DISCLAIMER

This project was conducted with financial assistance from a grant from the Metropolitan Water District of Southern California (Metropolitan), the U.S. Bureau of Reclamation, the Central Arizona Project, and the Southern Nevada Water Authority through Metropolitan's Innovative Conservation Program (ICP). The ICP provides funding for research to help document water savings and reliability of innovative water savings devices, technologies, and strategies. The findings of this project, summarized in this report, are solely from the project proponent.

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Final report for 2014 study for Metropolitan Water District

What is AquaSmart PRO?

AquaSmart PRO is very fine sand that is engineered to absorb up to 12 times its weight in water and water soluble nutrients. AquaSmart accomplishes this by taking a very small sand particle (around 100 mesh) and attaching an even smaller super absorbent polymer that is similar to those used in diapers.

These polymers were developed by the USGA and have been around for many years. Until recently the manufacturers had a hard time getting them to release the moisture that they were absorbing to release to the plant. Recently they have been formulated and cross linked with potassium, allowing the water to flow freely from the polymer to the root when they come into contact. Below you can see a few different sizes of super absorbent polymers when they are fully hydrated and some pictures of AquaSmart PRO before and after water has been added. These polymers will continue to absorb and release water for a period of up to 5 years and are defined as “INERT” by the EPA. They are completely bio-degradable and will turn into a combination of potassium, water and carbon dioxide when it has completed its ability to absorb water.

By adding AquaSmart PRO to the growing media the overall holding capacity of the soil will be improved. This creates a better overall growing environment for the plant (trees, shrubs, flowers, turf) and improved water efficiency. This improved water efficiency tends to lead to a healthy plant on the surface, improved root growth below the surface and water savings over time. AquaSmart is a new technology that was invented by a Texas cotton farmer that saw water as an increasingly more difficult resource to get.

In the photograph above you can see The AquaSmart PRO granules on the top left and how they absorbed the added water on the bottom right. AquaSmart is a new technology that was invented by a Texas cotton farmer that saw water as an increasingly more difficult resource to get. AquaSmart PRO will continually absorb and release moisture for a period of 3 – 5 years.

How AquaSmart Benefits the Soil

Once AquaSmart PRO is added to the soil it will increase the moisture and nutrient holding capacity of the soil. You can see in the illustration below that moisture on the right hand side is captured by the AquaSmart PRO granules that would normally leach below the root zone.

Below you will notice an up close illustration of an activated AquaSmart PRO granule that has absorbed moisture. This extra water is available to the plant when the rest of the soil dries out. On the right hand side you can see that the root zone has expanded and grown towards the available water and begun extrapolating the moisture for the benefit of the plant.

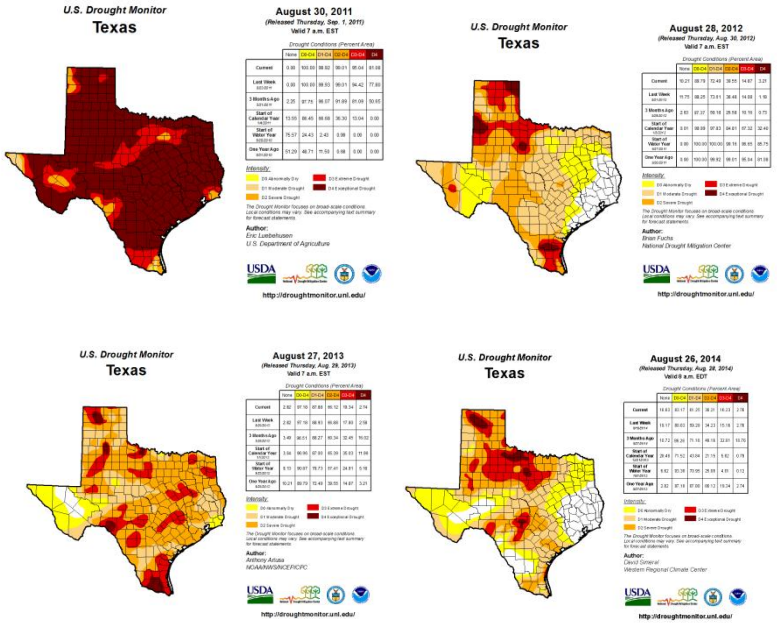
AquaSamrt PRO is in essence acting as a moisture and nutrient reservoir below the surface to benefit the plant when the soil dries out. This is always beneficial to the plant but even more so during water restrictions when the soils moisture holding capacity can't sustain the plant in the summer until the next scheduled irrigation.

