This presentation premiered at WaterSmart Innovations

watersmartinnovations.com

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INNOVATIONS

Medical Facilities and Laboratories Offer Huge Savings Opportunities

The Speakers

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- Green Hospital Design

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- Hospital Retrofit

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Water Using Areas

- Food Service
- Plumbing
- Landscape
- Boilers
- Cooling Towers
- Laundry
- Water Treatment
- Cleaning
- Leaks

- X – Ray
- Sterilizers
- Laboratory cooling
- Dental
- Vacuum Systems
- Hydrotherapy
- Kidney Dialysis
- Hood scrubbers
- Process equip.
- Other

- Metering and Sub –metering
- Pressure regulation

Topics Covered

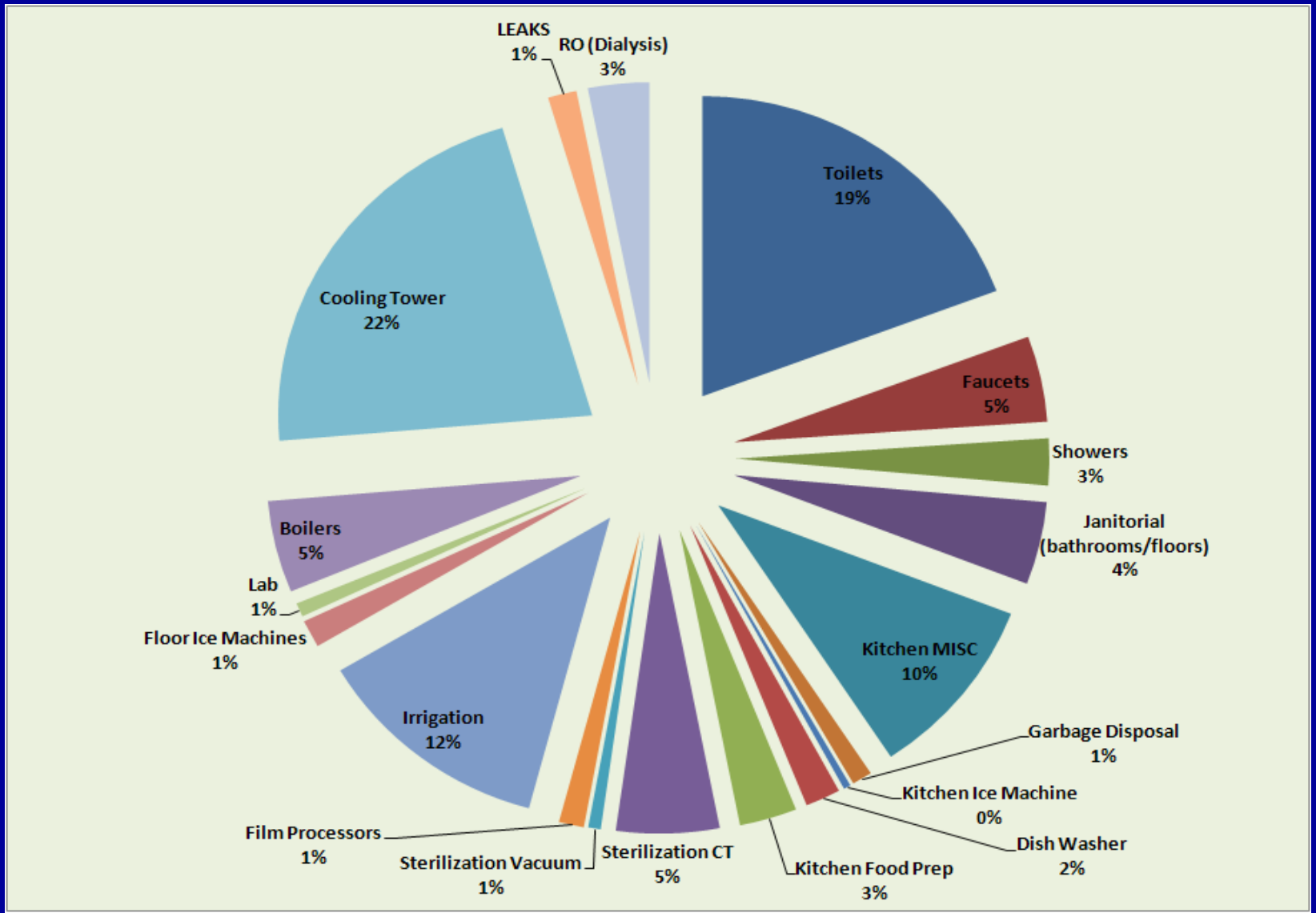
- ***Where does the water go*** – **The Audit and general information**
- ***Building new hospitals*** – **The Potential of Designing for Water Efficiency**
- ***Retrofitting existing facilities*** - **Technical aspects**
- ***Tools that can help*** – **Green building and other sources**

Hospital and Medical Facility Water Use

by

Francis Wheeler

Water Balance



Challenges in Hospital Benchmarking

- Facility type/usage (O/P, research, county hosp)
- Extreme rate deviation ($2 - $20 Kgal)
- Geography (temps, rainfall, humidity)
- Facility size (new facility or older – less shared rooms)
- Lack of Data (two meters, often direct paid by A/P)
- Lack of sub-meters on site

ASHE Study Data (2002)

- Over 240 hospitals
- Detailed water data
- Detailed water balance
- Potential savings
- Categorized within 4 facility types
  - Major Medical Teaching with Research
  - Major Teaching General Hospital
  - City Based General Hospital
  - Community Based General Hospital

Macro Data Findings

- Average of 504 gallons per bed / day
- Deviation was HUGE
  - Memorial Hermann Houston 724 Beds 130,000,000 gallons annually
  - New York University Hospital New York 734 Beds 300,000,000 gallons annually
- The more dynamics uses of water the higher the use per bed (significantly)
- The more dynamic uses of water the more interesting the water balance

Other Data Findings

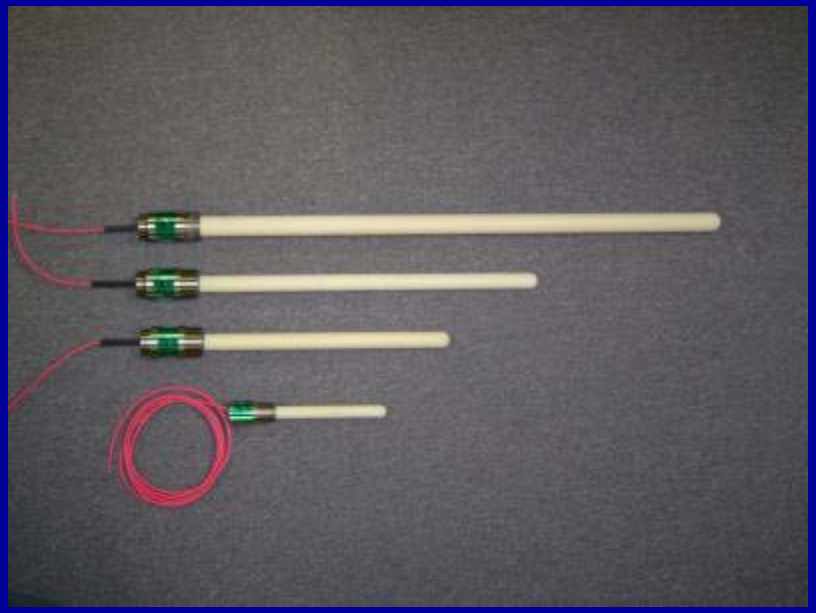
- Post project implementation Average of 402 gallons per bed / day (roughly 20%)
- Other countries use way less per bed per day
  - Jordan 10 hospitals ranging from 80 per bed / day to 300 which appears and anomaly, but 200 was not
  - Average of middle 8 facilities was per bed / day 181
  - Over 55% less water usage
    - No cooling towers
    - No sterilizer water use
    - Minimal irrigation

