

**“Community Water Harvesting – The missing element in Sustainability”**

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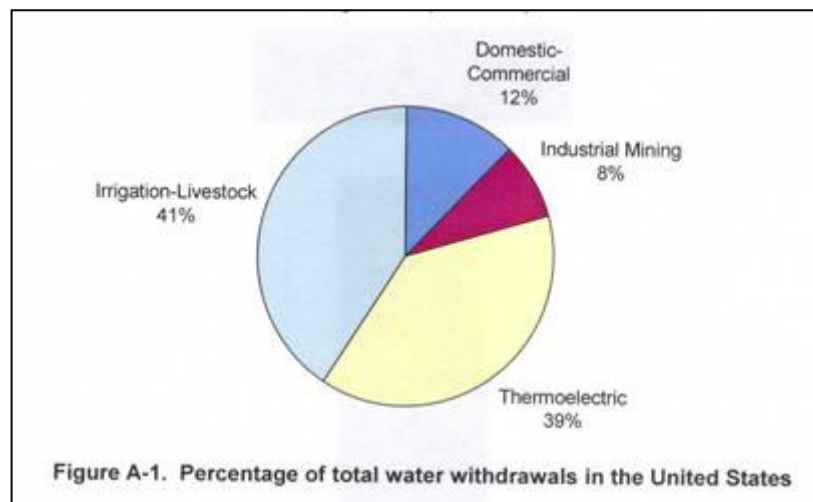
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To quote a recent Reuters Press release - *“Faced with record low dam levels, Australia’s major cities have introduced limits on household water use, and city dwellers are sharing the pain of a drought that has devastated rural production and cut 0.5 per cent from economic growth.... In the suburbs of Sydney, Perth, Melbourne, Adelaide and Brisbane, the lush green lawns which were once a hallmark of Australian suburbia, have mostly turned brown after authorities banned the use of sprinklers.... In the second largest city of Melbourne, 100 officers in 30 cars are on suburban patrols around the clock, issuing fines to people that waste water.... In the dry and dusty nation’s capital Canberra, authorities have banned people from washing their cars.... Across the country, authorities want to cut water consumption by between 20 and 30 per cent by 2030.”*  
(James Grubel, Reuters, Feb. 13, 2007)

The impending water “crisis” exists not because we are creating a larger carbon footprint but simply because existing infrastructure related to water management is inefficient.

In an analysis of any water use models as in the following chart, it clearly shows that domestic use and consumption is a relatively small percentage of total water use.



Yet most of the regulatory policies and proposed curtailment changes are in the arena of water conservation on the domestic side. Watering times, water saving devices, lot sizes, grass or no grass policies, etc.

Two outdated yet ingrained philosophies of infrastructure design that greatly affect water use inefficiency are: **1. Domestic water supplies for indoor and outdoor use must be**

**of drinking water quality, and 2. Storm water is a waste product that must be shed off the property as quickly as possible.** Both philosophies evolved to extensive regulation, and construction standards for an expensive infrastructure procedure and systems.

Pressurized domestic water supplies have a historical rationale based in sound Public Health Policies and indirectly have been adapted to support the technical shortcomings of conventional sprinkler delivery systems. In urbanized semi desert climates, however, 2/3 of the domestic water supply use is consumed for outdoor applications. The irrationality is that we clean and polish water sources to impeccable drinking water standards and then post-contaminate 2/3 of this water with fertilizers so the plants can grow. The many contaminants we have removed are nothing more than nutrients needed by plants and present in raw water.

Since the advent of the first patented sprinkler system by Joseph Smith in 1894 watering plants by imitating rain has and is the dominant means for irrigation. Hence because of direct droplet exposure to humans, secondary watering supplies for irrigation were never considered and the bulk of irrigation continued with a system that at best is only 60% efficient. Many agricultural research projects have demonstrated improved water use efficiency and crop productivity through subsurface irrigation over 30 years ago, yet the lack of water conservation interest, some technical difficulties in delivery systems made these early attempts on water conservation poorly accepted.