Purpose of the Study

In 2014 AquaSmart conducted two studies that were designed to quantify the effects of AquaSmart PRO on new plants for the purpose of helping growers save water, and applying AquaSmart PRO on existing lawns to quantify overall water savings for a summer versus the control yards.

Testing on Existing Yards in Texas

One of the main applications of AquaSmart PRO has been for the purpose of saving water on an existing lawn. Landscapers have been using the product more and more frequently in the last 2 years, especially in areas that are under water restrictions. One of those areas has been in the Austin area that has been under watering restrictions since 2011 when the almost the whole state of Texas was under exceptional drought. As you can see below, the state has been in mostly drought conditions since then and many municipalities have kept those water restricted practices in place.



Georgetown, Texas

Over the past 3 years the area that has the most contractors using AquaSmart PRO is Georgetown, TX. Located almost exactly in the middle of the state, Georgetown is host to a large Del Webb Community called Sun City. The residents of this community live there because of the warm weather in the winter months and want to enjoy their landscaping during the summer. This has become increasingly difficult due to the water restrictions that they must comply by in the hot summer months. This is where AquaSmart PRO comes in. By increasing the moisture and nutrient holding capacity of the soil AquaSmart PRO allows the residents of Sun City to enjoy a green yard even under strict water restrictions.

Protocol for the Study

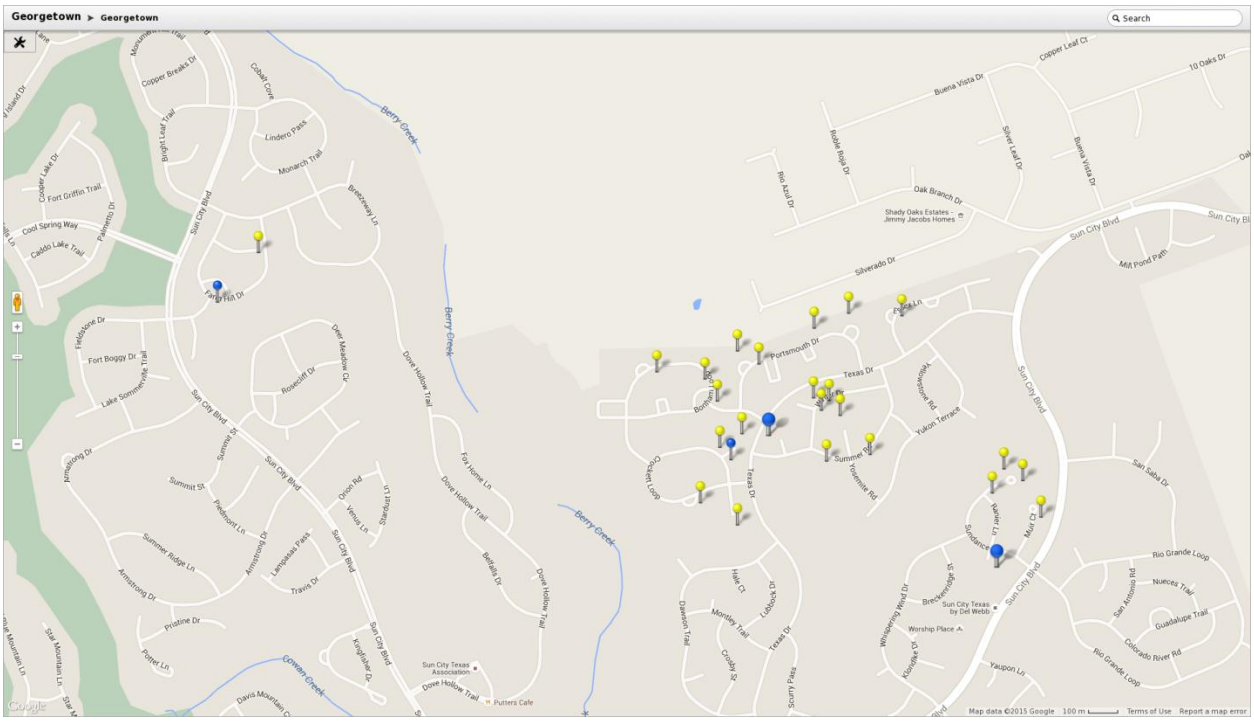
In Sun City we applied moisture sensors on 29 yards. The sensor used was Baseline S100 that uses electronic pulses to measure the volumetric moisture in the soil. Each sensor was installed and calibrated so that it would provide a moisture floor that would tell the irrigation system to either give the lawn some water, or wait till the next available watering day. Below is an example of the moisture sensor being installed.