A few key points

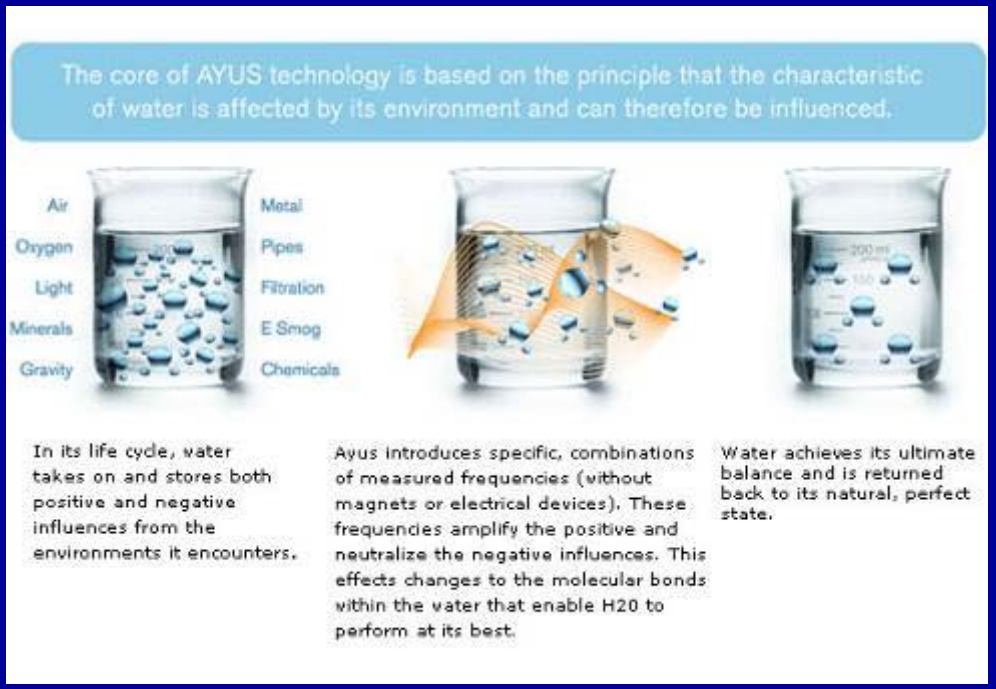
- **Hospitals are huge somewhat unknown water users**
- **Water & sewer costs even in high rate area = .005% of the hospitals operating budget**

- **DON’T FORGET THE FACILITY MISSION**
- **DON’T OVER DO IT – PATIENT CARE IS FIRST**

DON'T Use Bleeding Edge Technology



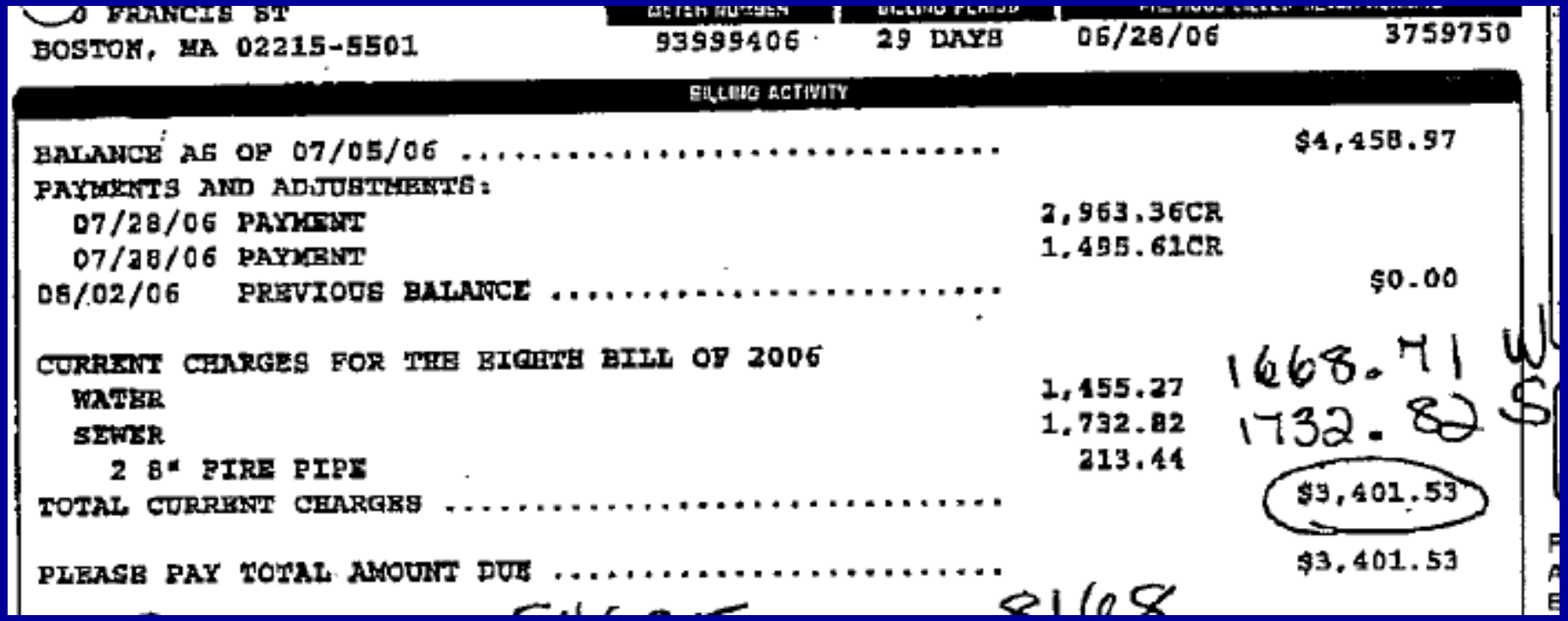
Cooling Tower Treatment



Water Treatment

Plumbing - DON'T over do it

DON'T forget to review billing



FRANCIS ST
BOSTON, MA 02215-5501

METER NUMBER	BILLING PERIOD	PREVIOUS METER READING	
93999406	29 DAYS	06/28/06	3759750

BILLING ACTIVITY

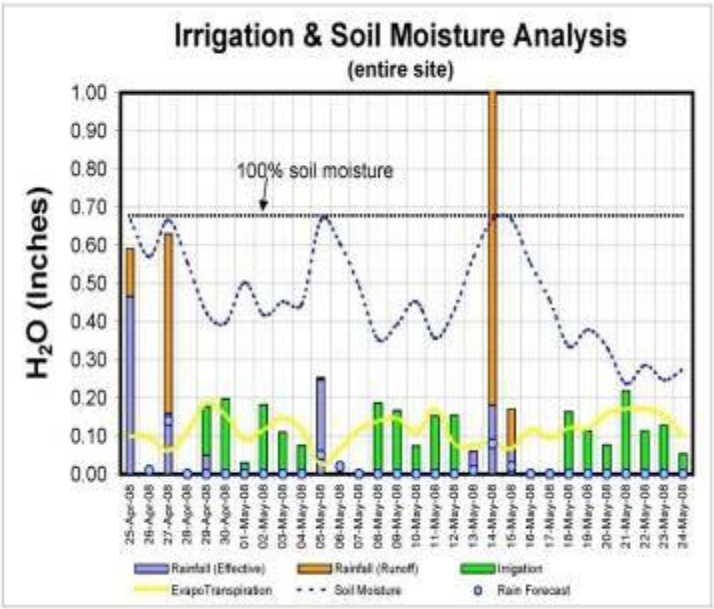
BALANCE AS OF 07/05/06		$4,458.97
PAYMENTS AND ADJUSTMENTS:		
07/28/06 PAYMENT	2,963.36CR	
07/28/06 PAYMENT	1,495.61CR	
06/02/06 PREVIOUS BALANCE		$0.00
CURRENT CHARGES FOR THE EIGHTH BILL OF 2006		
WATER	1,455.27	1668.71
SEWER	1,732.82	1732.82
2 8" FIRE PIPE	213.44	
TOTAL CURRENT CHARGES		$3,401.53
PLEASE PAY TOTAL AMOUNT DUE		$3,401.53

