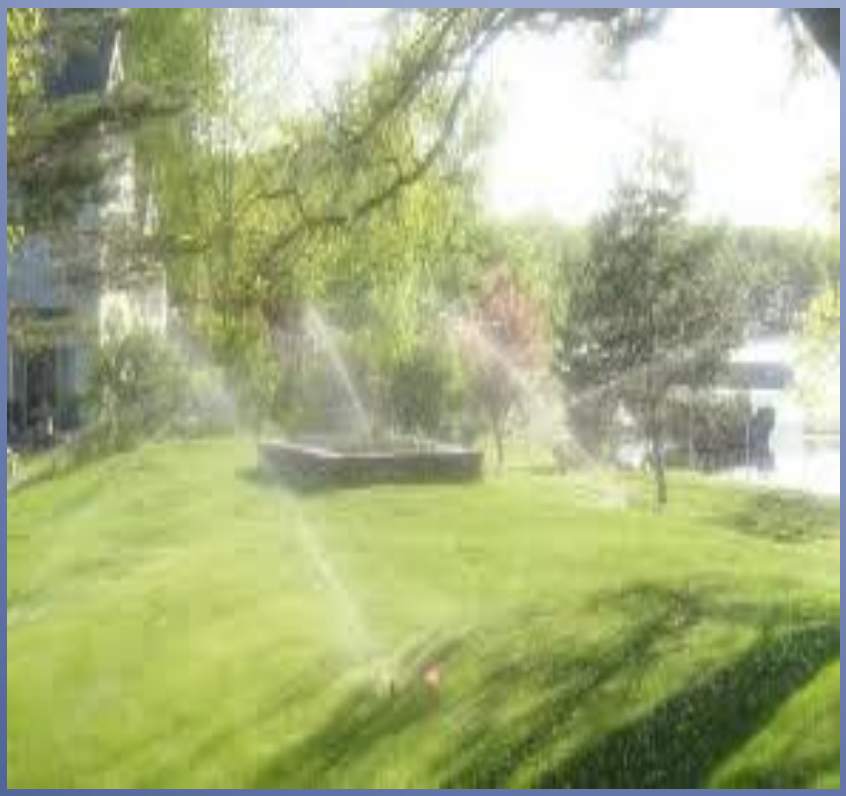

How Inefficient Irrigation Wastes Water And Costs Money

Part of a series of documents created by Tim Guishard Enterprises discussing relevant subjects in the groundwater industry.

This document discusses how efficient irrigation design and irrigation audits cost effectively reduce water consumption.

I want to install a well to irrigate my yard, because my water bill is "THROUGH THE ROOF". What is the cost to drill a well?

We in the Groundwater industry get this call a number of times each year. There is not an easy answer to this question. All wells are not the same. Some might be deeper or shallower than others. One might produce more or less water than a well just a few feet away. Some have unanticipated treatment costs. Some irrigation systems might need a storage tank and booster pump system to meet the pressure and volume requirements of the irrigation system.

First off, let's discuss why your water bill (or use) is so high. Some Facts:

FACT: All underground, automatic, irrigation systems are inefficient in the first place. At best, you can only expect an efficiency of 80% when using drip irrigation products. When using spray products, you might be able to get 70% efficiency. *When Irrigation Audits are done, many irrigation systems are found to be as low as 30% efficient, and very few are over 50% efficient.*

THE REASON: It is impossible to set a time clock and expect that it will need to know exactly how much that tree, plant or grass will need on a given day. The temperature, humidity, and wind, on a specific day will impact how much water plant will need to get. ***Unless you either modify the time clock manually each hour, or have a sensor attached to the controller that will adjust for these climatic events, you are probably overwatering.***

FACT: If plants are located in different microclimates around a yard, the plants have differing water needs. *Example: a plant that receives full sun will require more water than a plant that only gets sun in the morning. Rarely is an irrigation systems designed to mitigate these microclimates, so some parts are overwatered.*

FACT: If plants are located in different soil types around a yard, the plants have differing water needs. *Example: a plant that is growing in deep sands will require more water than a plant that is located in clays. Sand allows water to drain freely, while clays hold water better for a plant to draw on for long periods of time.*

