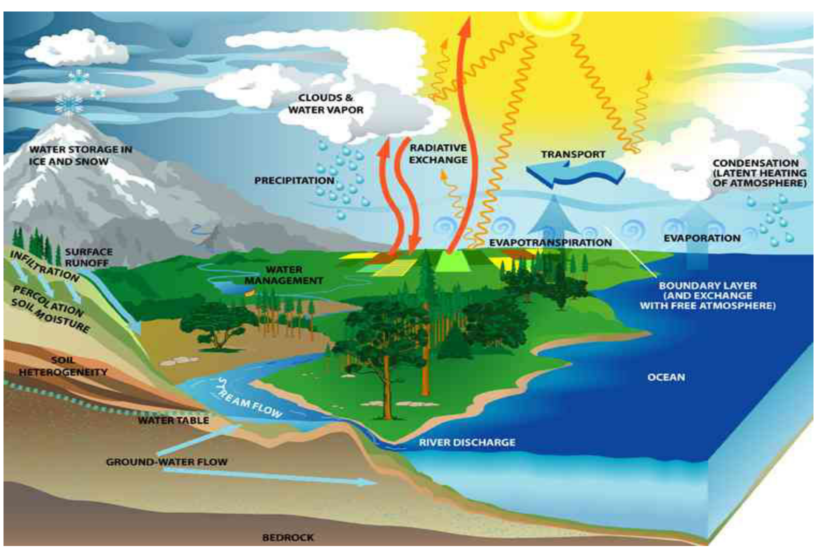
Drip vs. overhead on large slopes and landscapes

By Ron Stuart

“When the well’s dry, we know the worth of water.” – Benjamin Franklin

What is Water?



Water is unique – Water is the only substance found on earth in three forms solid, liquid and gas. Water is relatively incompressible. Water regulates the earth’s temperature. Unlike other liquids, water expands in freezing.

Water is quality of life – We use water to bathe, cook, clean, recreate, add ambiance. Water causes us to travel to it just to look at it i.e. the ocean, a lake, a fountain. Water is used for a multitude of manufacturing processes and waste removal.

Water is property value – Property values are typically higher in areas located near lakes, streams or other bodies of water or where water is readily available through import or processing. They sharply decline in areas where water is not available.

Water is economy – The nursery and landscape industry employs over 600,000 workers during peak seasons. The nursery and landscape industry revolves solely around the application, channeling and management of water in a given area. The multi-billion dollar industry creates controllers, piping, sprinklers, filters and a multitude of other devices for the given purpose of keeping plant material alive and healthy.

Water is life – The human body is made up of 66% water, the human brain is 75% water. Water is essential for the flow of blood, absorption of nutrients and division of cells. Water is the most precious resource on earth and the only one we readily throw down the gutter.

Introduction

The landscape industry as a whole is quite unique. No other single industry has as large an impact on the direct property values in California. Aside from this, no other industry has been entrusted with the only resource in our world that we literally cannot survive without. It is also has one more unique quality. It is the only industry of it's kind that requires no formal education or experience to participate in, in fact it is often looked upon as the job people find when they are uneducated and cannot get a "real" job. When was the last time you heard of a person looking for the lowest bid for open heart surgery? Even the workers at your favorite fast food restaurant are required to study and pass a test just to serve your food. As an industry, we need to bring the value of our positions and abilities back into the market so others do not dictate the future of our careers. Lack of education is the single largest waster of water in the world! We simply do not fully understand it's value.

As our communities grow and water becomes a more precious resource, we are looking to innovative ways of irrigation to meet the changes in legislation and off set the increases in water use and water costs. Even though, the concept of point drip irrigation is little used in the ornamental landscape industry it has been effectively used for years in both the nursery and agricultural industries. This type of irrigation has been successfully used in Middle East countries where water is very scarce and extremely expensive for years. The design of the irrigation layout is just as important as plant selection. Although certain plants do not perform as well under this type of irrigation in our desert climates, many plants perform even better than under a traditional style of overhead irrigation.

