NEW WATER MANAGEMENT STRATEGIES FOR OUTDATED CONVENTIONAL INFRASTRUCTURE DESIGNS

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INTRODUCTION:

In the last century water management practices for water supplies and waste water disposal have changed very little in the form of philosophy or approach in design. In summary centralized filtration and treatment systems procured water from locally available sources be it surface or underground aquifers, polished it to drinking water standards, and through pressurized piping systems provided "running" water at the consumer end.

At the other end used and "dirty" water was channeled into larger low pressure piping systems for direct discharge as is the case for storm drains, or to treatment facilities for sewage water before discharge to the Environment. For the most part the systems were hidden underground or located in remote areas of the community, and the average consumer knew little of the dynamics or structure. As long as water flowed when the faucet was turned on, and the "toilet flushed", life was good, and there was no need to fix something that appeared to be not broken.

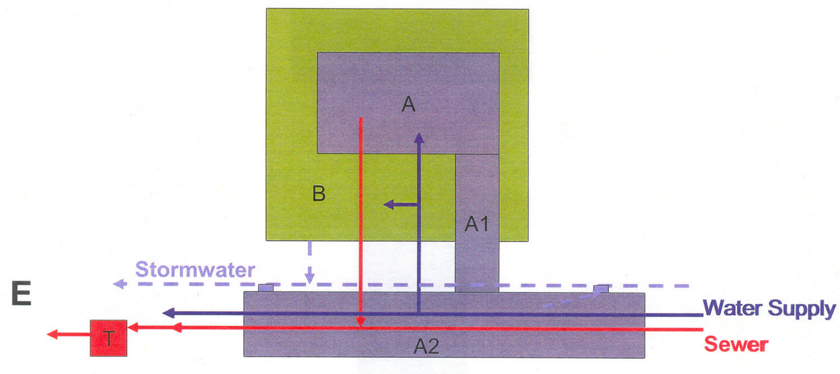
Population increases, migration shifts to live in "sunny" desert environments, periodic drought, and higher volume and quality demands have applied pressures on existing water supplies. In this century, in many locations, supply shortages are approaching critical levels. On the waste water side - pollution, environmental degradation, treatment costs, increased discharge regulations, and public awareness have increased pressures on improving the disposal of waste water.

Traditional systems are indeed broken and need to be fixed.

CONVENTIONAL DESIGN

While physical buildings and surrounding areas have an infinite variation in form, size, occupancy and function; in terms of water management all community structural developments can be summarized in the following diagram of Fig.1.