Are we being charged the correct rates, receiving deductions or credits
MENTION - IMPERVIOUS SURFACE CHARGES FOR WASHINGTON DC

DON'T forget to look for Distribution Losses

30" line – 250 GPM

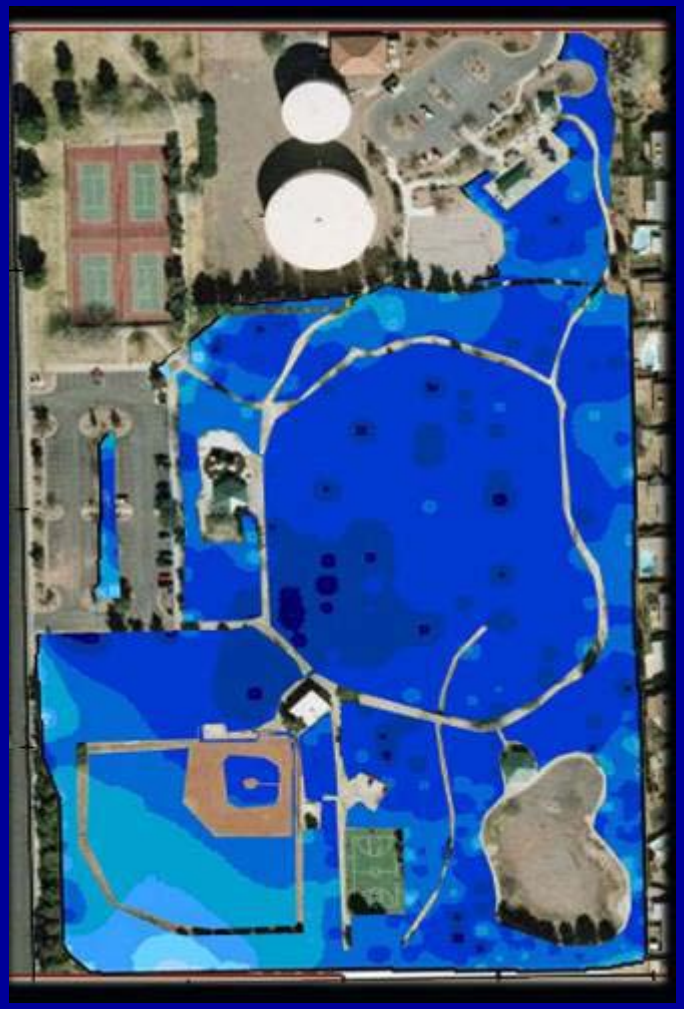
DO Augmenting Mother Nature with Intelligence



Irrigation is 20% of water usage in East 70% in West

Summary of Measurements

Distribution Uniformity	62.01%
Total data points	627
Average reading	63.1
Minimum value	3.1
Maximum value	99.9
Standard deviation	18.2 (68%)
Max length in feet	1243.6
Max width in feet	708.8
Area in Acres	20.19



Newer Irrigation Technologies

Weather Station

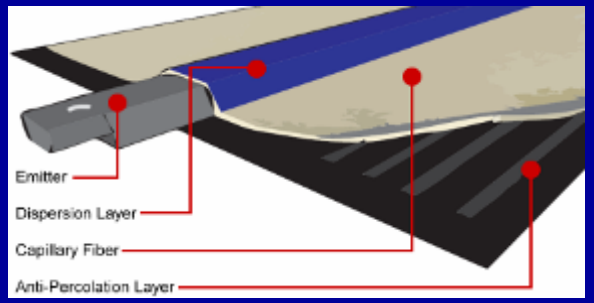
Combination Analog-Digital Flow Sensor

Web Enabled Cell Phone

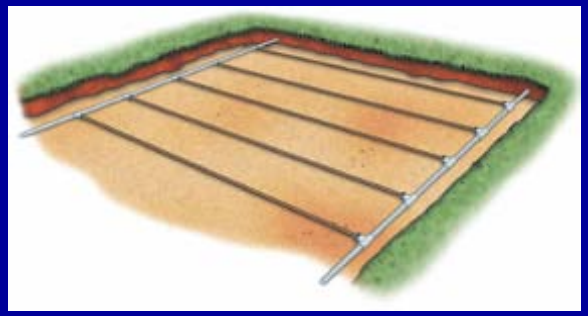
Soil Moisture Sensor

Remote Control

Newer Irrigation Technologies



Control Valves



Subsurface Irrigation

PR Valves

Pressure Regulating Heads

VFD Pump Stations

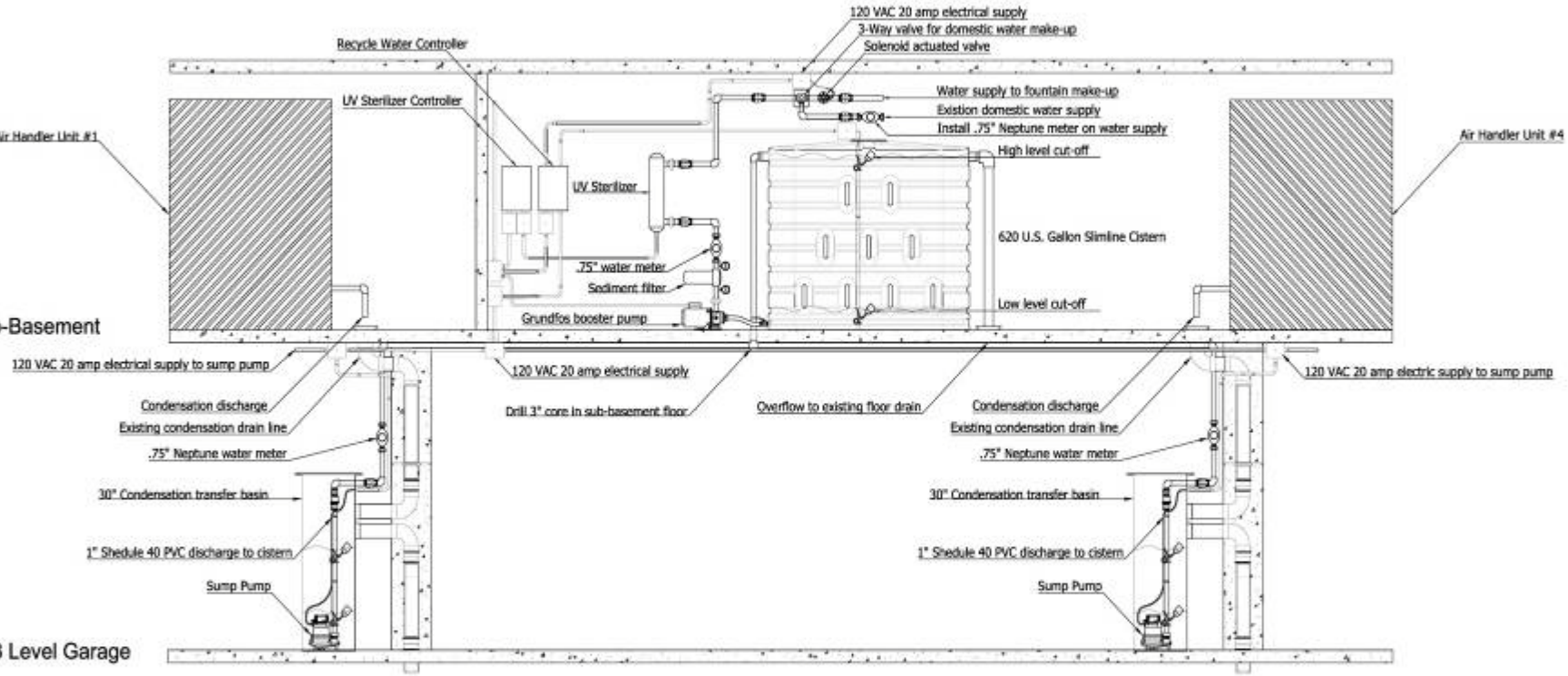
DO Use Mother Nature to Catch the Rain

Catching the Rain is Scalable

DO Use Mother Nature to Catch the Rain

DO Condensation Harvesting


DO Condensation Harvesting



RAYBURN HOUSE OFFICE BUILDING
Washington, DC 20515

CONDENSATION HARVESTING SYSTEM

CR.1.1

DESIGN DEVELOPMENT

DO Condensation Harvesting

DO Improve Process Applications

DO staff training

Especially those who heavily impact water usage
Dietary, house keeping, researchers, laundry