Background

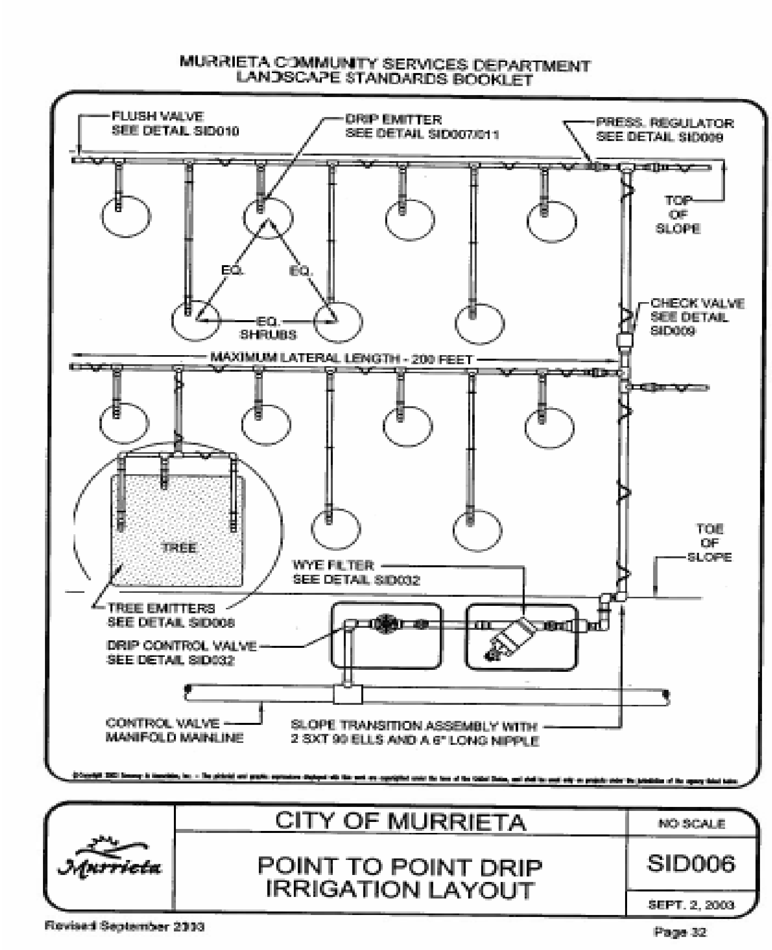
Back in 1999 we ran into a dilemma regarding budgeting and power shortages to our projects, since 1997 with the passage of proposition 218 we were no longer able to just raise assessments to cover year to year increases as they occurred from local utilities. By 1999 the State of California was experiencing shortages in electrical power and electricity costs were expensive and increasing. Around this same time, a Developer submitted a plan for review and approval which incorporated the use of multiple controllers, 3" mainlines and the use of two booster pumps to irrigate the 8+ acres of hillside landscape around two new communities. With the ability to charge for fluctuations in assessments being locked, the costs of electricity going up, the uncertainty of available power and the long term costs of using and maintaining these booster pumps we decided to meet with the Irrigation Designer, Sweeney and Associates. We wanted to see if we might be able to explore any non-conventional solutions to the impending money pit.

The designer told us of another design he ran across that incorporated the use of a "point drip" type irrigation system, (irrigation that is installed on a predetermined grid pattern to cover a specific area rather than laying out the irrigation to a preinstalled plant layout), and we asked him to draw it up. The original idea seemed to work well and considerably reduced the installation costs by alleviating the need for booster pumps, mechanical joint restraints on the larger pipe (smaller mainlines now worked hydraulically), the total number of valves was reduced enough to use single controllers and all the piping was downsized. It even resolved issues with water window conflicts. A few modifications and the plans were approved.

Before we began the physical installation of the project, the installing contractor stopped the development stating that the design wouldn't work. Since neither our department nor the irrigation designer had extensive knowledge in this type of application, we chose to listen. The original design showed piping going both uphill and downhill off the horizontal lateral lines or branch lines. This was changed to prevent siphoning back into the lines when the system was off and draining through the downward facing lines, as well as a few other key elements and off we went again with the design and installation. Eight years later we discovered some amazing data that was not even considered during the initial design and installation.

The Design

The design is based on a preset on center spacing that is held constant across a system or valve, typically we used either three or six feet on center spacing dependent on plant variety. The original installations were installed in soils which ranged from course sandy loam to clay to heavy sand. The average PH was about 7.5-7.7.



Critical elements for long-term maintenance consist of a large variety of other considerations. Because visual verification of system performance can be difficult to obtain, a controller capable of reading accurate flow was used. This allowed for personnel to check valve performance at the controller and also alert them to any potential problems. Although this is a useful tool, it doesn't alleviate the need to walk the systems on a regular basis as is done for traditional systems. Once an average flow was obtained for each valve, pre-set high and low numbers should was used. This prevented the controller from continuing to "learn down" flow rates if the system slowly plugs over time.