FACT: The steepness, or flatness, of the land affects how much water can be applied without running off, or going so deep that the plants cannot use the water that is applied. *When the same amount of water is applied to areas of differing slopes; the flat land will generally accept more water before ponding occurs, while water will run off the sloped areas frequently onto roads or other areas where the water does no good.*

Tim Guishard Enterprises
3508 Alpine Boulevard
Alpine, CA 91901
timswatersolutions.com
619-589-9433 Office
619-659-8419 Fax
guishard@sbcglobal.net

FACT: Frequently people do not design, or maintain, irrigation systems or landscapes for efficient irrigation. *When the landscape was designed, the landscape designer may not account for the type of irrigation heads that are available to water that specific shape, thus overspray lands onto areas it was not needed. Alternately, over the years the landscape changed, and areas that used to be grass, are now shrubs. No one gone back and changed the irrigation system to match the new match the new landscape design. Sometimes the grass and plants are allowed to grow above the sprinkler head, and the head no longer sprays as far as it used to.*

FACT: When a landscape area has a dry spot, the first thing people typically do is add more heads. *This practice ruins the hydraulic efficiency of the piping system. What should be done is delete, adjust, or redirect, heads in the wetter areas.*

FACT: Most people do not test their irrigation system enough, and replace irrigation heads when they are broken. *At a minimum, irrigation systems should be tested weekly, but rarely are they even tested monthly.*

FACT: Many people who install and repair irrigation systems do not have the knowledge to properly design for hydraulic efficiency, or do not take care to do the proper design. If your residential irrigation system requires more than about 60 PSI, the irrigation system is probably hydraulically inefficient. This can create areas where the water pressure is too high, or too low for the heads to work properly. *When the pressure is too high, the water droplets coming out of the head are to light and wind easily blows the water everywhere except where they are needed. At pressures that are too low, the water droplets are too heavy and fall to the ground way sooner that they need to get where they were supposed to spray to.*

FACT: Most spray type irrigation heads only require 15-30 PSI, and when the pressures are out of these ranges the heads to not spray evenly. *A sprinkler head running at 30 PSI versus 15 PSI: discharges about 30% more water, waters 45% more area, and this equates to precipitation rate that is 30% lower per square foot, than if the head were run at 15 PSI. The pressure in each irrigation zone should be maintained within 10% from the beginning to end, to keep hydraulic efficiencies within cost effective tolerances.*

FACT: Most rotor type sprinklers need more pressure than spray heads, and deliver about the same GPM, but water more area. *If spray heads and rotors are installed on the same valve, you will have dry and wet spots.*

IRRIGATION AUDITS can detect where irrigation improvements can be made to reduce water usage. They are easy to perform, by even and untrained person. A simple test uses tuna cans that are placed around the yard in a 10’ or 20’ grid pattern. Do this for every irrigation zone (valve). If an area gets water from different zones, make sure that you leave the cans in place until all zones in that area have watered.

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3508 Alpine Boulevard
Alpine, CA 91901
timswatersolutions.com
619-589-9433 Office
619-659-8419 Fax
guishard@sbcglobal.net

1. Run the sprinklers for their normal time period.
2. Measure the volume in each can and record both the volume and where it came from. Anything from a graduated cylinder to a tape measure can be used to measure the quantity. A small 50-100ML graduated cylinder is probably the most accurate.
3. Take the lowest volume and divide it by the highest volume to get a percentage.
4. Add the volumes and divide by the number of cans to get an average.

If you get more water on average in a specific irrigation zone, lower the time in that zone.

Likewise if you have a zone that has less water than other zones increase the time.

Where you have a detected a wet-spot in a specific zone, reduce the number or volume of heads near the wet spot, or redirect heads to dryer areas.

Retest after the modifications have been made.

More often than not, huge savings can be realized by making modifications that were found in an irrigation audit. Proper maintenance of the irrigation system can also save money. These savings alone will pay for themselves in a matter of months, in reduced water consumption.

Tim Guishard Enterprises
3508 Alpine Boulevard
Alpine, CA 91901
timswatersolutions.com
619-589-9433 Office
619-659-8419 Fax
guishard@sbcglobal.net

Some of the issues with irrigation systems, that are compounded by wells and their related pressure systems.