Fig. A – Conventional Infrastructure For Water Management

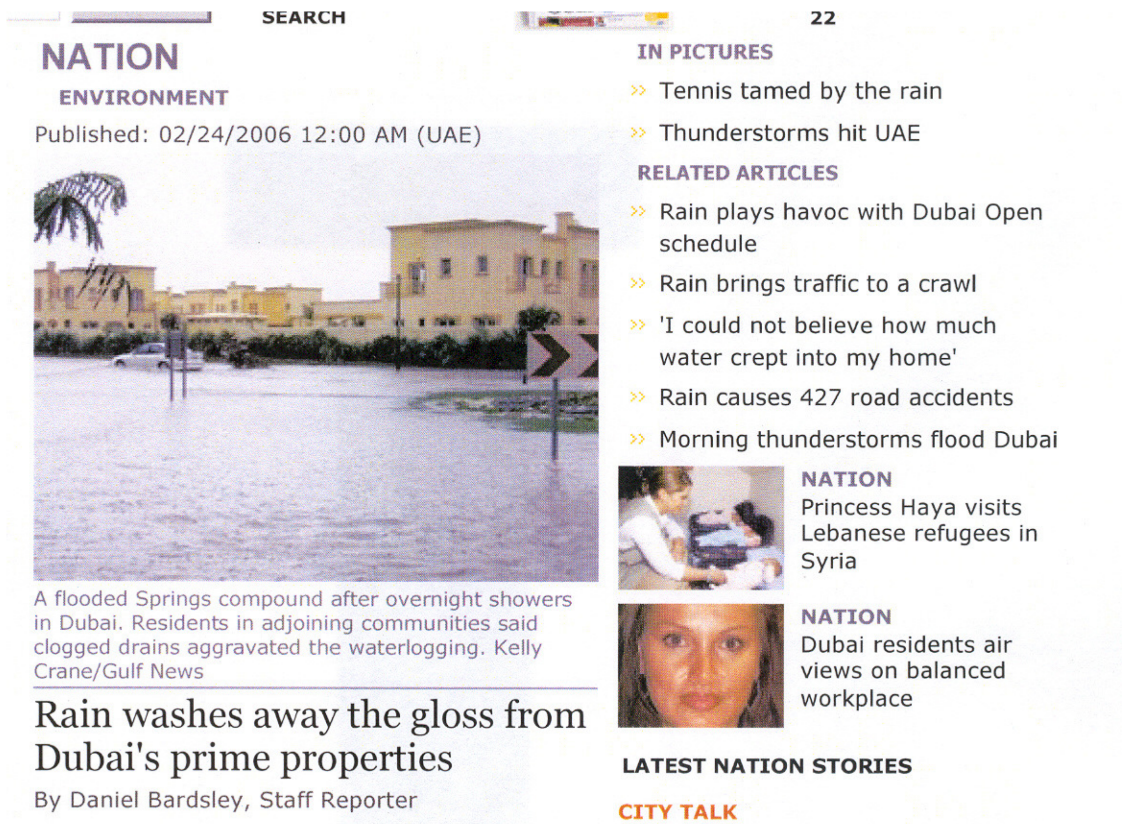


Any development whether it is a single family house, a high rise building, a shopping mall or a sports complex is connected to a street **(A2)** by providing access or parking surfaces **(A1)**. The occupied building **(A)** is usually supplied with a potable **water supply** that is used for domestic consumption and landscape irrigation. Waste water from the building is then channeled to the street **sewer system** where it flows to a treatment plant **(T)** and then is discharged to the environment **(E).**

For functional and aesthetic purposes structures **(A)** are often surrounded by variable sizes and designs of landscape areas **(B).** Landscape areas **(B)** may be small landscape gardens, small turf areas or large athletic fields on specific developments. Although landscape areas can traditionally absorb some of the water from rain events, current conventional landscaping practices have two inherent design problems. One, the use of traditional soils with a compacted clay content limits actual absorption, and two, combined with (code driven) surface slopes of 1% or larger cause rain water simply to shed to the low points of the property.

The erected structure on the developed lot **(A)** along with the traditionally impervious surfaces of **(A1)** and **(A2)** form a water shedding surface. Thereby to manage the water from cumulative storm events shed by **(A), (A1), (A2)**, and **(B)**, the common wisdom is to construct a curb and gutter system at street level. These systems, though mathematically functional on the initial design, are frequently overwhelmed by real life storm events due to plugged debris at catch basin openings, sediment accumulations in the transfer pipes, or downstream cumulative back-ups. The net result is temporary flooding events.

Stormwater management for most communities is a costly enterprise in initial structure, downstream superstructures, and subsequent long term maintenance procedures. Though frequently designed for larger storm events, most communities will experience some type of localized flooding or erosion problems in just about any rain event that approaches 1" of rainfall. Even historically dry desert climates as in Dubai, UAE are not immune from these events.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A flooded Springs compound after overnight showers in Dubai. Residents in adjoining communities said clogged drains aggravated the waterlogging. Kelly Crane/Gulf News

Rain washes away the gloss from Dubai's prime properties

By Daniel Bardsley, Staff Reporter

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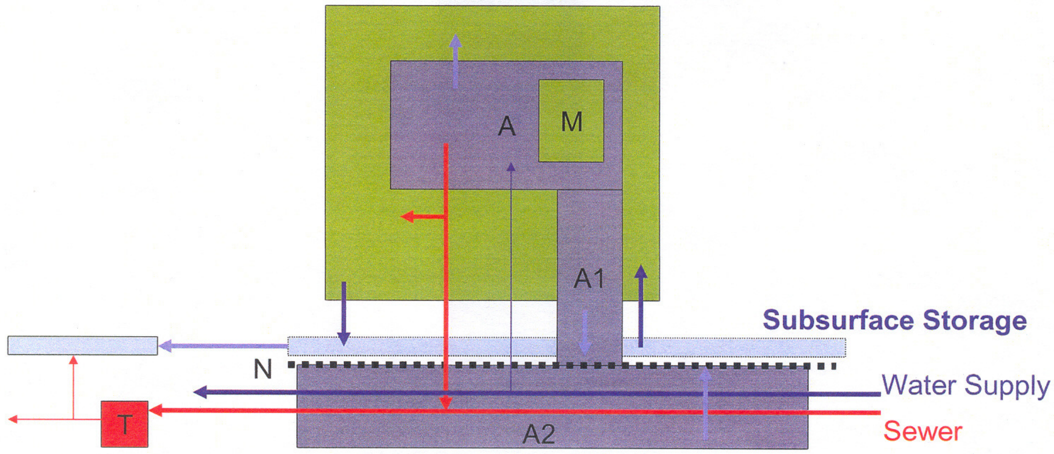
Though intended for storm water relocation, conventional "curb and gutter" designs are also by nature street litter and pollution drains. Litter, leaves, animal droppings, automobile wash water, engine drippings, eroded soil etc. are simply intentionally or naturally washed away into the storm drain system to be dumped (or occasionally treated) somewhere downstream into larger bodies of water (rivers, bays, oceans).

