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Water Efficient Plumbing

An AIA Continuing Education Program

Credit for this course is 1 AIA/CES Learning Unit for HSW and SD

ASID Course #7892

USGBC EDUCATION PROVIDER

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Course Number:
ITO22B
Course Title:
Water Efficient Plumbing (FTF)

EPA WaterSense

EPA WATER EFFICIENCY LEADER AWARD

NKBA

ASID

An American Institute of Architects (AIA) Continuing Education Program

Course Format: **This is a structured, Face to Face course.**

Course Credit: **1 Health Safety & Welfare (HSW) learning unit (LU)**

Completion Certificate: **A copy is sent to you by email upon request. When you fill out the Form B please indicate if you need one. Also please make sure the information you provide is legible. Send email request to carol@ronblank.com**

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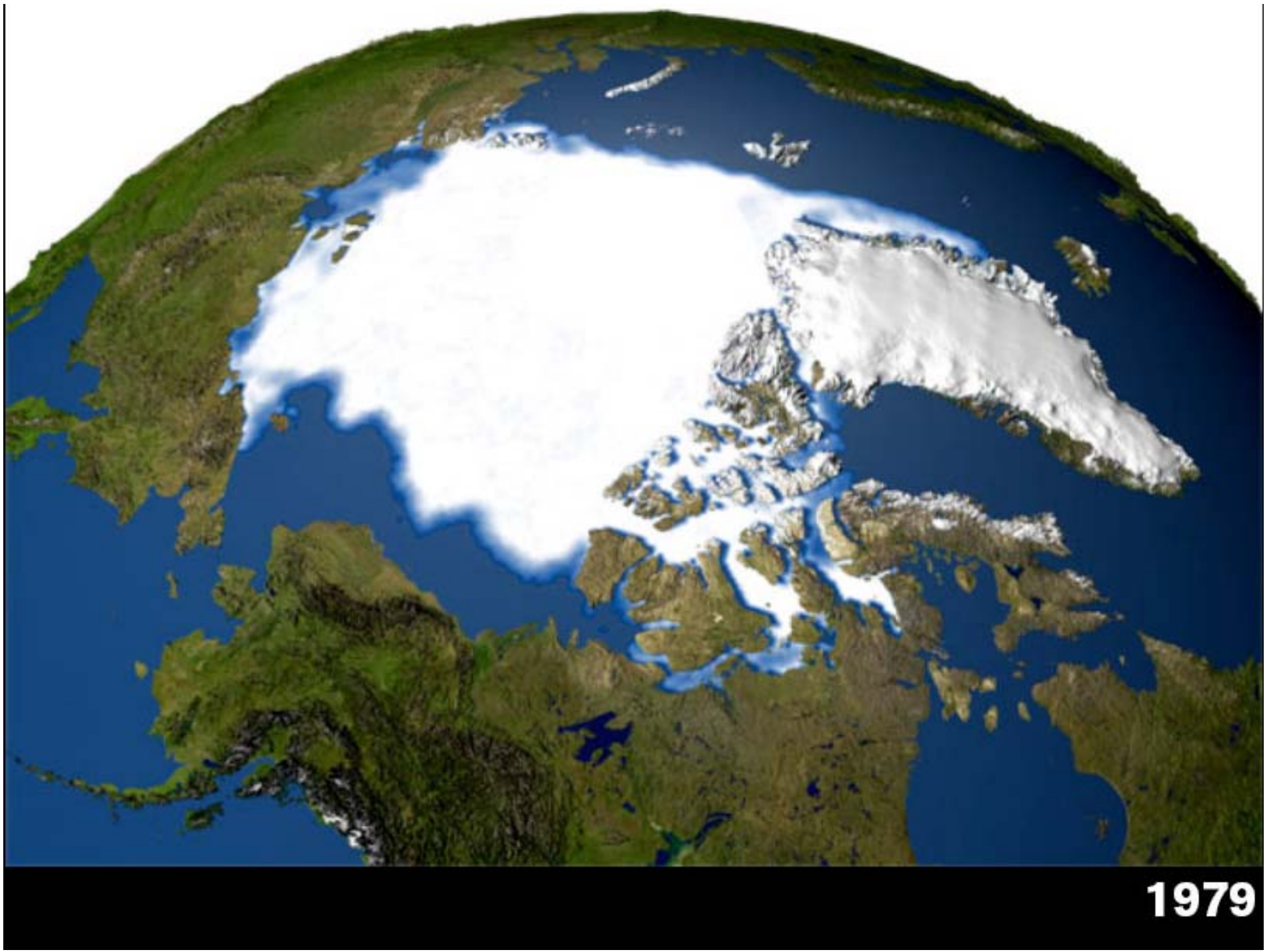
Learning Objectives