Obviously, with the usage of a controller that reads flow, a flow meter was used. The flow meter was compatible with the controller and able to read within the ranges used by the system. Accurate control of the system by the use of a flow meter allowed for larger systems to be designed because the potential for an unseen failure was great. Examples of these were the large 2:1 slopes in the back open space areas.

Along these same lines, the system was designed with a pressure regulator and master valve to shut the system down if there was a high flow reading. Even though the point drip system releases at a lower flow rate (typically 16-23 GPM's), than a traditional system, a stuck valve can run unnoticed longer and saturate a slope to the point of potential slide. A master valve properly used greatly reduced the opportunity for this scenario to take place. The master valve was used with a pressure regulator, this allowed for the pressure to begin lowering in the system reducing the ultimate stress to the mainline over time. The pressure regulator should also be of a type that will effectively regulate within the given system parameters.

Every RCV was also a pressure regulating type. This continued to adjust the pressure down in steps and also allowed for more site-specific regulation according to each zone condition. All valves were designed as 1” size for consistency in zone size and to reduce overhead.

Contamination from debris is the number one cause of failure in a commercial drip irrigation system and the usage of proper filtration is critical to the long-term effectiveness of the system. At the POC, a basket/flushable screen was used. After each RCV the use of a disc strainer was also incorporated. Every emitter installed on the system was also individually able to flush debris through their orifices. If it cannot perform this action than a filter at the emitter should be installed. This allowed the individual emitters to not clog as easily and has given years of satisfactory performance to the system.

Immediately after the RCV assembly area, the piping was installed at 1 1/4” along the main lateral or “trunk lateral” of the grid pattern, larger than the hydraulic needs required. This allowed the system to “reserve” a larger mass of water creating a quicker charging of the system, which reduced the total run time for each station. The reserve of water in this column was maintained through the usage of either swing check valves or spring check valves. These check valves were placed at the toe of slopes and one foot uphill of any tee or tee assemblies off this line. This allowed for a maximum amount of water to be reserved and also gave ease in the locating of these check valves.

One foot off the main lateral from the transition tees, a low flow pre-set in line pressure regulating valve was used on each branch line. This allowed for the continual step down of the pressure and for even pressurization of each line eliminating the need for compensating emitters. By using the low flow in line regulating valves, we found that in the case of a break, they reduced the flow of water by shutting down and kept erosion to the landscape at a minimum.

Drip layout shown on slope

All the branch laterals were designed to be only a ½" size in diameter and laid horizontally to grade. This not only reduced the total cost for the installation and the maintenance of the system but also reduced the total time for charging and discharging the lines, giving more accurate irrigation control. These lines were also made from rigid PVC piping to reduce the incidence of breakage and also alleviate damage from digging or rodents. At the ends of these pipes a flush cap was installed.

After the initial design using hard PVC piping and street ell assemblies to the plant, a flexible PVC lateral change was made to irrigate each individual plant from the rigid branch lateral line to the emitter. These "stick lines" all generally placed in a downhill format to create a positive draining of the system and reduce back siphoning when the systems are turned off. This flexible line allowed for a better attachment to any variations in the grade and could be moved aside to either work on the emitter or dig around the plant. The flexible PVC lengths were sized according to design and final plant spacing and pre-assembled by a manufacturer for consistency and quality control. All the flexible PVC laterals were Teflon taped to reduce the chance of undesirable leakage in the system. All of the piping from the valve to the emitters was j-hooked into place on a ten foot spacing.

The emitter was a ½" threaded type. These not only sped the process of installation and repair but also tended to be more durable, lasting longer in a commercial application without leaking through a punched hole. Every emitter had the same flow rates. This prevented the maintenance personnel from having to decide which emitter goes where and changing the distribution uniformity through lack of knowledge.

Because the field conditions and square footages varied from the drawings, all the laterals were installed prior to any actual plant layout and the irrigation grid determined the final plant placement. ***We did not irrigate by the planting plan!*** The planting plan was considered diagrammatic for purposes of uniform bidding and concept only. This greatly reduced any confusion and cost to the installation personnel with regards to the final layout of the irrigation. It also ensured a more uniform, higher efficiency system. Although, the irrigation design can be considered “inappropriate” by conventional design standards, we have found that the end result was significant enough to consider it an absolute success.