Some well and pump facts (and a few myths):

FACT: No well will last forever. *Wells are affected by so many factors; it could take several pages to discuss them all. I will discuss a few below. Wells constructed to keep the initial price low, will last less than 20 years. Quality wells, that are designed for longevity might be 2-times more costly today, but will not need to be replaced for 40 years or more.*

FACT: Just like local droughts affect surface water or streams, droughts effect wells usually in a time delayed fashion. *Rain today, may mean groundwater several years down the road. A drought today may not affect a well for many years later. Studies have computed that water only travels about 1-2' per year into the formation. Your 500' deep well is producing water that fell on the ground 250-500 years ago!*

FACT: No well is sand free. No matter how much you spend on getting a well drilled, it will never be sand free. Frequently property owners only look at the price when choosing their well driller, and choose the lowest price. To compete for price; drillers cut corners and omit development or set shallow steel casings in their well construction estimates. Both of these factors affect the final outcome of a well. Add in Mother Nature that likes to throw in her 2-bits, and now you have a recipe for disaster. *The driller may not want to increase his price, because you are on a tight budget and may not even drill a well if it gets too costly. If he comes back for a change order, you think the driller is trying to take advantage of you. Well drilling estimates should never be compared by the price-per-foot. Drillers are at fault here for quoting by the foot, and not by the actual time and materials needed to properly construct a well.*

If a well only has 20' of casing, it most likely is not cased into really hard rock, and may even start to collapse during drilling. Too many times, drillers think that the well is collapsing down deep, when the problem is really just below the bottom of the casing. I highly recommend having a video survey before a "liner" is installed in a new well. It is much better to add more casing than install a liner. Once a liner is installed, the well cannot be deepened in the future.

AGAIN: No well is sand free! *Sand also wears out your sprinkler heads, causing them to consume more water, which lowers the pressure, decreases the irrigation efficiency, and increases the maintenance costs. Likewise, sand wears on the pumps as well, increasing maintenance.*

FACT: Many wells will need borehole maintenance just to keep providing water. Water chemistry like hardness, or microbiology like Iron Reducing Bacteria, will plug a well. *Chemical intervention is needed to*

Tim Guishard Enterprises
3508 Alpine Boulevard
Alpine, CA 91901
timswatersolutions.com
619-589-9433 Office
619-659-8419 Fax
guishard@sbcglobal.net

restore capacity. For cost reasons in today's marketplace, chemical intervention is costly. However if you only have one place for a well, and it can be brought back up in capacity, this might be a viable option.

FACT: The pressure variations that are inherent to all submersible and booster pump systems when controlled by a pressure switch will decrease the hydraulic efficiency of the irrigation system. *When the pressure varies by 20 PSI or more as needed for the pressure switch to work, or the water levels in a well change (reducing pump output by 50% or more), these are transferred to the irrigation system. This is especially troublesome if a pump is oversized or the well is deep. VFD or Variable Frequency Drive technology improves the pump system efficiency and makes the pressure more stable so that irrigation systems work more efficiently, within the capacity of the pump. A VFD is like a cruise control for your pump.*

FACT: Not all pumps are created equal. Pump efficiencies vary by model and manufacturer. *One should not choose a pump by HP and price alone. The buyer should choose a pump by the: electrical, and hydraulic, efficiency that can described as GPM @ Total Dynamic Head (or pressure in PSI) combined with the motor's horsepower and electrical efficiency. Frequently the more efficient a pump is; the motor HP can be lowered, resulting in a lower cost for the electricity to operate the pump in the long run. We also have what are known as PREMIMUM EFFICIENT motors available, and these motors can save several KWH over a standard motor. Since KWH is what your electric bill is based on, the savings are directly impacted.*

MYTH: Bigger is better when it comes to motors! The reality is: *Larger motors cost more to buy. Larger motors, on most household power supplies, have shorter life spans than smaller motors on the same power supply. Larger motors consume a lot more energy to get started than a smaller motor. Larger motors that are not worked at their design capacity consume more KWH than a smaller motor that is worked at design capacity. This is kind of like putting an 8-cylinder motor in a compact car. A certain amount of gas is needed just to get the large engine to idle.*