NEW ALTERNATIVE SOLUTIONS

A number of new proprietary devices and designs are in this century being pioneered and implemented by Rehbein Environmental Solutions. The new designs have been combined not only the solve the inherent problems of conventional "curb and gutter" practices, but also to integrate spin-off benefits for water supply and waste water treatment systems. For new developments water supply procurement can be reduced by **50% – 80%** and downstream waste water treatment by **30% - 50%.**

The design changes do not alter the appearance or function of existing buildings, nor do they alter the expected lifestyle of its occupants. Land use becomes more efficient to both the developer and the end users. Conservation measures, water usage restrictions, or extensive use of "zero – scaping" are not being implemented. In fact the technology actually encourages the expanded use of living landscape areas. **See Fig 2.**

Fig. 2 – EPIC Infrastructure For Water Management



Note that in the hypothetical model **(A), (A1),** and **(A2)** have not changed, however curb and gutter systems have been replaced by a Netpave **(N)** or other pervious paver collection system strips along the street. All surface runoff is now channeled for immediate surface filtration and then storage in accompanying horizontal vaults. **Stormwater is cleaned and then stored**. Porous openings along the street structure actually far exceed traditional openings available by conventional catch basins.

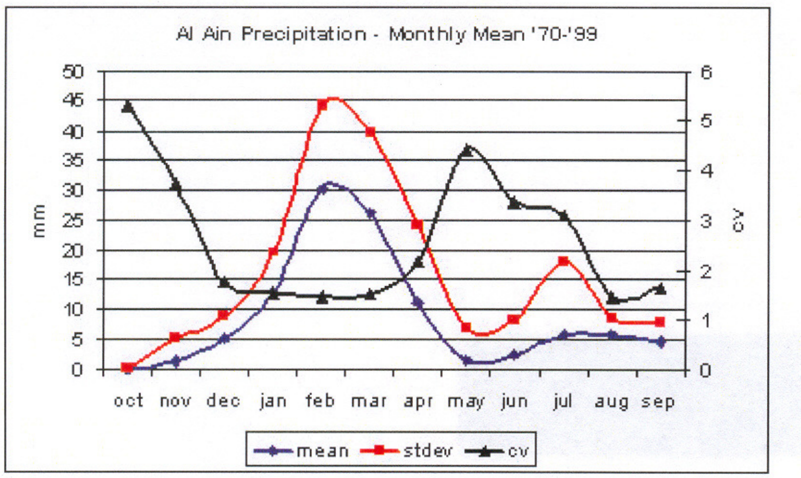
Landscape areas have been replaced by **EPIC** system landscaping that provides subsurface irrigation and drainage in the same package. **EPIC** landscaping only uses **50%** of the water requirements of inefficient sprinkler irrigation, and as it is also a non pressurized system it can mix and blend water from many sources. Captured stormwater is reused for irrigation. It becomes a valuable resource and eliminates associated problems of downstream erosion and pollution.

Selected waste water fractions can also be diverted directly for irrigation use, as well as air-conditioning condenser waste. Since watering occurs passively underground, public health issues associated with waste water become mute and even the introduction of controversial treated waste water in close proximity of residential developments becomes an acceptable option.

Lightweight and functional roof top planters as developed by the Muellner Roof Sytem **(M)** can expand functional landscape areas on roofs or parking structures. The systems not only attenuate stormwater runoff areas, but also provide shade, cooling, and aesthetic and functional use benefits to the residents.