Upon completion of this course the designer will be able to:

- List reasons for water efficiency requirements and incentives
- Describe “Voluntary” Toilet Performance Standards in North America
- Explain:
  - The need for realistic media tests
  - The emerging consumer based standard: UNAR
  - The EPA’s WaterSense program
- Compare Modern Toilet Technology to traditional plumbing and how other EPACT fixtures and fittings work in this regard
- Apply knowledgably the Indoor Water Efficiency Credits for LEED™
- Explain what “sustainable” plumbing means in the future

Before we start:
Is our climate changing?
Is there energy consumption imbedded in water use?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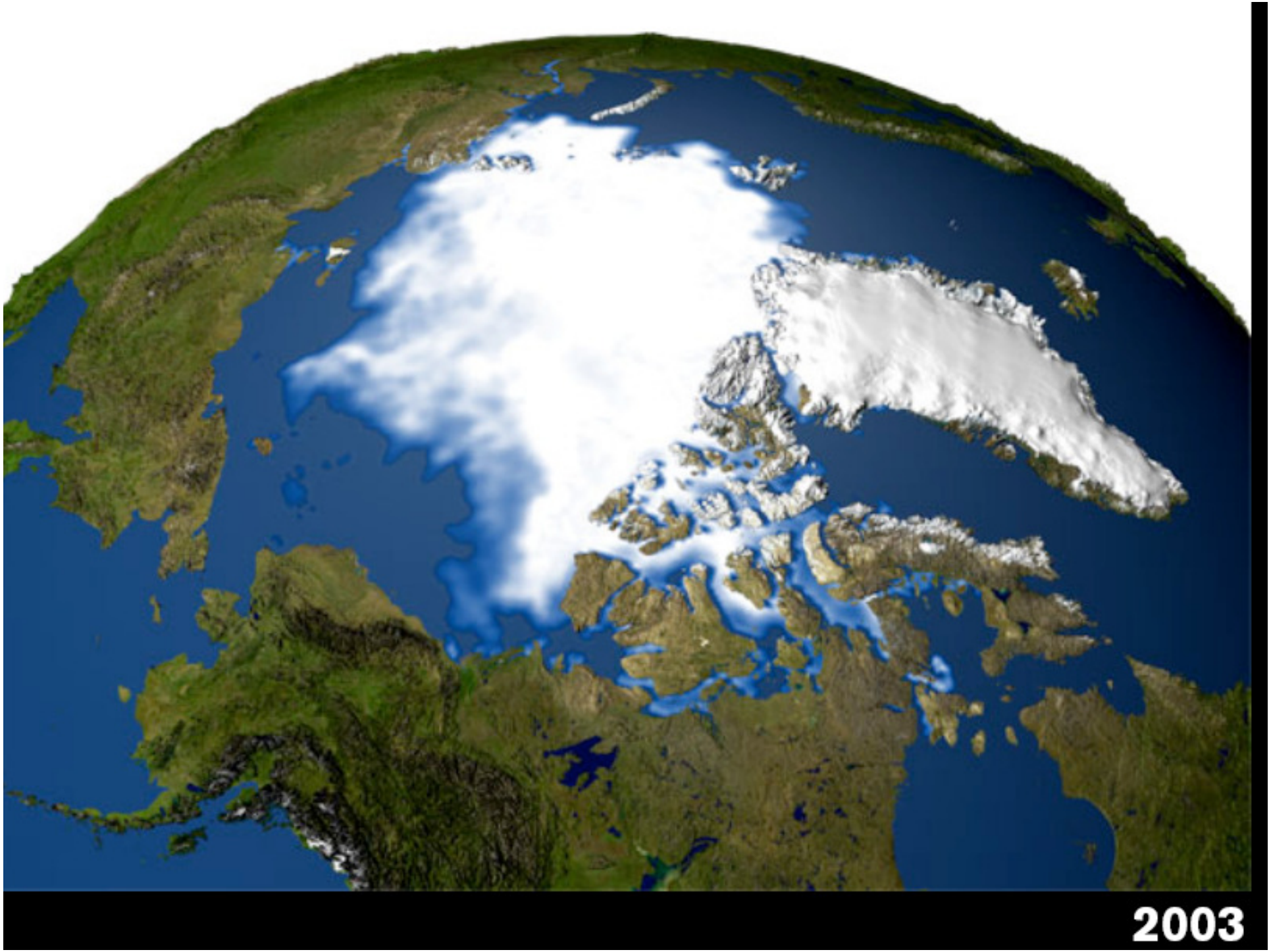