MYTH: A bigger pump is better than a small one! Again the truth here: *Larger pumps cost more to buy. Using a larger pump than is needed, is like applying the brake on your car instead of letting off the gas, when you need to go slower up a hill. You are only wasting energy. If the pump is controlled with a pressure switch, the bigger pump will turn on and off more frequently, which is like traveling in stop and go traffic. The pressure variations significantly affect the irrigation efficiency again.*

MYTH: A VFD will reduce power consumption, even on an oversized pump system. There is also some truth here! *However since the larger pump and motor take more energy just to idle, putting a VFD on an oversized pump will not be as efficient as using a property sized pump and motor. This would be like one person taking a bus to work, when they only need a mid-sized sedan or maybe even a compact car.*

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619-659-8419 Fax
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MYTH: Well water is free! *While the water you get today might be free, the cost to drill and equip the well in the first place, the electricity to pump the water, and the costs to maintain the pump/ well/ and related components, is not free. If you hire a contractor by price alone, you might end up with a well that only lasts a few years. Additionally, there are efforts by people at various water districts that think that by you pumping water out of "their watershed" you are stealing "their water". Be careful, the next time you see a ballet measure that is looking to "protect our rivers and streams" or "some other catchy water, or pollution, related title", as it might be the measure that takes the well (you paid to construct and develop) away from you.*

MYTH: The well pump needs to be set at the bottom of the well to get everything the well will produce. OR The drillers log accurately shows how much water the well makes. While this may be true for a small percentage of wells, this is not the truth for most constructed in fractured rock found in San Diego County.

Frequently some water is obtained at very high fractures in the well. The driller and property Owner might be looking for more water production, which is never found. In these cases the well should be backfilled to within 50', or so, of the lowest producing fracture. Then tested for production using a pump and what is known as a "step-draw-down test".

Sometimes water is found in many fractures, all the way to the bottom of the well. Again a step-draw-down test, with a pump, should be conducted.

A step-draw-down test is a test where an oversized pump is installed in the well. The water levels in the well are monitored while pump is turned on and adjusted to various flows based on time. The results are then tabulated and one can determine various data like:

- How much total volume in GPM is really available? *Sometimes the air used to purge the cuttings from the well, and this air will actually hold back some water. When the well is pump tested there is more water at a higher elevation available than the airlift indicated. More often than not, the well driller hits a fracture with a lot of storage, but little recharge and the well reduces capacity after a short time.*
- Where in the well is most efficient? *Pumping from a higher elevation takes less electricity, than pumping the same amount of water from a deeper elevation. Ta higher pumping level can allow a smaller pump to be installed, which also allows using smaller wire, saving money at the time of installation and future maintenance.*
- What will the pumping level be? *Pumps are designed to work within a set of specifications. Work outside these specifications, and the pump may cavitate, have excessive up-thrust, or continuously overload the motor, causing the pump or motor to fail prematurely.*

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Alpine, CA 91901
timswatersolutions.com
619-589-9433 Office
619-659-8419 Fax
guishard@sbcglobal.net

Follow a step-draw-down test with a constant-rate test, and one can determine the effects of long term pumping. This test has shown that many wells cannot sustain long term pumping at a rate shown on the drillers log, and can predict the well will go dry after days-weeks-months. It also can show that at a specific pumping rate and you can pump the well 7-24 without worry (assuming there are no external factors added in later, like another well being drilled that is on the same fracture!).

MYTH: A well costs less than city water! *I had to increase the font to make the point! While you currently can pump more water with electricity than the same cost of water, you need to calculate in your water cost:*

- *The initial cost of the well.*
- *The cost of maintenance.*
- *The future cost of power/water.*
- *The eventuality the well will need replacement.*

At today's costs for power and water, most residential well owners will never realize a true cost savings by constructing their own well. Well water costs much more to produce and maintain, especially if the well is not constructed properly or well. However if water rationing ever comes into play, then a well can pay for itself overnight by saving your landscape.

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Alpine, CA 91901
timswatersolutions.com
619-589-9433 Office
619-659-8419 Fax
guishard@sbcglobal.net