At the completion of the first location we had two different emitter manufacturers do some catch can testing and they found that the design met with their performance standards. We also invited two different landscape architects, a maintenance contractor, an installation contractor as well as several other municipalities. We wanted to find what flaws would be discovered from the different disciplines. Everybody felt that all the difficulties with irrigating large areas on drip in a commercial application had been addressed. When all was said and done the entire area was mulched with a 4” layer of rough grade tree trimming mulch, which had a good balance of both leaf matter as well as wood fiber.

Results

The following was our findings in both installation costs and water usage over the past seven years.

As you can see by the tables below, there has been a significant reduction in water usage compared to actual budget amounts. The numbers provided were the water usage as provided by the Rancho California Water District from a history search. The water rates as well as the energy costs were generated from the actual charges found on a typical potable water bill at the time of the calculations, water rates have gone up since this study. As is apparent the water savings vary from approximately 63% to as high as 90% depending on year and maintenance practices. An overall average of low to mid 70% savings has been experienced over the past seven years.

These numbers are reflective of an uncontrolled real world environment. This area was under the control of the installing contractor and developer in the first two years, the County of Riverside CSA143 and it’s maintenance contractor for a few years, the City of Temecula as well as the Redhawk Communities Homeowners Association currently. The pattern showed no control over usage, typical of the average contractor’s knowledge and abilities to irrigate the area. The only constant is the usage remains around 70-75% and the landscape continues to grow as seen in the pictures.

Drip Usage vs. Overhead Usage Comparison — Tuesday, September 30, 2008

Project Name: Vintage
Meter #: 1561966 — Account #: 01-0000067-2
Square Footage: 366,237 — *MAWAB: 18,186

	Base	2008	2007	2006	2005	2004	2003	2002	2001	2000
Unit costs:		$0.6607	$0.6607	$0.6607	$0.6607	$0.6607	$0.6607	$0.6607	$0.6607	$0.6607
Energy Costs:		$0.1021	$0.1021	$0.1021	$0.1021	$0.1021	$0.1021	$0.1021	$0.1021	$0.1021
January	673	549	362	326	7		306	60	283	
February	928	203	224	124	0	153	300	64	79	
March	1291	0	282	219	0	114	366	72	9	
April	1328	163	247	332	0	116	110	127	22	
May	1964	808	274	407	644	390	507	329	34	
June	2273	699	440	300	172	731	312	376	103	
July	2546	784	793	420	644	1747	551	449	122	257
August	2437	634	794	643	841		567	532	259	225
September	1964	808	848	595	1087	1156	729	778	383	287
October	1328		797	607	715	990	775	772	349	291
November	837		733	440	825	683	578	466	313	363
December	618		929	187	320	12	428	381	146	359
Yearly Total	18,186	4,642	6,723	4,600	5,255	6,092	5,576	4,426	2,102	1,782
Amount Saved		13,544	11,463	13,586	12,931	12,094	12,610	13,760	16,084	16,404
Percent Saved		74.48%	63.03%	74.71%	71.10%	66.50%	69.34%	75.66%	88.44%	90.20%
Percent Used		25.52%	36.97%	25.29%	28.90%	33.50%	30.66%	24.34%	11.56%	9.80%
$$ saved		$10,331.67	$8,744.28	$10,363.70	$9,864.07	$9,225.61	$9,619.21	$10,496.43	$12,269.18	$12,513.27

Total Saved: $90,427.42 — Average: 72.69%
Units Saved: 122,460 — * MAWAB (Maximum Annual Water Allocation Budget)

Drip Usage vs. Overhead Usage Comparison — Tuesday, September 30, 2008

Project Name: Eastridge
Meter #: 2658784 — Account #: 01-0000066-2
Square Footage: 224,018 — *MAWAB: 10,576