2003

Are You Aware That:

- About **8%** of the electricity used in the U.S. is for the delivery and treatment of potable water.
- In CA **19%** of the electricity is used for delivering Water! **32%** of the natural gas consumption is for treating water and wastewater!
- **Saving Water Saves Energy**!

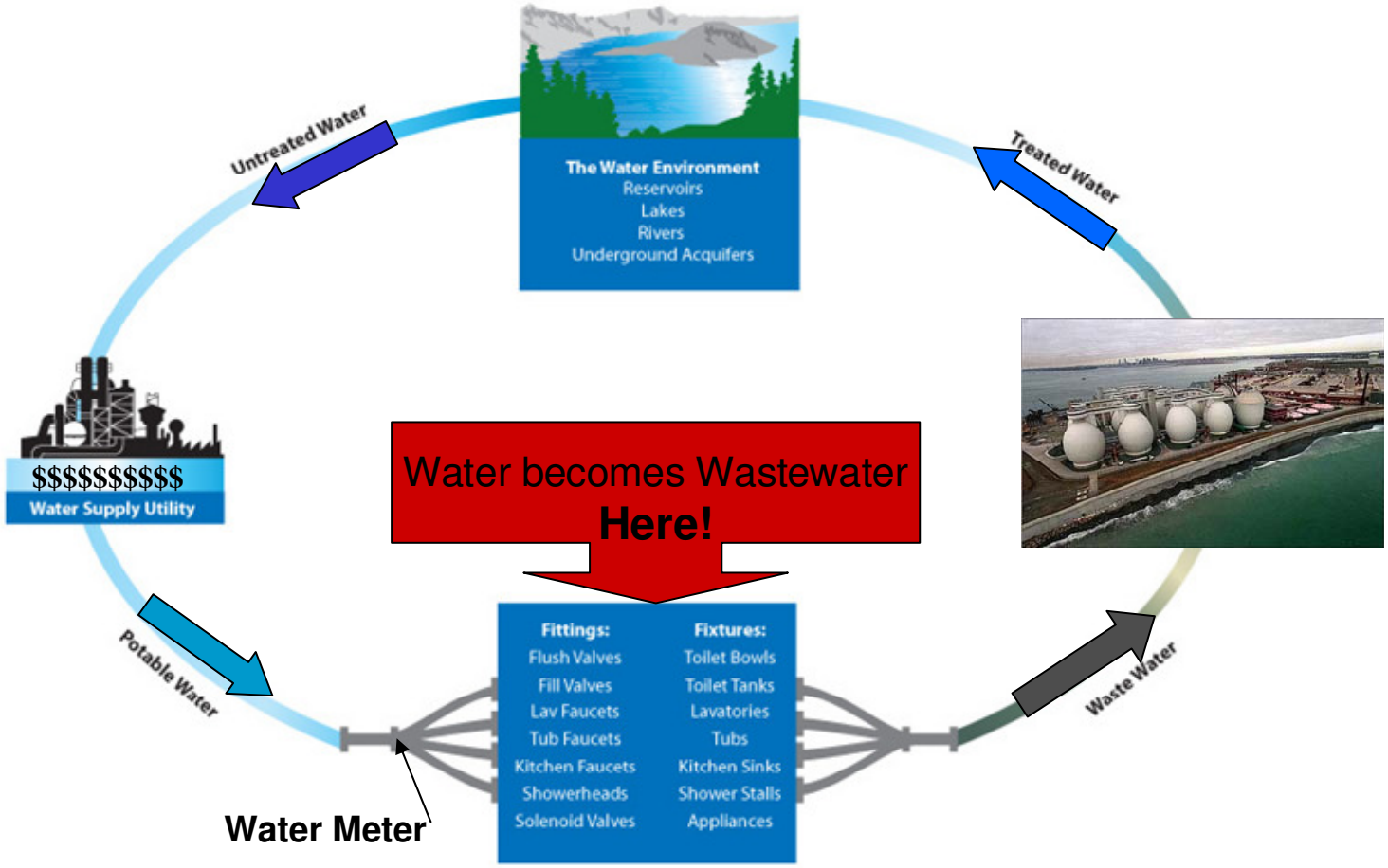
Saving water also reduces one's

And more…

Water and energy are closely linked.