DO Educate Kitchen Staff

DO Measure & Verify

DO Leverage Rebates

Leverage rebates for toilets, free showerheads, aerators

- Austin Texas
- South Florida
- Denver
- Southern CA
- Washington DC

WATER SAVERS at the Enviro-Center

Francis Wheeler
(713) 504-6684
fwheeler@thewater-savers.com

DO Hire a Professional

Designing Hospitals for Water Efficiency

Smart from the start!

By

Winston Huff

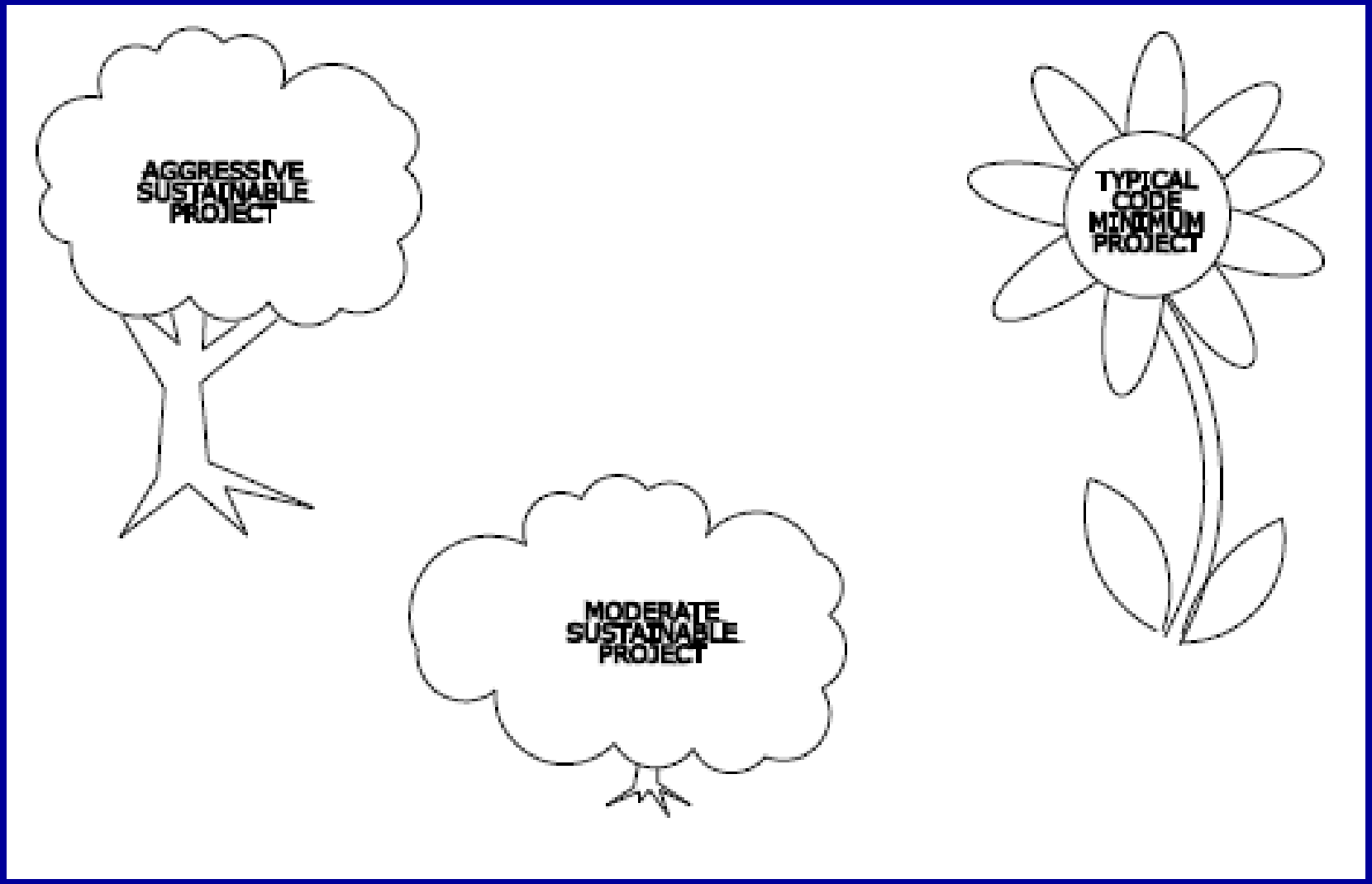
Sustainable Coordination of Hospital Water

- Water Sustainable Coordination
- Sustainable Coordination Application Examples:
  - Plumbing Fixtures
  - Cooling Towers