	Base	2008	2007	2006	2005	2004	2003	2002	2001	2000
Unit costs:		$0.6607	$0.6607	$0.6607	$0.6607	$0.6607	$0.6607	$0.6607	$0.6607	$0.6607
Energy Costs:		$0.1021	$0.1021	$0.1021	$0.1021	$0.1021	$0.1021	$0.1021	$0.1021	$0.1021
January	391	0	214	183	0		52	24	257	
February	539	52	338	68	0	102	194	28	41	
March	751	18	212	307	0	31	198	27	10	
April	772	64	129	143	0	53	31	70	16	
May	[illegible]	174	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19	
June	1322	184	334	239	65	286	160	173	59	
July	1481	512	369	307	159	404	289	241	77	0
August	1417	509	388	279	181	330	296	279	74	0
September	1142	471	462	331	20	754	485	395	222	69
October	772		180	223	193	588	514	451	247	13
November	486		416	150	165	249	443	379	191	174
December	360		508	102	223	0	315	151	90	248
Yearly Total	10,576	1,972	3,682	2,549	1,040	2,991	3,270	2,420	1,303	504
Amount Saved		8,604	6,894	8,027	9,536	7,585	7,306	8,156	9,273	10,072
Percent Saved		81.35%	65.18%	75.90%	90.17%	71.72%	69.08%	77.12%	87.68%	95.23%
Percent Used		18.65%	34.82%	24.10%	9.83%	28.28%	30.92%	22.88%	12.32%	4.77%
$$ saved		$6,582.76	$5,258.37	$6,122.63	$7,273.69	$5,785.47	$5,572.65	$6,221.03	$7,073.06	$7,682.56

Total Saved: $57,552.23 — Average: 76.69%
Units Saved: 75,449 — * MAWAB (Maximum Annual Water Allocation Budget)

How much does all this cost? The average cost per square foot is comparable to slightly higher than a traditional overhead design. A typical installation cost for traditional overhead system of a 33,750 square foot project in 2005 was $0.8637 per foot. A 332,134 square foot drip project in 2006 was rated at $0.8382 per square foot and a 94,519 square foot project in 2007 was only $0.9638 per foot. Even if the costs were identical, the water savings alone for the drip, soon tips the scales in it's favor.

Benefits

The water savings was tremendous. Between the initial two installations, a savings in excess of more than 203,512 units of water has been realized. According to statistics provided by the Environmental Protection Agency, the average adult requires 64 ounces or a half gallon of water a day to survive. Given these statistics the saving from these two projects equates to enough water to keep over 834,118 people healthy for one year.

Water savings also translates into energy savings reducing the carbon footprint as well as a very real financial benefit both through the water costs and a reduction in maintenance costs by as much as 20%.

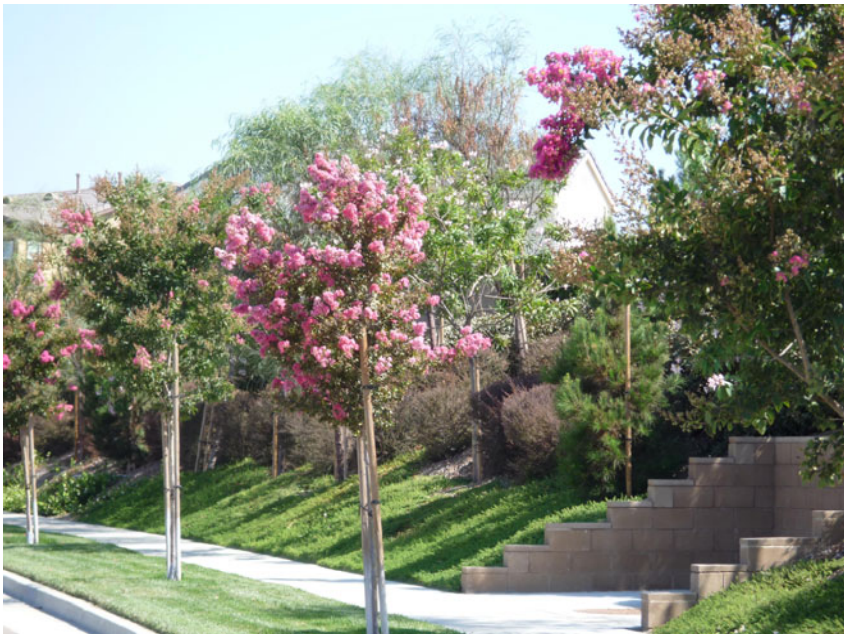
Based on water costs alone, these two developments have produced a savings of over $155,248.36 since initial installation. These numbers will vary based on water costs and increases within a given district.

As landscapes mature and fill in drip systems do not require the raising of heads or trimming back of plant material which are blocking the spray patterns, causing dieback in the interior of the landscape and exposing the systems to increased vandalism.