- Running a hot water faucet for five minutes consumes as much energy as using a 60-watt light bulb for 14 hours. (EPA WaterSense factoid)

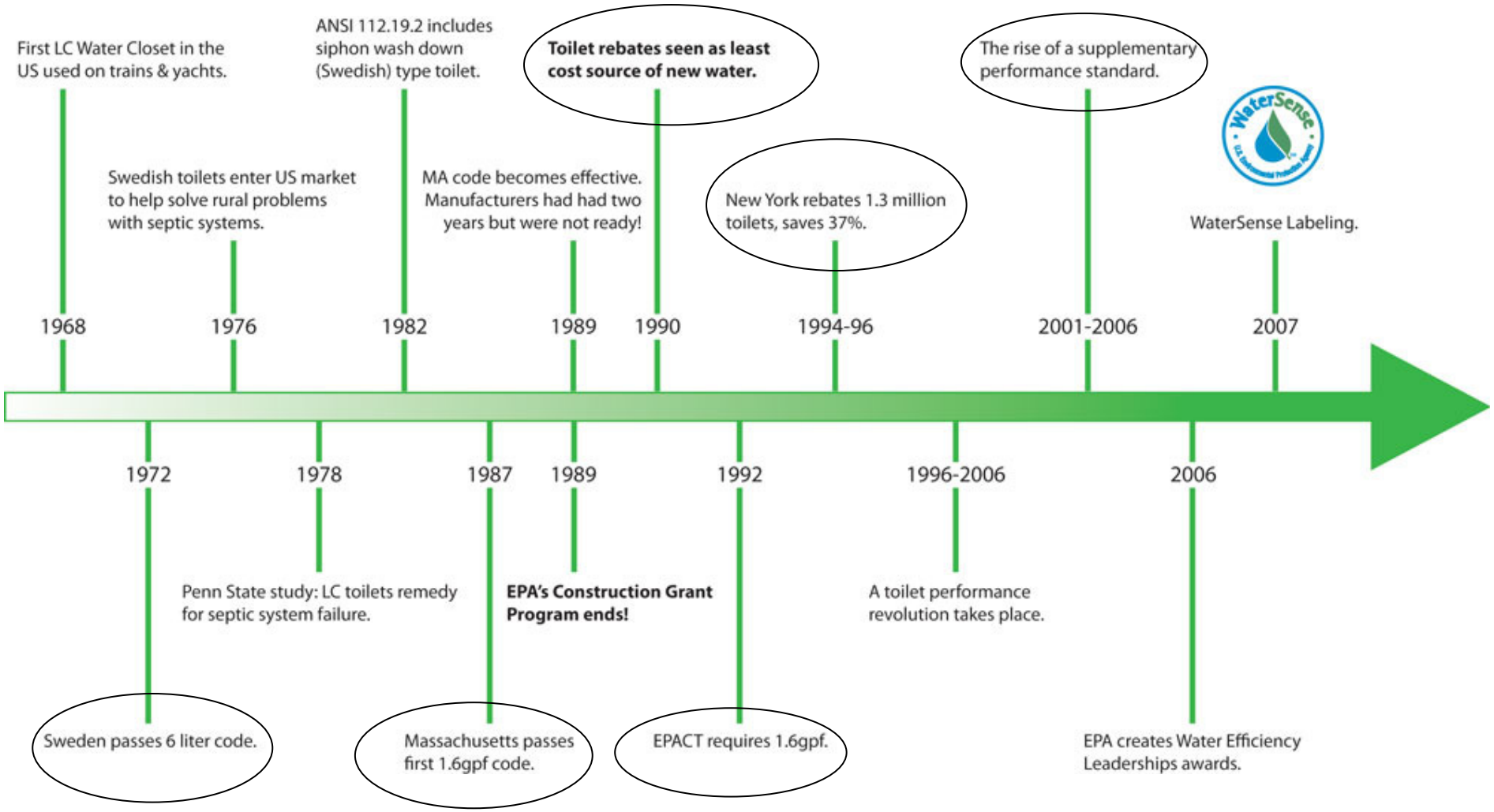
Is this Cycle Sustainable?