Water management efficiency then translates to a substantial reduction of water supply need. Less water needs to be treated, desalinated or drawn from underground aquifers. Direct reuse of waste water fractions for irrigation reduces the volume of waste water that needs to be treated at the waste water treatment plant. The intentional reuse of treated waste water for irrigation not only further reduces potable water need, but it also means that treatment quality of waste water intended for discharge to the environment can be reduced as many of the contaminants of concern in waste water are actually nutrients required by the plants. EPIC landscaping becomes part of the contaminant treatment process.

Can however, stormwater events in desert environments be a serious source of irrigation water? Extreme desert environments as the Arabian Peninsula, while dry and hot most of the time does get seasonal rains as depicted in the earlier picture. The historical precipitation pattern average from 1970 - 1999 is depicted in the following graph.



The monthly averages for rain in millimeters is expressed in the following **Table 1.**

Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
10	30	20	5	2	2	5	5	5	0	2	7

The yearly average is **93 mm (3.7 inches).** However if we only capture and store the yearly rain event from a hectare surface (2.57 acres), we are provided with **256,811** gallons of water. This amount in EPIC landscaping is sufficient to irrigate a landscape area of 0.10 hectare (11,194 sq.ft.) for about five months or 40% of the yearly demand.

Sealed, filtered water stored in underground structures makes water available when needed without issues of evaporation loss or mosquito breeding problems. By interconnecting storage structures with gravity transfer piping, the system can collect from areas that have a high impermeable surface ratio and transfer (for storage and use) to areas that have a high EPIC landscape ratio. No water is wasted, just simply managed better.

The **internal** home water consumption distribution category average for a **family of four** in the United States is shown in **Table 2**.

Table 2: US average domestic water use for a family of four.

Category	Gallons used/day	Percentage
Bathing	80	31%
Bathroom Sink	8	3%
Cooking and Drinking	12	5%
Dishwashing	15	6%
Laundry	35	14%
Toilets	100	39%
Utility Sink	5	2%
Yearly Total	**93,075**	100%

The above figures mean that 63 gallons per person day go to the sewage treatment plant for processing. However water consumption for the household that has to irrigate conventionally a 3000 sq. ft. landscape area in a desert environment (Reno, NV) will add another 203,000 gallons or 139 gallons per person per day for a combined water demand of **202** gallons per person per day. In this study **69%** of the domestic supply was dedicated to irrigation.

Relative **domestic** conservation measures have already been implemented in Dubai. Figures show that a city with a population of 2,000,000 treats 70,000,000 gallons of sewage per day, or 35 gallons per person per day. Substantially less than the US average of 63 gallons per day. Yet daily water consumption for UAE residents is **110** gallons per person per day. (See, Gulf News: *"UAE Residents Use More Than 100 Gallons of Water Daily"*, 21 April 2006)
Which again means that 75 gallons per person per day **(68%)** was dedicated to outside irrigation use.

Incorporating EPIC designs in landscaping can reduce water needs over conventional sprinkler designs by better than 50%. This EPIC incorporation alone **reduces overall water demand by 39%.** Diverting and adding bathing water as part of the irrigation reuse formula reduces overall water demand to **49%**, and incorporating effective stormwater harvesting techniques can further reduce overall water demand to **68%** of the current standards.

The benign direct secondary use of bathing water by EPIC landscaping can also mean that **sewage treatment costs can be reduced by 31%,** or worded differently, existing sewage infrastructure capacity to treat has increased by 31%.

SUMMARY POINTS:

- Incorporating EPIC landscaping can reduce water consumption by better than 50% over existing sprinklers and drip line systems, and provide all the side benefits of having subsurface, non-pressurized irrigation.
- EPIC landscaping can reduce overall water supply demand 39% - 68%.

- Effective stormwater water harvesting manages flooding, provides clean “salt free” irrigation water, eliminates downstream pollution, and further reduces the need to use drinking water for landscape irrigation use.
- Incorporating EPIC landscaping provides the potential to reduce sewage treatment costs by 31%.
- Reduced water supply demands for ground water reserves reduces recovery pressures of regenerating underground water tables, and slows salt water incursion into fresh water aquifers.
- Managed storm water collection means cleaner rivers, beaches and water recreation resorts.
- Sub-surface storage of stormwater means the elimination of mosquitoe breeding areas, land loss to detention basins, and less expensive and more versatile infrastructure piping.