Prior to the moisture sensors being installed we applied AquaSmart PRO on 4 of the lawns. It is recommended that AquaSmart PRO be installed after the lawn is aerated (in this case we double aerated) this allows the granules to penetrate the soil where they can be most beneficial to the root system. After Aeration we would then apply AquaSmart PRO with a drop spreader. The drop spreader allows for a more even distribution and also keeps the light material from blowing into the neighbor's yard. Below is a picture of two bags of AquaSmart PRO in a Gandy drop spreader.

We used two different application rates of AquaSmart PRO. The product is available in 40 lb. bags so we applied 20 lbs. per 1000 sq. ft. on two yards and 40 lbs. per 1000 sq. ft. on the other two yards. Once the product is applied it is recommended to give it a solid watering to activate the product.

After installations we took daily readings of the moisture sensors, rain amounts and weather readings. The study began in March and readings were taken until the end of October.

All Homes were within 1.5 miles of each other, with the majority of the homes within a .4 mile radius in the Sun City community. The map below shows the homes that were tested. The yellow pins represent the homes that only had moisture sensors installed. The smaller blue pins had moisture sensors and 20 lbs. per 1000 of AquaSmart PRO. The larger Blue pins had a moisture sensor and 40 lbs. per 1000 of AquaSmart installed.



Georgetown testing results

From March 2014 to October 2014 there were 55 total irrigation events in Georgetown, TX. The study was taken in a 30 week period and the rain sensors would have interrupted irrigation 5 times from March to October. This means that the average yard that did not have AquaSmart PRO or a moisture sensor installed would have watered 55 times throughout the time frame.

In this study yards that only had moisture sensors installed would be considered the “control group”. Every yard in the facility outside these 29 yards would have irrigated 55 times. The irrigation results of the yards that had the Baseline moisture sensors installed are as follows:

	March	April	May	June	July	Aug	Sept	Oct	Total	
118 Muir	0	0	3	2	8	9	5	2	29	
502 Sundance	0	2	5	6	1	5	5	0	24	
513 Sundance	1	4	8	7	5	8	5	1	39	
514 Sundance	3	5	5	9	9	8	3	3	45	
101 lovett	1	1	7	5	5	8	5	3	35	
111 Lovett	1	2	7	4	4	8	4	1	31	
211 Crockett	0	2	7	5	4	8	5	4	35	
516 Crockett	1	3	3	3	5	5	1	1	22	
215 Yosemite	4	4	7	5	9	8	3	0	40	
100 sunbird	1	5	6	6	1	7	3	0	29	
114 Winter	0	3	5	6	7	9	4	0	34	
202 Winter	0	5	6	7	8	9	5	2	42	
206 Summer	2	1	8	3	0	5	6	8	33	
306 summer	0	3	6	7	5	7	3	1	32	
103 Sunnyside	1	4	5	5	8	8	5	3	39	
117 Sunnyside	1	3	5	5	6	7	2	0	29	
533 Farmhill	0	4	5	1	3	9	7	5	34	
224 Bonham	0	2	4	6	5	9	3	2	31	
270 Bonham	1	5	4	5	5	6	2	0	28	
275 Bonham	1	1	3	2	4	5	3	1	20	
130 Portsmouth	1	3	6	7	7	8	3	0	35	
150 Portsmouth	1	4	6	9	8	9	6	0	43	
320 Portsmouth	0	2	6	6	5	9	5	1	34	
131 Nassau	0	3	7	7	5	8	4	6	40	
122 Essex	0	1	5	5	3	8	5	2	29	
				Average Irrigation events and savings					33.28	39%

You can see that on average there was just over 33 irrigation events total that resulted in an overall reduction of watering of 39%.