Part 1
Why do we have Water Efficiency Requirements and Incentives?

A Brief History

A Brief Recent History of Water Efficiency



EPA WATER EFFICIENCY LEADER AWARD

A Case Study: Expanding Water Infrastructure

- Tunnel No. 3 is one of the largest and most complex capital construction projects in New York City history **(Translation: VERY EXPENSIVE)**

- 1998: Completion of Stage 1 of the Tunnel, delivering water through the Bronx, down Manhattan across Central Park and into Astoria Queens.

- 2009: Brooklyn/Queens leg will be activated.

- 2012: Lower Manhattan portion will begin delivering water.

- 2020: Tunnel completed, ensuring the dependability of the City's drinking water supply well into the next century.

- Commissioner Lloyd went on to say that, "We do understand that the blasting can still be disruptive for local residents, and we do our best to keep it to a minimum. We ask the public for your patience as we work to continue bringing you the safe and reliable drinking water you currently enjoy."

Source –NYC DEP

What does EPACT require?

- The following **may not be manufactured for sale in the USA** which have an average consumption of over the amount indicated:
  - Toilets 1.6 gpf
  - Faucets 2.2 gpm (reduced from 2.5 in 1998)
  - Showerheads 2.5 gpm
  - Commercial Faucets: .25 gals. per cycle **or** 0.5gpm
  - Urinals 1.0 gpf
  - Spray rinse valves: 1.6 gpm (2005)
- Toilets and urinals must meet ASME/ANSI Standard 112.19.2 revised

Part 2
Voluntary Performance Standards

Until 2003 toilets in the U.S. were tested with the following media:

Low Consumption Toilets started out poorly because of very weak Performance Standards

Some examples of meaningless testing protocols used until 2000 follow!

2000 U.S. ANSI Standard Performance Tests

Flush 75 out of 100 to pass

Leave < 125 behind to pass

Leave < a total of 2” to pass

Leave a dilution ratio >100/1 (light blue)

And in Canada

20 Synthetic Sponges

20 Kraft Anti-tarnish Paper Balls

30 ml Saw Dust

100 ml Poly-ethylene Granules

30 ml Dye

Comments:

- Neither had an effective clogging test
- Test media is unrealistic
- Expectations are very low!

Revisions made in 2003

- The following tests were added to the U.S. and Canadian Standards in 2003 in an attempt to improve the performance requirements.

Part 3
There was a need for more realistic media tests.

Uniform North American Requirement UNAR

So the Maximum Performance (MaP) Test protocol was developed in 2003

- Soybean Curd Paste
  - Starting with 50 grams
  - Flush
  - Add another 50 grams
  - Flush
  - Add another…..
  - Flush, flush, until clog
  - Record Max. flushed