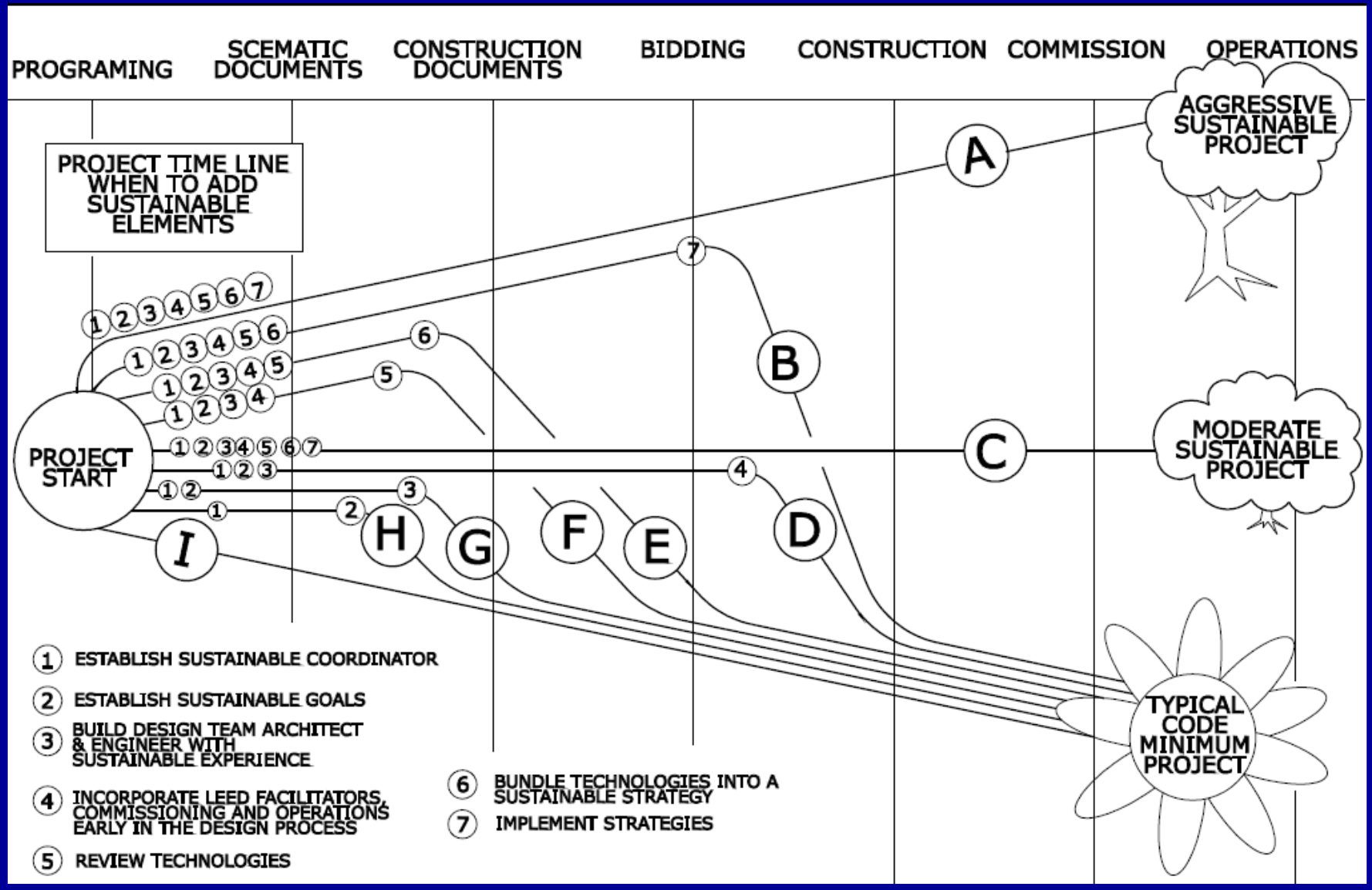
Sustainable Coordination

- Establish a Sustainable Coordinator
- Establish your Sustainable Goals
- Build a Design Team with Sustainable experience
- Incorporate LEED Facilitator, Commissioning and Operator
- Review Technologies
- Bundle Technologies into Strategies
- Implement Strategy

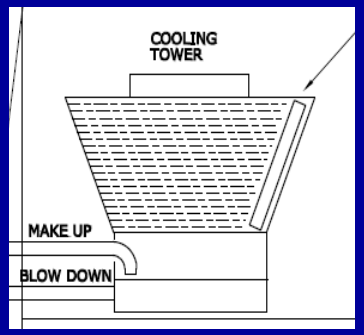
FACILITY SUSTAINABLE GOALS



AIM HIGH


PROGRAMING
SCEMATIC DOCUMENTS
CONSTRUCTION DOCUMENTS
BIDDING
CONSTRUCTION
COMMISSION
OPERATIONS
PROJECT TIME LINE WHEN TO ADD SUSTAINABLE ELEMENTS
PROJECT START
A
B
C
D
E
F
G
H
I
AGGRESSIVE SUSTAINABLE PROJECT
MODERATE SUSTAINABLE PROJECT
TYPICAL CODE MINIMUM PROJECT
1 ESTABLISH SUSTAINABLE COORDINATOR
2 ESTABLISH SUSTAINABLE GOALS
3 BUILD DESIGN TEAM ARCHITECT & ENGINEER WITH SUSTAINABLE EXPERIENCE
4 INCORPORATE LEED FACILITATORS, COMMISSIONING AND OPERATIONS EARLY IN THE DESIGN PROCESS
5 REVIEW TECHNOLOGIES
6 BUNDLE TECHNOLOGIES INTO A SUSTAINABLE STRATEGY
7 IMPLEMENT STRATEGIES

REVIEW TECHNOLOGIES



LOW FLOW WATER CLOSETS

- Recent advancements have allowed toilets to use 20 (1.28 gpf) percent less water than the current federal standard, while still providing equal or superior performance.
- Piston type valves
- Spec valve and bowl
- These fixtures may be too aggressive for Hospitals

Dual Flush Water Closets

- Two methods of flushing
- One option will flush the same 1.6 gallons of water as the conventional water closet
- The full-flush option only when flushing solid wastes out of the bowl

Low Flow Lavatory

- The base design for LEED allows for 2.2-gallons-per-minute lavatories. Low-flow lavatories are rated around 1.8 gpm. Work very well for clinical uses.
- Some low flow lavatories are rated at .5 gallons per minute and work well in public applications.

Faucets No Touch

- This is a popular trend with the public and clinical uses because users are increasingly conscious of hygiene, and wary of touching objects handled by scores of people.
- New light-activated lavatory systems use photovoltaic (PV) cells integrated into the top of a lavatory system to convert restroom lighting/day lighting into energy. While others use a turbine to charge the batteries.
- Hands-free faucets in public facilities can also encourage more hand washing, which is a critical step in resisting infection.

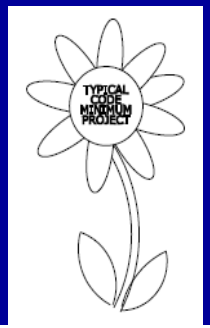
Faucets and Lead

- SACRAMENTO — Ongoing efforts by state legislators to provide the safest drinking water possible to the residents, and especially to the children of California, has resulted in the creation of California Assembly Bill 1953 (AB1953). Slated to take effect on January 1, 2010, this new bill requires **residential and commercial faucets that dispense water for human consumption must not exceed a total weighted average of 0.25% maximum lead content.**

www.californianewswire.com

Low Flow Showers

- The Clean Water Act of 1991 requires that the maximum flow is 2.5 gallons flow per minute. A code minimum building will use 2.5 GPM showers.
- A Moderate Sustainable Approach is to use a Shower systems that uses less than 2.5 GPM these work well in Hospitals.
- An Aggressive Sustainable Approach could use a 2.0 GPM shower system but not less.
- Us a shower system that includes a shower head and mixing valve.
- Do not install a low flow head on a mixing valve not rated for low flow because of scalding issues.
- Staff will have to keep heads clean of debris that reduce flow.



Low Flow Urinals

- Standard Urinals use 1 gallon per flush
- Low flow urinals use .5 gallons per flush
- What you need to know
  - Installation same as standard
  - Maintenance same as standard
  - Cost is usually the same as Standard fixtures.
- Moderate Sustainable Approach

Ultra-low flow urinal

- Ultra Low flow urinals will use as low as .125 gallons per flush.
  - Urinal and flush meter have to be used together as one unit.
  - Cost more
  - Installation the same as standard
  - User will not notice difference
  - Sensor operated
- Aggressive Sustainable Approach

Non-Water Urinals

- The can work well in some applications.
- Not usually recommended for Hospitals because of the added housekeeping responsibilities.