The mulch acted as a short term fertilization program that amended the soil and stimulated the bacterial activity in the soil matrix. It also became a quite effective erosion control and brought aesthetic integrity to the job.

Drip designs eliminate Storm Water Pollution Prevention concerns. This photo depicts a low volume stream spray system. Overhead systems all have this inherent problem.

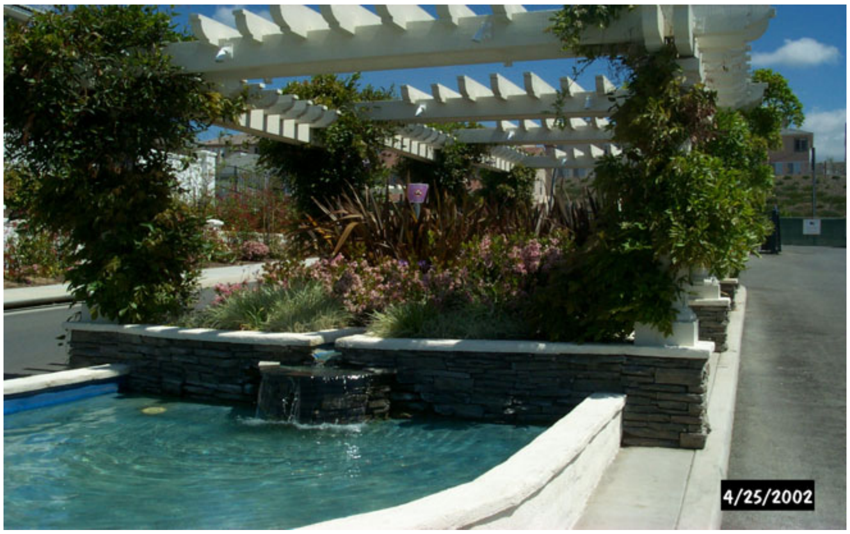
These benefits do not come at the cost of aesthetics either. The plant palette was typical of those found within our region and not only have they performed as well as in any other landscape but many outperformed the traditional overhead system. Based on a six foot grid pattern, we have experienced plants touching as soon as six months and areas completely filling in by eighteen months. We have planted drought tolerant plants such as Pyracantha and Acacia spp., as well as higher water users such as roses, Raphiolepis and Myoporum. With very few exceptions, most plants performed better under the drip environment. Baccharis is one exception.



We quickly created this to be a standard within the County of Riverside which was followed by the City of Temecula, the City of Murrieta and Valleywide Parks and Recreation Department. More municipalities may have adopted the design that we are not aware of. Each entity has taken the original design and performed slight modifications and product preferences but the concept remains the same.
We have successfully installed millions of square feet of this system into the landscape and development areas including 1:1 granite hillsides that required rappelling equipment to install the irrigation and plant material, sandy slopes that fall apart when they get too wet, in parks, parkways, medians and retrofits.

As a follow up with Lance Sweeney of Sweeney and Associates, he states that some clients have increased the number of emitters per plant to provide additional water. Rudy

Adame with Adame Landscape who is in charge of much of the Valley Wide designs keeps their designs to no further than 4' on center spacing. Kevin Herrington of the Temecula Community Services Dept., has stated their only problem is they don't have enough systems and the maintenance contractors continually need to be reminded to clean the filters. Maintenance practices are slightly different for this type of system. Keeping the filters clean on a regular basis greatly increases the long term success of the system.



Although there are many great ideas for water management, we have never seen any so consistent in its performance. With the water saved in the non turf areas, perhaps we will be able to still maintain healthy full dimensional gardens and landscapes. There are course other solutions to our water crisis that are suggested but less than desirable.

This can be our future if we don't consider what we are doing and start to react in a more positive approach.

This paper is dedicated to the memory of Sam Toby of Salco products, whose inspiration, encouragement and help have all been tremendous driving forces in the long term success of this endeavor.

References

Tim Barr, Resource Planner, Rancho California Water District, 42135 Winchester Road, Temecula, Ca 92590

Lance Sweeney, President, Sweeney and Associates, 38730 Sky Canyon Drive, Suite C, Murrieta, Ca 92563

Rudy Adame, President, Adame Landscape, 41863 Juniper St., Murrieta, Ca. 92562

Kevin Herrington, Parks Superintendent, City of Temecula, 43200 Business Park Drive, P.O. Box 9033, Temecula, Ca 92589-9033

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