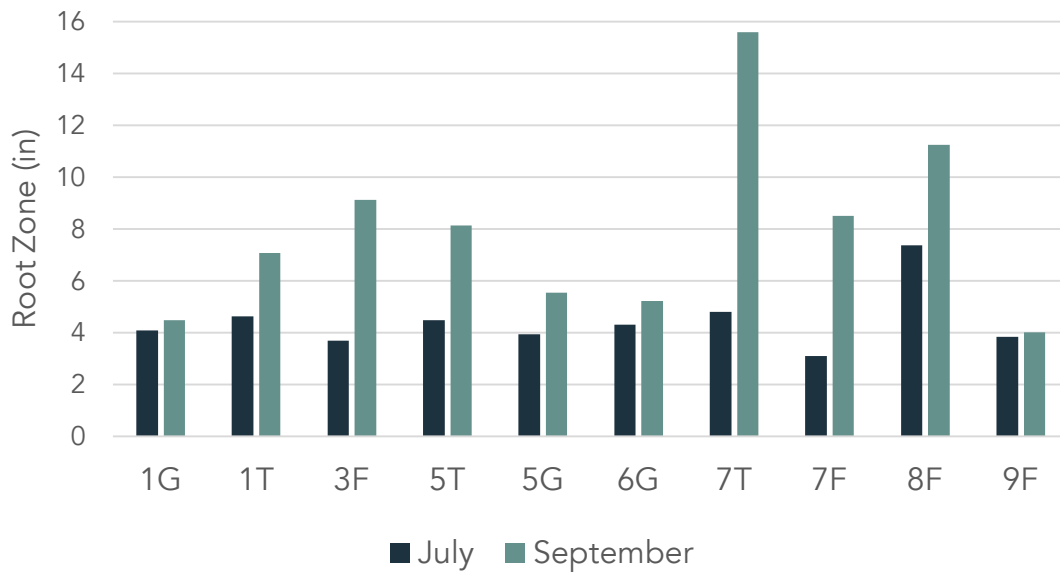
Average Root Zone on Tees (in)			
Root Zone	July	September	% change
PRM	4.556	7.600	67%
Control	5.073	4.844	-16%

The root zone expanded across all playing surfaces with PRM. In the example above, the root zone of tees increased by 67% with PRM. Root zone of the control tees decreased by 16% from July to September, which is what we would typically expect with the hottest month of the year being August.

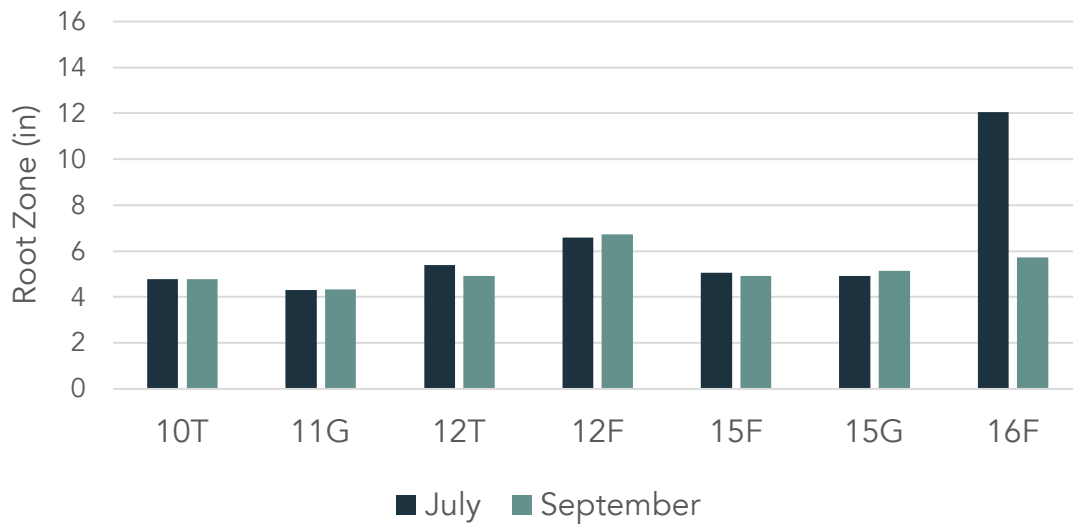
PRM expanded the root zone across the property during the most difficult time of year to grow roots. The root zone expansion demonstrated across all playing surfaces is one of many factors that support a causal relationship to the many agronomic improvements attributed to PRM.