Cooling Tower Options

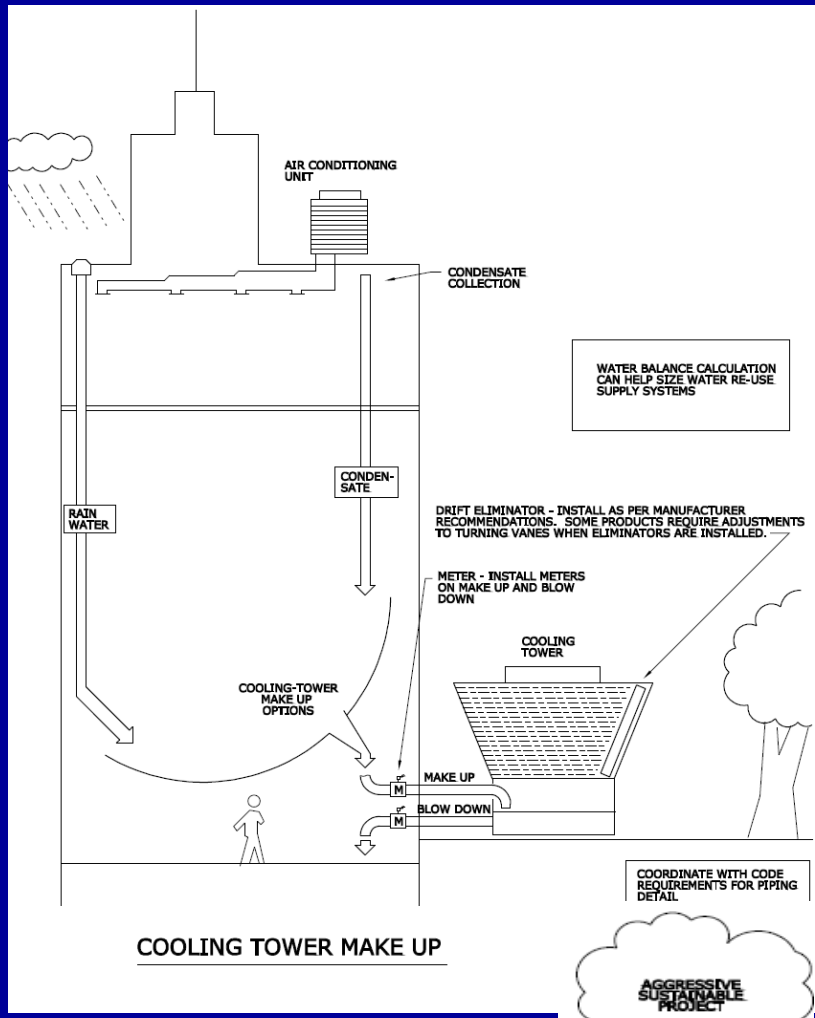
Water meters should be placed on the cooling tower make-up connection to the domestic water feed.

A second water meter should be connected on the cooling tower blow down. Meter systems shall connect to the building management system or to a system from which the building operator can collect water meter.

Where condenser water is being lost to the atmosphere, drift eliminators should be used.

In other cases, combination sensible and evaporative type cooling towers are applicable.

water balance



COOLING TOWER MAKE UP

AGGRESSIVE SUSTAINABLE PROJECT

Cooling towers

- Drift eliminator.
- Calculate a preliminary **water balance** on the proposed water demand to the cooling tower and possible water sources other than municipal water that can supply water to the cooling towers.
- Efficient type facilities should monitor and improve the cooling tower's **"cycles of concentration".** This is calculated as the ratio of the concentration of dissolved solids (or conductivity) in the blowdown water compared to the make-up water. The more solids and minerals in the water result in a higher blowdown rate.[1]
- The goal should be to use no more potable water than **2.3 gallons per ton hour** for cooling tower make-up.
- Concentration cycles in cooling towers around the country usually range from 3 to 7. Most systems should have a goal of **5 cycles.**
- The plumbing engineer or the mechanical engineer can specify a **conductivity meter** in the blow down system that will reduce the amount of water used in the blowdown system. These activities will help achieving the USGBC LEED EB Cooling Tower Water Management Credit.
- [1] http://www1.eere.energy.gov/femp/water/printable_versions/water_bmp10.html U.S. Department of Energy - Energy Efficiency and Renewable Energy, Federal Energy Management Program – Water Efficiency BMP #10 - Cooling Tower Management

Liquid Ring Pumps

One type of Clinical Air compressors and Vacuum Pumps use a liquid seal of water.
Domestic water flows through the pump and directly into the drain.

Vacuum/Air Water Savings

Electric Cost /kWh
$0.055
Harris Methodist Fort Worth

Water Cost
$ 4.79

	Operating hours per Year	% On-Time	Existing kWh/year	Estimated Future Operating Amperage	Estimated Future Electric Consumption kWh/year	Estimated Future Electric Savings $/year	Flow Rate (gpm)	Annual Water Savings (gals/year)	Annual Water Savings ($/year)	Total Annual Savings ($/year)
SRP Vacuum #1	1,104	12.6%	33,583	36			9	596,019	$ 2,855	
SRP Vacuum #2	1,062	12.1%	34,803				9	573,738	$ 2,748	
Plant Vacuum #1	1,790	20.4%	47,704				9	966,752	$ 4,631	
Plant Vacuum #2	1,520	17.3%	47,008				9	820,687	$ 3,931	
		62.5%	163,099		139,315	$ 1,308			$ 14,165	$ 15,473
SRP House Air #1	1,347	15.4%	141,851	26			15	1,212,050	$ 5,806	
SRP House Air #2	1,103	12.6%	121,369	26			15	992,334	$ 4,753	
Plant House Air #1	1,453	16.6%	166,564	26			15	1,307,983	$ 6,265	
Plant House Air #2	2,626	30.0%	283,194				15	2,363,240	$ 11,320	
		74.5%	712,979		359,843	$ 19,422			$ 28,144	$ 47,567
										$ 63,040

Existing Electric Consumption estimated by logging operating amperage and loaded time percentages extrapolated over whole year.
Estimated Future Electric Consumption based upon future multiple compressor rack motor load to meet instantaneous operating demand.

Use over 3 million gallons of water a year.

Vacuum/Air Pumps

- Scroll type air compressors and claw type vacuum pumps are popular replacements.
- Provide Air Conditioning in the rooms.
- Little or no additional cost when compared to liquid ring pumps.

Retrofitting Existing Facilities

Make the old like new

By

Bill Hoffman

Medical Equipment

- ✓ vacuum systems
- ✓ sterilizers
- ✓ water-cooled equipment
- ✓ laboratory hood scrubbers
- ✓ X-ray film developers
- ✓ hydrotherapy
- ✓ kidney dialysis
- ✓ special equipment

Steam Sterilizers

- Applies to large steam sterilizers
- Does not apply to table top models, boiler less types, or non-steam types

Large Hospital Steam Sterilizer

Comparison of Condensate Retrofit Savings

Retrofit Equipment	Sterilizer Type	Before Retrofit (Gal./Day)	After Retrofit (Gal./Day)	Reduction (%)
Steris Corporation	AMSCO 3021 Gravity	4326	1354	68%
Steris Corporation	AMSCO 3023 Vac.	3187	525	84%
Omega Medical	AMSCO 3021 Gravity	3870	305	92%
Omega Medical	AMSCO 3023 Vac.	3419	64	98%
Continental Equipment	AMSCO 3021 Gravity	1519	117	92%
Continental Equipment	AMSCO 3023 Vac.	2510	267	89%

University of Washington Field Evaluation

Venturi on a Sterilizer

Venturi vacuum systems use up to 15 gallons per minute and operate form 30 minutes to 1.5 hours per load

Liquid Ring Pumps for Sterilizer Vacuum

Comparison of Ejector Savings

(10 uses per day & 250 days per year)

Ejector Flow Rate (gpm)	Total Use (Gal./Cycle Pre-Retrofit Water)	Pre-Retrofit Use (gpy)	Post-Retrofit Use with Liquid Ring Pump (gpy)	Post-Retrofit Use with Dry Vacuum Pump (gpy)
6	198	495,000	123,750	0
11	363	907,500	226,875	0
18	594	1,485,000	371,250	0

Kidney Dialysis

Typical Patient Unit

Water use is about 35 gallons per session

Typical RO System for Dialysis

Reverse Osmosis Unit Controls

Reuse of RO Reject Water

Non-Medical Equipment

- Food Service
- Plumbing
- Landscape
- Boilers
- Cooling Towers
- Laundry
- Water Treatment
- Cleaning
- Leaks

Food Service Operations

- Scullery Operations
- Cooking and Food-Service Equipment
- Refrigeration Equipment
- Washing and Sanitation

Scullery Operations

- **Pre-rinse spray valves**
- **Garbage disposers**
- **Dishwashers**

Example

10 HP

8 Gallons per minute

Scrap Basket Strainers

Old System

Scrap Basket

Scrap Basket

Garbage Disposal Comparison

	Grinder	Salvajor	Pulpier	Strainer Basket
Solids to Sewer	Yes	No	No	No
Recirculate	No	Yes	Yes	No
Strain Solids	No	Yes	Yes	Yes
Compost Prod.	No	Yes	Yes	Yes
Solid Waste Prod.	No	Yes	Yes	Yes
Flow Restrictor?	Yes	No	No	N/A
HP	1-10	0.75-7.5	3-10	0
GPM (Potable only)	3-8	1-2	1-2	0
Sluice Trough GPM	2-15	2-15 *recirculation?*	2-15 *recirculation?*	0