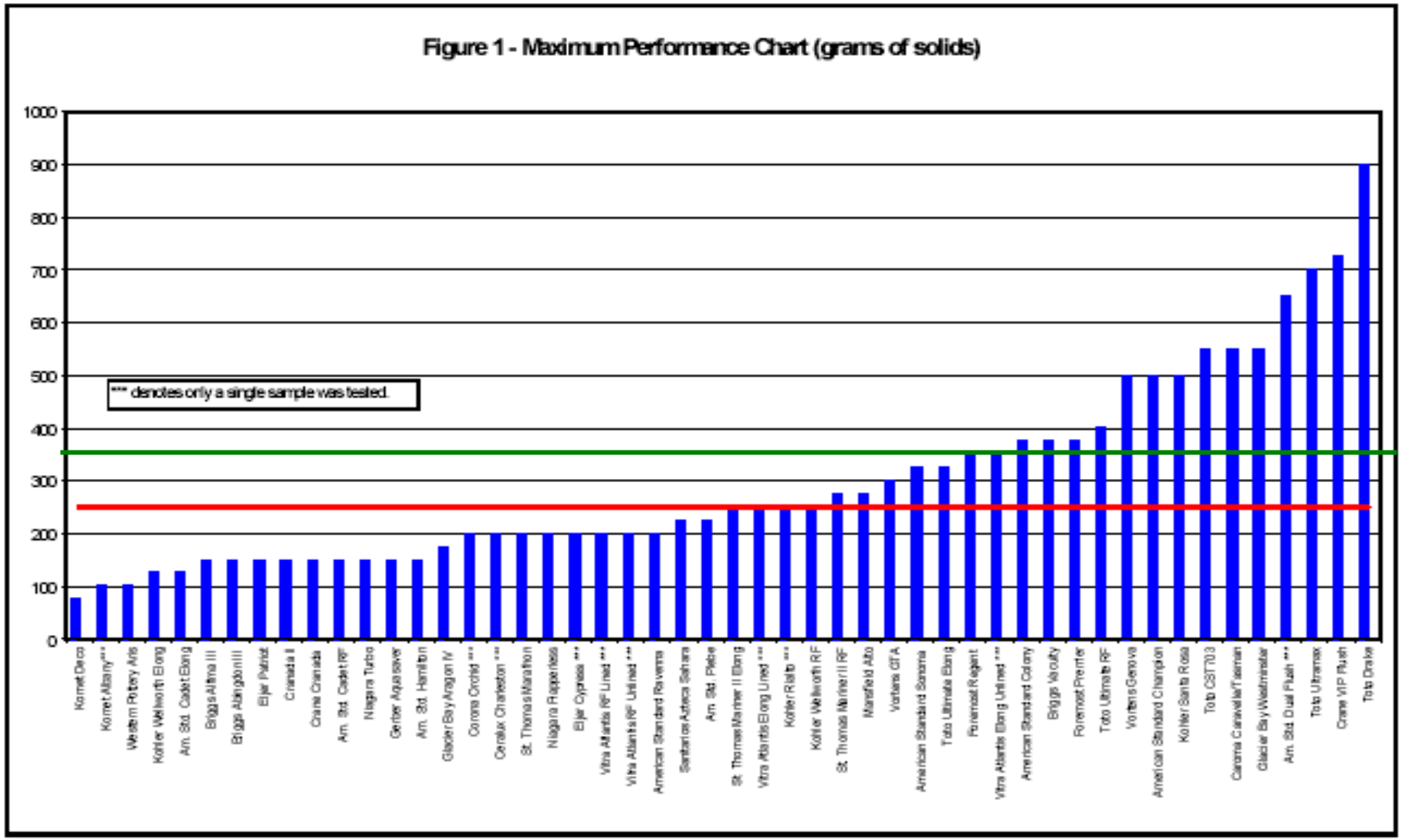
MaP Test Protocol Change

- But:
- In late 2005 the protocol changed and the media was encased in latex cylinders.
- This dramatically changed the results
- New media tests do not correlate to old
- Density of bowl water is no longer changed by partial media dissolution
  - Ability of the bowl to siphon is affected by density.
- Scores with cased media should not be compared with uncased media. BUT THEY ARE!
- **Be aware of testing dates when looking at MaP test reports.**
- **Optimum MaP scores are between 500 and 800**

MaP Test is Very Limited in Scope

- Even The MaP test encased media is a big improvement over the ANSI and CSA tests but it only measures the ability to evacuate **one** of several forms of waste
- So, unfortunately, **specialized products** are being designed that **only** do well on a sinking, encased media test.
- Very high MaP test scores beg the question: What type of simulated media have been ignored to achieve such a result?
- Marketing emphasis on the high MaP test score is becoming common. Consumers don't understand. Everyone simply wants a "winner"!
- Performance needs validation.

What the City of Toronto discovered in 2003



There is still a need for Performance Validation

MaP test

Sinking (Wrapped)

Industry “Standard”

The Real World

Sinking

Toilet paper

Big

Well balanced

Floating

Granular

The reason for all of this performance testing is to ensure **Water Efficiency**

Water Efficiency must be defined in terms of gallons <u>needed to do the job</u> instead of gallons per minute or gallons per flush.

Part 4
WaterSense

EPA WaterSense

EPA's WaterSense Program

- The program was created with the assistance of many stakeholders such as water utilities, manufacturers and environmentalists.
- Manufacturers of labeled products need to sign a Partnership Agreement with EPA.
- A WaterSense label will be put on products from partnered manufacturers which meet the WaterSense specification for that product.