In 1999 breakthrough technology identified as the EPIC system turned the world of irrigation upside down. Using a sand based rootzone, capillary physics for vertical water distribution and gravity for horizontal and drainage distribution, the passive system achieved 100% efficiency in irrigation, better turf quality and affordable low maintenance construction. Direct comparative studies demonstrated 58% less water needs as compared to sprinklers, and overnight the 2/3 water allocation in outdoor use for desert climates could be reduced significantly, without a change in landscape area, plant species or cultural habits.

	<b>Sprinklered lot</b>	<b>EPIC lot</b>
Domestic indoor use	407,000 liters.	407,000 liters
Outdoor irrigation needs	823,000 liters	346,000 liters
Total water allocation	1,230,000 liters	753,000 liters
Add storm water capture	1,230,000 liters (N/A)	407,000 liters

The non-pressurized EPIC system changed the first cardinal rule that irrigation water has to be pressurized and of drinking water quality. Irrigation could now be achieved with a number of water sources without any public health concerns. Domestic water, shower water reuse, and reclaimed water from sewage treatment plants could all be blended and be reused even in residential settings without any public health issues. However easier and more importantly, the EPIC system opened the doors for efficient capture and reuse of storm water directly. The system acted as a pre-filter for runoff sources prior to storage and then flipped as an efficient irrigation system during dry periods.



Figure 1. The above EPIC backyard provides 100% efficient irrigation and total storm water capture by collecting roof and hardscape runoff into system.

This changed the second cardinal rule in subdivision design – in that Storm water has to be viewed as a waste product and be removed from the property as quickly as possible. In recent years storm water capture and sub ground storage was made possible by a number of products from different companies. Inexpensive void spaces can be created by fiberglass tanks, arched polymer structures, bladder systems and concrete voids. Unobtrusively placed under driveways, road side edges, or landscaped areas, the structurally sound storage voids could now store water indefinitely for future use not only for irrigation but also for fire reservoirs or heat exchangers for geothermal heating and cooling systems.

Landscape design and irrigation became part of storm water capture and management. Lots could be custom tailored to climatic events and cycles to be totally self-sufficient for water irrigation needs with free water that came out of the sky. This is even possible in the driest parts of the world with less than 7” (17.7 cm) annual rainfall. Roof, driveway, and street runoff became integrated collection systems where water was pre-filtered, stored and then reused when needed. Infrastructure had a paradigm shift from waste to sustainability.

Most of the public does not realize that a one acre lot (4,000 sq. meters) of hardscape produces 715,000 liters of water in a 7” (17.7 cm) rainfall climate per year. This is enough irrigation water to sustain a landscape area of 4000 sq. ft. (371 sq. meters) a full year.



Figure 2. Cambria Elementary School, California

On a larger scale, (above) the Cambria Elementary School on the central California coast captures and stores storm runoff during the rainy winter months off a 12 acre site (48,000 sq. meter) to be reused as irrigation water for the rest of the year. With the collected and stored runoff the campus maintains 130,000 square feet (12,000 sq. meters) of turf grown in an EPIC profile. The property has no runoff issues even for 100 year storm events, and is off the supply grid for irrigation water.

These examples demonstrate that policies of ripping out grass and greenery for the purpose of saving water are simply reactionary policies that are unwise and unnecessary. Substantial greenery can be retained by simply managing available storm water at any development. Greenery is a vast improvement in aesthetic value, property value (hence tax base), cooler ambient air temperature, improved air quality and usable land space. Lack of greenery adds to runoff volumes, downhill erosion, increased ambient air temperature, increase in air pollution, and increased energy use. A test study in a Phoenix development (USA) showed that cooling energy needs can be reduced by a third by simply reducing the ambient air temperature from 90 degrees F (32.2 C) to 80 degrees F. (26.6 C). A ten degree cooling environment is easily achieved with evaporative cooling provided by living plants. The final irony is that the water that is lost in the process of power production to produce the extra energy needed to cool the building can actually be more than the water that is “saved” by ripping out the greenery. Narrow visions of water savings often ignore the complex interrelationships of energy and water.