ROOT ZONE

2019 PRM Results Root Zone



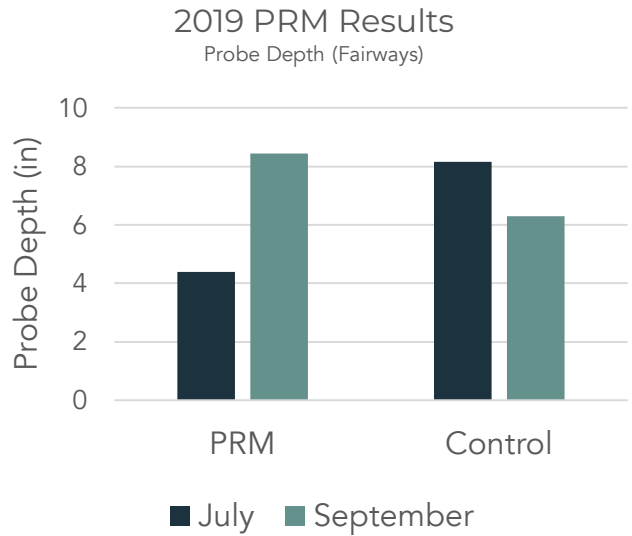
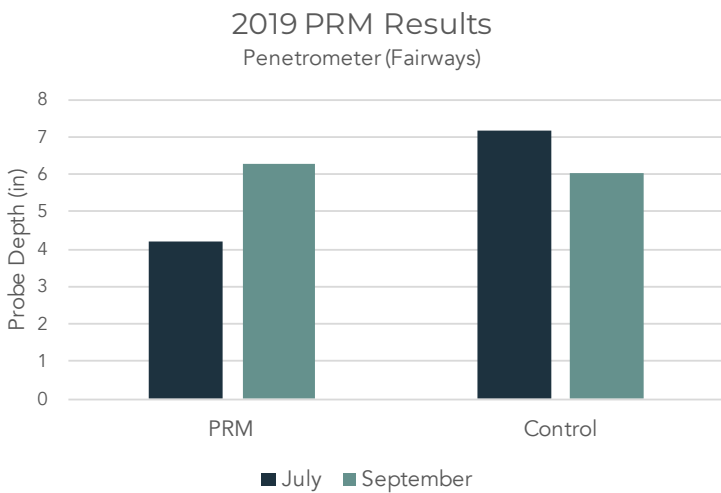
2019 Control Root Zone



COMPACTION REDUCTION

Compaction is the result of a combination of factors that affect growing a stand of turf grass. Factors that affect compaction include: thatch accumulation, traffic and a deteriorating soil profile. Compaction causes shallow root zones, reduced nutrient uptake, poor drainage, and accumulation of organic matter.

Over the course of the 2019 season, we managed to reduce compaction with the PRM program. Reduced compaction led to a healthier, expanded root zone, improved nutrient uptake, and led to the growth of denser and more resilient turf. The figures below display the reduction of compaction over the course of the 2019 season.



Average Compaction on Fairways (in)			
Penetrometer	July	September	% change
Control	7.183	6.042	-16%
PRM	4.184	6.288	50%

Average Probe Depth on Fairways (in)			
Probe	July	September	% change
Control	8.167	6.304	-23%
PRM	4.381	8.441	93%

PRM alleviated compaction in fairways especially. We significantly reduced compaction, between 50 and 93% depending on which way we measured it.

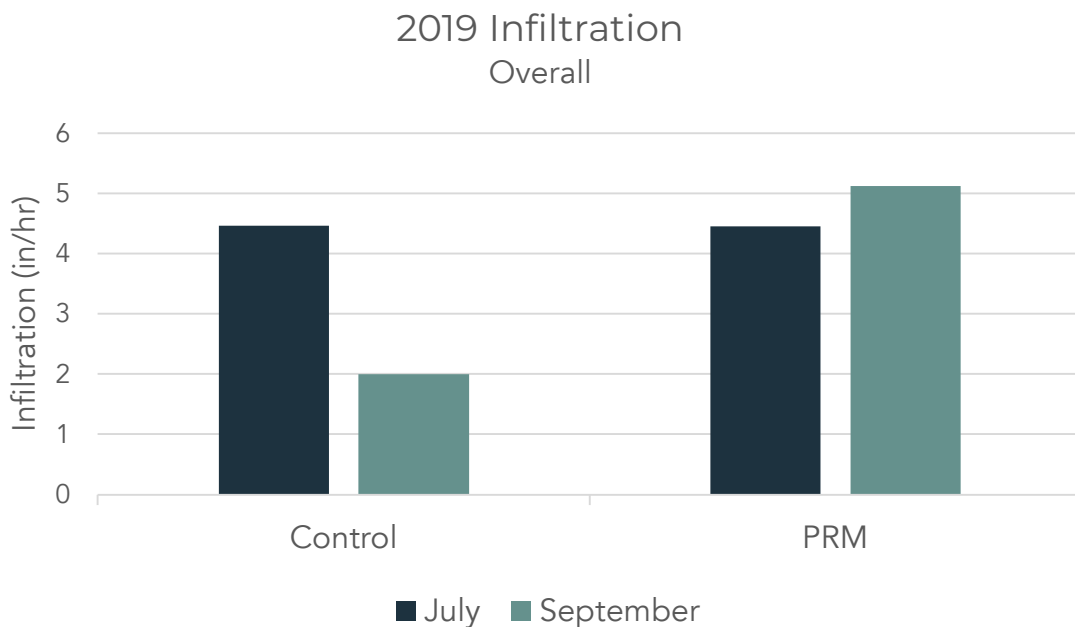
Data taken in July is a direct reflection of how the back 9 had better agronomic conditions and had historically grown better turf than the front 9. On the control surfaces, compaction increased between July and September. The increase in compaction observed on the control surfaces is due to increased thatch accumulation and reduced root zone.

DRAINAGE IMPROVEMENT

Drainage is the result of a combination of agronomical factors that are interrelated. Reducing thatch and compaction allows water to flow through the soil profile and also causes increased root development. Infiltration readings were taken with a TurfTec Infiltrometer on greens, fairways, and tees on July 17 and September 20. We took the blended averages of infiltration rates to generate the graph below *2019 Infiltration Overall*.

With PRM, infiltration rates improved over the course of the season. Infiltration rates improved with PRM as a result of thatch breakdown, reduced compaction, and an expanding root zone.

The control sites experienced a decrease in infiltration rates overall. The control's decrease in infiltration rate is due to thatch accumulation, increased compaction, and a decreasing root zone.



SUMMARY

PRM improved the agronomy and playing conditions across the course by reducing thatch, reducing compaction, expanding the root zone, and increasing infiltration. Improved turf conditions included denser, greener turf. Improved efficiencies will enable us to track a reduction in water use and other management practices on the front 9 of the golf course.