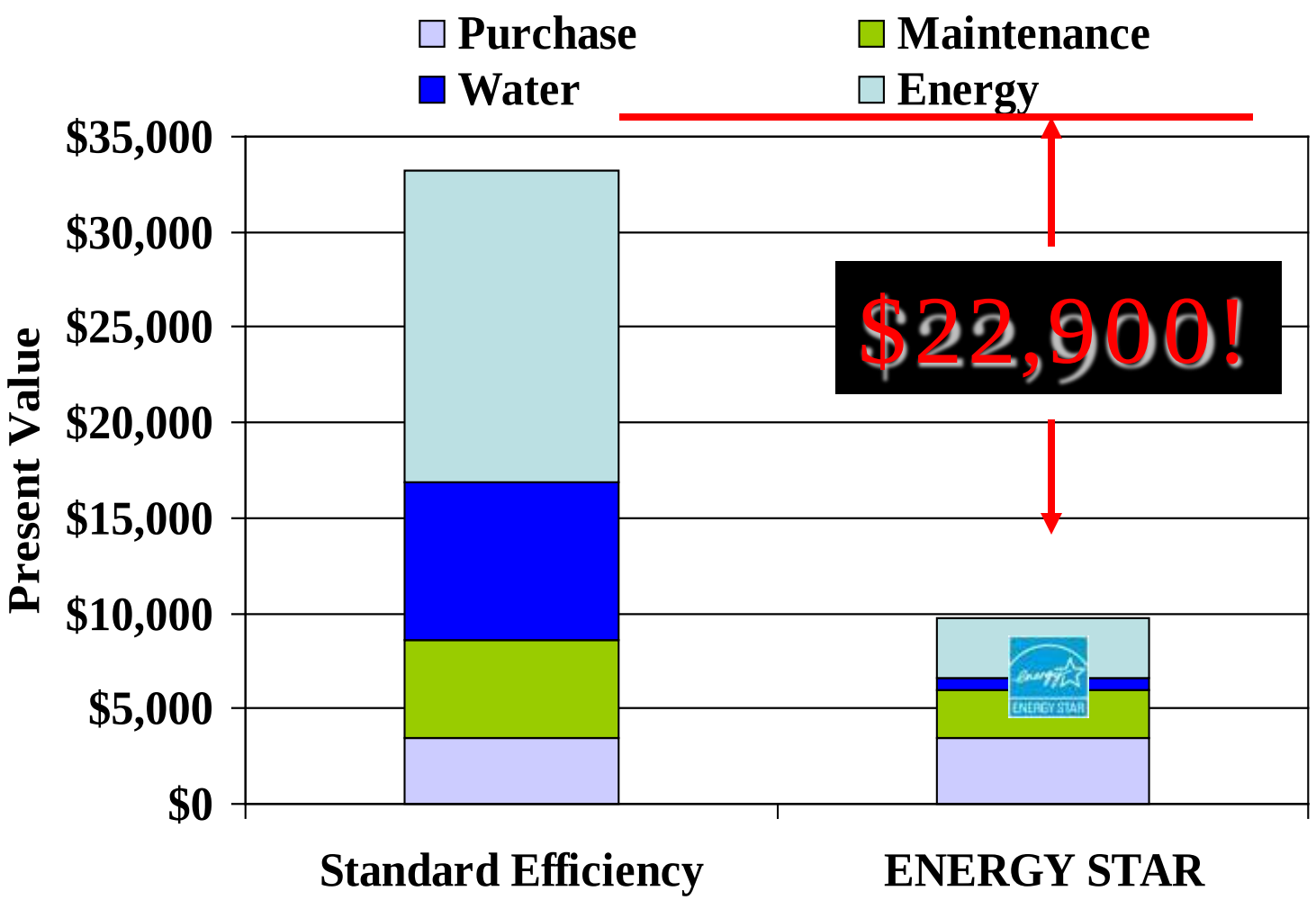
Cooking and Food Service Equipment

- **Steam kettles**
- **Steamers**
- **Combination ovens**
- **Pasta cookers**
- **Dipper wells**
- **Woks**
- **Steam tables**