Table 2. Total Consumptive Use of Water for U.S. Power Plants

Power Provider	Gallons Evaporated per kWh at Thermoelectric Plants	Gallons Evaporated per kWh at Hydroelectric Plants	Weighted Gallons Evaporated per kWh of Site Energy
Western Interconnect	0.38 (1.4 L)	12.4 (47.0 L)	4.42 (16.7 L)
Eastern Interconnect	0.49 (1.9 L)	55.1 (208.5 L)	2.33 (8.8 L)
Texas Interconnect	0.44 (1.7 L)	0.0 (0.0 L)	0.43 (1.6 L)
U.S. Aggregate	0.47 (1.8 L)	18.0 (68.0 L)	2.00 (7.6 L)



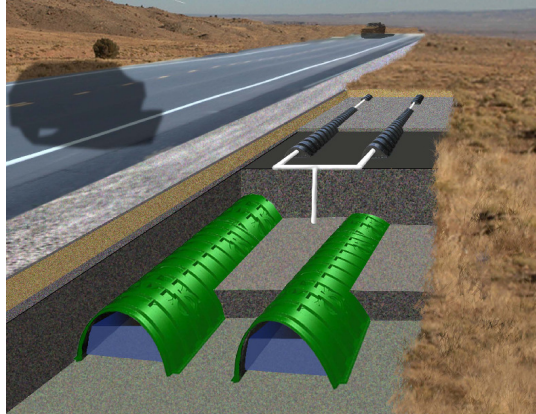
Hoover dam's generators produce 126 kWh per second, yet in that brief time period 74,800 gallons (283,000 liters) are released by the dam to achieve this energy rate. While it is true that downstream water volume has secondary agricultural and recreational applications, but it does illustrate an important association – 593 gallons (2,244 liters) of water have to be dumped to produce 1 kWh of power. The average household central air conditioning use in the western United States is 3392 kWh per year. You do the math!

The lack of implementing new infrastructure designs for the capture and reuse of storm water events is simply a waste of a valuable resource. The extensive hardscape created in our communities in the form of roads, parking lots, roof areas etc. can be viewed as necessary heat creating urban heat island structures or it can be viewed as collection areas for storm events. The trick for efficiency is to pre-filter the water prior to storage, enable early collection, provide underground storage to avoid evaporation loss, provide the mechanisms of reuse and transfer such that the systems are ready to receive the next storm event. The science and tools are available, the missing element is the broad political vision to implement the paradigm shift on how we treat storm water.

On a yearly basis communities are missing out on a potential free water resource of 4,624,000 acre feet (**5.6 billion m<sup>3</sup>**) in Melbourne; 11,953,000 acre feet (**13.5 billion m<sup>3</sup>**) in Sydney; 5,461,000 acre feet (**6.6 billion m<sup>3</sup>**) in Brisbane; 3,792,000 acre feet (**3.6 billion m<sup>3</sup>**) in Perth; 413,000 acre feet (**492 million m<sup>3</sup>**) in Canberra, and even 33,000 acre feet (**40 million m<sup>3</sup>**) in desert areas as Alice Springs.

In the US massive water procurement projects in the west like the Salt River Project in Arizona, Hoover dam, Lake Powell or the California Aqueduct and dam system are engineering marvels that made civilization possible in the arid west and are still the backbone for water needs. Yet new systems of this nature are no longer viable as we have no new river system to harness or empty canyons to fill. As the population demands increase, a total reliance on old infrastructure is a losing proposition. We have to be innovative and take advantage of natural storm water events regardless of frequency and duration and incorporate storm water capture as an integral part of procuring new water sources.

A simple technique is to look at roads as not merely transportation surfaces but potential aqueducts that capture and automatically transfer water resources to desired locations for reuse. Currently road storm water passes to the road shoulder to be absorbed in dry soil to grow a few weeds, or passed to road side ditches (a safety hazard) to the nearest dumping ground. The current philosophy is “**shed it, move it, and waste it!**”



The sustainability philosophy should be “**Shed it, filter it, store it, move it, and reuse it!**” Technologies are available to achieve the new philosophy’s goals at costs that are comparable to current expenditures to storm water movement systems in road construction.

Nevada, the driest and one of the least populated states in the USA has a roadway network of 33,951 miles (54,639 km.). Nonetheless the lost potential from these surfaces is **229,000 acre feet** (74,425,000,000 gallons) (**276,000,000 cu. meters**) of water. A new water resource without drilling a single well or tapping into a new river system?

The technologies for water sustainability are here. Do we have the political vision to start taking advantage of them?