The Irrigation results of the yards that had Both AquaSmart PRO and Baseline moisture sensors installed were as follows:

AquaSmart at 20 lbs. per 1000										
100 Lovett	1	2	6	7	5	6	2	2	31	
610 Fieldstone	0	1	3	0	3	5	2	0	14	
			Average Irrigation events and savings at 20lbs per 1000						22.5	60%
Aquasmart at 40 lbs. per 1000										
205 Ranier	2	1	2	2	0	3	3	0	13	
107 Hummingbird	0	2	2	3	4	6	3	0	20	
			Average Irrigation events and savings at 40 lbs per 1000						16.5	70%

You can see that by holding extra moisture below the surface the AquaSmart PRO would allow for more irrigation interruptions and overall water savings. The 16.5 irrigation events represents a 70% water savings from the control and an almost 50% water savings from the yards that only used Baseline.

Below is a matrix showing the performance of the test yards over the average 3000 sq. ft. yard in the Sun City development for the summer of 2014. In March and April there is only 1 allowed irrigation per week and that goes up to two per week in May. In this case the average yard would be set to water 1500 gallons every time the irrigation turned on. The numbers to the right represent the projected amount of gallons saved by skipping those irrigation events, assuming the home owner used a combination of soil moisture sensors and a full rate of AquaSmart PRO.

MONTH	Scheduled Irrigations*	Irrigation events No Aqua	Irrigation events Aqua@ 20 Lbs.	Irrigation Events Aqua @ 40 Lbs	Gallons saved @ 40 lbs.
MAR	4	1.1	.5	1	4500
APRIL	4	2.7	1.5	1.5	3750
MAY	9	5.3	4.5	2	10500
JUNE	7	5.3	3.5	2.5	6750
JULY	9	5.4	4	2	10500
AUG	8	7.4	5.5	4.5	5250
SEPT	8	4.1	2	3	7500
OCT	6	2.1	1	0	9000
TOTALS	55	33.3	22.5	16.5	57750

Conclusion

Our conclusion is that the application of AquaSmart PRO can allow for increased turf performance under severe water restrictions and in many cases save water. These results are somewhat predicated on some strategic rainfall which will re-activate the AquaSmart PRO but we can conclude that we will have a greener more vibrant turf situation under more restricted irrigation practices. We also concluded that 40 lbs. per 1000 sq. ft. was the ideal application rate. The yards below were treated with AquaSmart PRO in 2013 with two day per week water restrictions. You can see the turf performance even though the irrigation was interrupted 30% of the time. We came to the conclusion that although AquaSamrt PRO will continue to absorb and release moisture for a period of 3 – 5 years the product should be applied every 2 years unless otherwise noted.

Both yards had AquaSmart PRO and Baseline moisture sensors installed in 2013. The result was a 30% water saving over the previous year with improved turf performance.

Testing Protocols for Plant Growers.

To test the effects of AquaSmart PRO on new plantings we went to Oklahoma State to do a Greenhouse study on different varieties of plants: Petunia, Rose Moss, Verbena, Lobelia, and Salvia. The idea was to test 3 different application rates (5, 10 and 20lbs. per yard of soil) vs. the control. All in all 200 plants were used so we could get enough replications of each variety. In order to test the amount of water that was given to each plant we watered 350 Ml every time water was needed and then measured the amount of leachate that came out the bottom of the 8 inch pot. We then allowed each plant to dry down to a certain weight we started out at 1500 grams and then moved it to 1650 grams. Each pot was measured daily and when it dried down to that weight we added 350 Ml's of water and measured what came out the bottom. This trial lasted from March till the end of June. The greenhouse is simply too hot in the summer months for greenhouse growing.

In this study, we conclude that the results are, or are not, statistically significant. NS means it was numbers were not statistically significant. One * means that the scientists involved believe strongly that the end user will see those results at least 95% of the time. Two ** means they are confident in the results 99% of the time and *** stars means 99.9% of the time.

Oklahoma State Test results

Petunia

In the Below chart we are measuring the water frequencies (total times the plants were watered on average), Water Retention (Total amount of water that was added – amount of water that leached out the bottom), The dry weight of the shoot/stem, and the dry weight of the roots. This measures watering and overall plant health. The larger the stem, and more importantly the root, the healthier the plant.