New Generation Steamers

- No deliming
- Longer Element life
- No vent hood

8 Year Live Cycle Cost Analysis of a Steamer



Boiler Based Steamer and Combi Oven

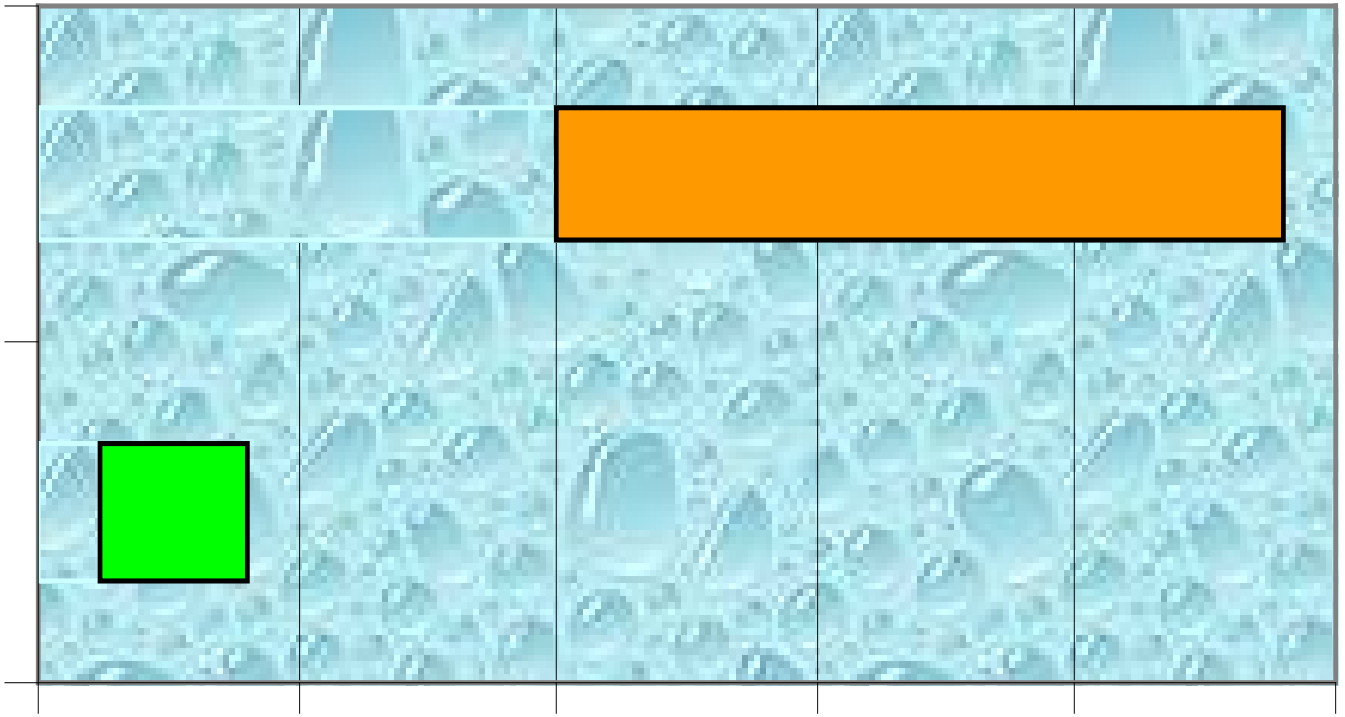
Average Water Usage = 40 gph

Ice Machines & Once Through Cooling

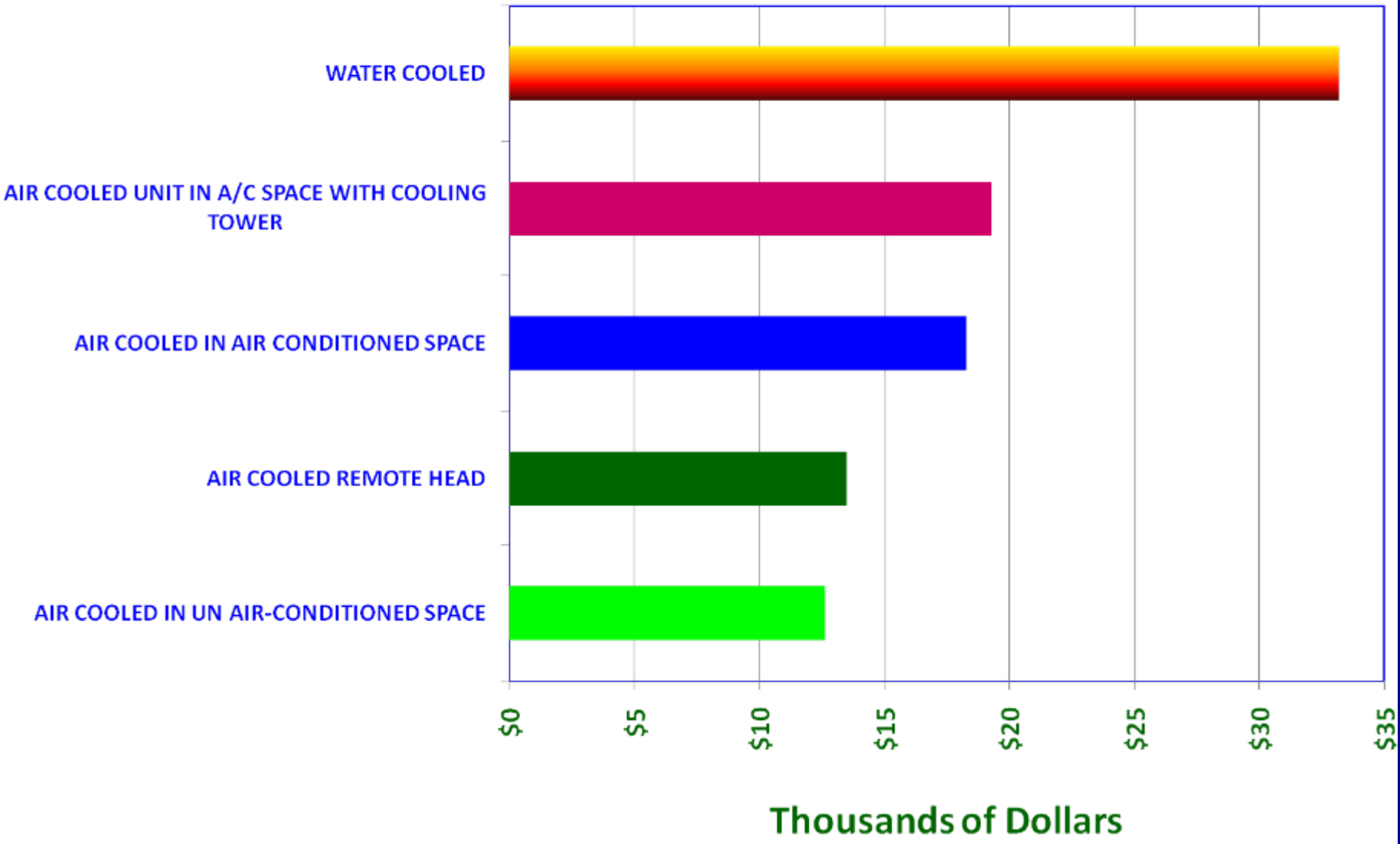
Air Cooled Ice Machines

Water Cooled Ice Machine

Commercial Ice Machine Water Use



Life Time Cost Comparison For Ice Machines



Regulations, Codes & Incentives

Green Certification

Many organizations now require

GREEN CERTIFICATION

for new projects and renovations including:

- Federal, State & Local governments
- Universities & Institutions
- Businesses and Industries

LEED for Hospitals

- **Credit 1: Water Efficient Landscaping**
- **Credit 2: Measurement & Verification**
- **Credit 3: Plumbing Fixtures**
- **Credit 4: Process Water & Building System Equipment including:**

Labs, laundry,
water treatment, pools & fountains,
medical equipment, boilers,
cooling towers, food service, etc.

LEED 2009

Table Comparison of baseline rates for plumbing fixtures

Fixture	LEED-NC Version 2.2	LEED 2009
Toilets	1.6 gpf (3.5 gpf for blowouts)	1.6 gpf (3.5 gpf for blowouts)
Urinals	1.0 gpf	1.0 gpf
Lavatory faucets, private*	2.5 gpm at 80 psi	2.2 gpm at 60 psi
Lavatory faucets, public	2.5 gpm at 80 psi	0.5 gpm at 60 psi
Lavatory faucets, metering	0.25 gallon per cycle	0.25 gallon per cycle
Residential kitchen faucets	2.5 gpm at 80 psi	2.2 gpm at 60 psi
Showerheads	2.5 gpm at 80 psi	2.5 gpm at 80 psi
Pre-rinse spray valves	n/a	1.6 gpm (no psi specified)

*Private lavatory faucets include both residential and private commercial applications such as hotel and hospital patient rooms.

Source: Table adapted from information developed and summarized by the U.S. EPA Office of Water based on requirements of the Energy Policy Act (EPAct) of 1992 and subsequent rulings by the Department of Energy, requirements of the EPAct of 2005.

Comparison of Water Use Reduction in LEED-NC v2.2 and LEED 2009

In LEED-NC v2.2, projects that achieve

- **a 20% reduction in water use earn 1 point,**
- **a 30% reduction in water use earn 2 points, and**
- **a 40% reduction in water use earn 3 points.**

LEED 2009 makes the 20% water use reduction a prerequisite, and credits are then awarded as follows:

- **a 30% reduction earns 2 points**
- **a 35% reduction earns 3 points**
- **a 40% reduction earns 4 points**

LEED 3.0

is in Development

Green Build Initiative

- **Project Management – 100 points**
- **Site = 120 points** **(including 28 for irrigation)**
- **Energy – 300 points**
- **Water – 130 points**
- **Resource and Materials – 145 points**
- **Emissions and Storage of Hazardous materials – 45 points**
- **Indoor Air Quality - 160**

Green Guide for Health Care

www.gghc.org

The Green Guide to Health Care contains both operational and facility and equipment design considerations.

Water Sense

- WaterSense, a partnership program sponsored by the U.S. Environmental Protection Agency, makes it easy for Americans to save water and protect the environment. Look for the WaterSense label to choose quality, water-efficient products.
- http://www.epa.gov/watersense/

IAPMO Green Technical Committee

- Uniform Plumbing Code
- Uniform Mechanical Code

Other Green & Code Efforts

- **International Plumbing Code just beginning (ICC)**
- **Over 300 local green codes**

Some good sources of information

- **WaterSmart Guidebook, A Water-Use Efficiency Plan Review Guide for New Business, East Bay Municipal Water District, Oakland California, 2008 www.cuwcc.org**
- **WATER CONSERVATION Checklist – Medical Facilities.. E V E R Y D R O P C O U N T S www.p2pays.org/ref/23/22006.pdf**
- **Water Conservation Strategies for Hospitals www.h2e-online.org/teleconferences/molydesc.cfm?...**
- **Eastern Health commitment to water conservation www.easternhealth.org.au/.../EH%20Water%20Conservation%20Strategies%20January%202007**
- **Healthcare Environmental Resource Center (HERC) www.hercenter.org/facilitiesandgrounds/waterconserve.cfm**