AquaSmart Rate	Root Dry Weight	Shoot Dry Weight	Frequency of Irrigation	Water Retention
Petunia				
0	2.32	16.32	21.6	7238
5	1.17	16.47	19.2	5544.2
10	2.87	16.67	23.4	7329.2
20	3.22	17.36	24.8	8153.8
Linear	NS	NS	NS	NS
Quadratic	NS	NS	NS	NS
Residual	NS	NS	NS	NS

For the petunia we noticed a 39% increase in dry root mass at 20 lbs per yard of AquaSmart but because we didn't see a consistent improvement from 5 lbs to 20 lbs we were not able to deem this statistically significant. We will have to replicate this more this summer to find out what happened at 5 lbs per yard.

Rose Moss

AquaSmart Rate	Root Dry Weight	Shoot Dry Weight	Frequency of Irrigation	Water Retention
Ross Moss				
0	1.08	18.36	17.2	5527
5	1.06	19.44	21.4	6096
10	0.9	15.82	18.8	5395.2
20	0.86	14.84	13.6	4039.6
Linear	NS	*	***	***
Quadratic	NS	NS	**	***
Residual	NS	NS	*	*

For Rose Moss we were able to reduce overall watering frequencies (especially at 20lbs per yard) and overall watering by 27% there was no statistical difference in root mass and stem mass. Therefore the conclusion with Rose Moss was that we could grow a comparably healthy plant with significantly less water than the control.

Verbena

AquaSmart Rate	Root Dry Weight	Shoot Dry Weight	Frequency of Irrigation	Water Retention
Verbena				
0	2.98	11.56	24	8263.6
5	2.06	10.26	24	7321.6
10	1.98	10.56	22.2	7263.4
20	6.06	11.92	31	9603.6
Linear	**	NS	*	*
Quadratic	*	NS	NS	*
Residual	NS	NS	NS	NS

For Verbena The study showed that we were able to save water at the lower rates but the plant really loved the higher rate and we were able to increase root mass by over 100%.

Lobelia

AquaSmart Rate	Root Dry Weight	Shoot Dry Weight	Frequency of Irrigation	Water Retention
Lobelia				
0	0.62	6.88	14	4753.6
5	0.6	6.84	15	4344
10	0.9	8.2	19.6	6084.4
20	1.18	8.58	17.6	5481
Linear	*	NS	NS	NS
Quadratic	NS	NS	NS	NS
Residual	NS	NS	NS	NS

For Lobelia the study did not show a statistically significant difference in watering amounts or watering frequency, but again showed a dramatic difference in dry root mass at the highest rate – 20 lbs per yard.

Salvia

AquaSmart Rate	Root Dry Weight	Shoot Dry Weight	Frequency of Irrigation	Water Retention
Salvia				
0	3.32	8.36	20	6885.2
5	2.94	8.24	24.4	6522
10	3.3	8.3	22.6	7102.2
20	5.16	9.62	22.4	7536.4
Linear	*	NS	NS	NS
Quadratic	NS	NS	*	NS
Residual	NS	NS	*	NS

As with the other plants, we saw similar results with Salvia. The watering frequencies were not statistically significant but the average root mass increase at 20 lbs per yard was around a 55% increase.

Overall findings at Oklahoma State

Our goal for this study was to begin developing growing practices, using AquaSart PRO, that would allow growers to use less water during their growing practices. As we were developing the protocol we felt that we would be able to show decreased watering frequencies and a longer shelf life of the plant. This would decrease the amount of plant returns and improve sales while using less water. The study proved to be faulty in this regard because we were watering based on weight and in most cases the plants that

had AquaSamart in the soil mix showed much larger root zones and would use more water in the pot and cause more evaporation. We were able to prove thought that by using AquaSmart PRO you would be able to produce a healthier plant with a stronger root zone. This should provide end users with a great tool when they are planting trees, shrubs, and plants and get them off to a good start in less than ideal growing conditions.

We are continuing this study in 2015 so that we can further replicate the findings and discover more information about the way AquaSmart will behave in the soil.

Goals for 2015

AquaSmart is continuing both studies in 2015. We have to replicate the exact greenhouse study for educational purposes at Oklahoma State, but are attempting to replicate the Georgetown, TX turf study at Oklahoma State as well. Adding moisture sensors to the soil and building a rain shelter. We are also adding more yards to the list in Georgetown in 2015. We applied AquaSmart PRO on other yards but did not change the irrigation schedules in 2014. The results were a good performing turf but little real data to compare. We increased the amount of homes we are aerating and applying AquaSamrt PRO so we can gather more data.