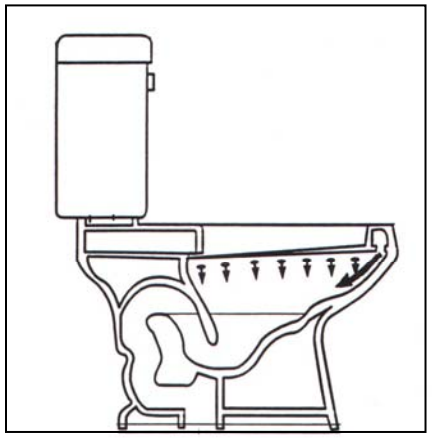
EPA HET Specifications

HET = High Efficiency Toilet

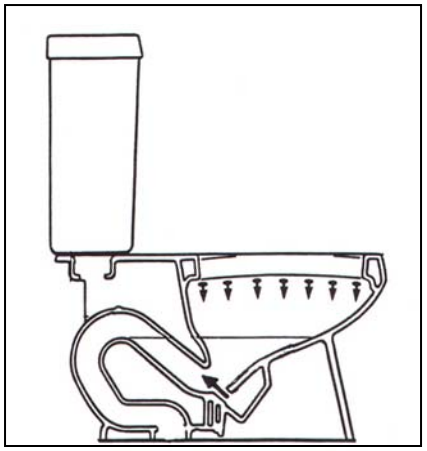
- Water Consumption of *1.28Gpf / 4.8Lpf* or less at original factory setting
- Water Consumption of *1.68Gpf / 6.8Lpf* or less with the following tank trim adjustments:
  a) Fill Valve set to highest setting (1/2 inch below over flow tube)
  b) Pilot style fill valve or ballcock with minimum fluctuation in WL
  c) Extra buoyant after-market flapper
- 350g **uncased** MaP type waste removal with Trap seal restoration
- Must meet all ASME/ANSI performance requirements

Part 5
Modern Toilet Technology

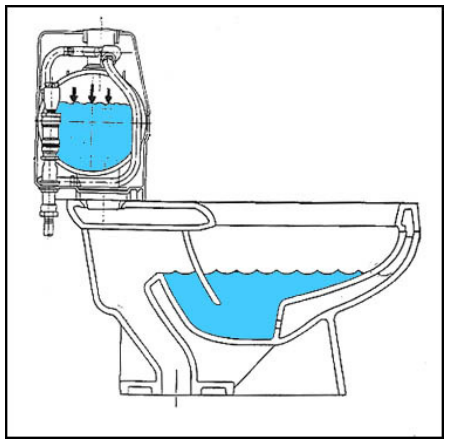
The Evolution of Flushing Systems



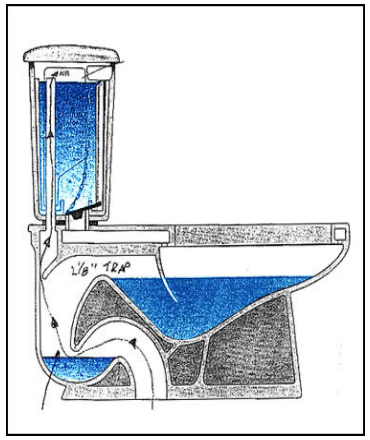
Siphon Wash down



Siphon Jet



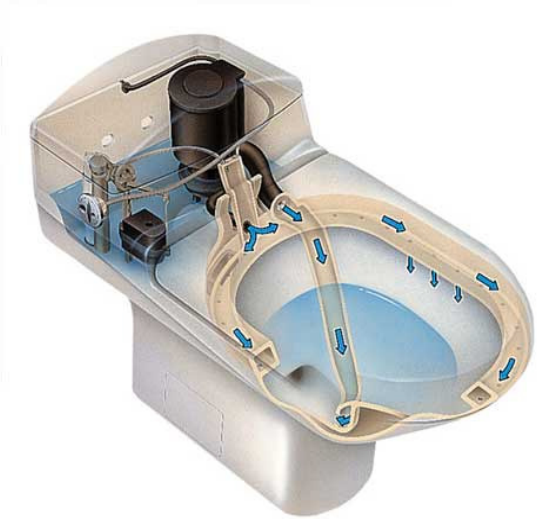
Pressure Assist



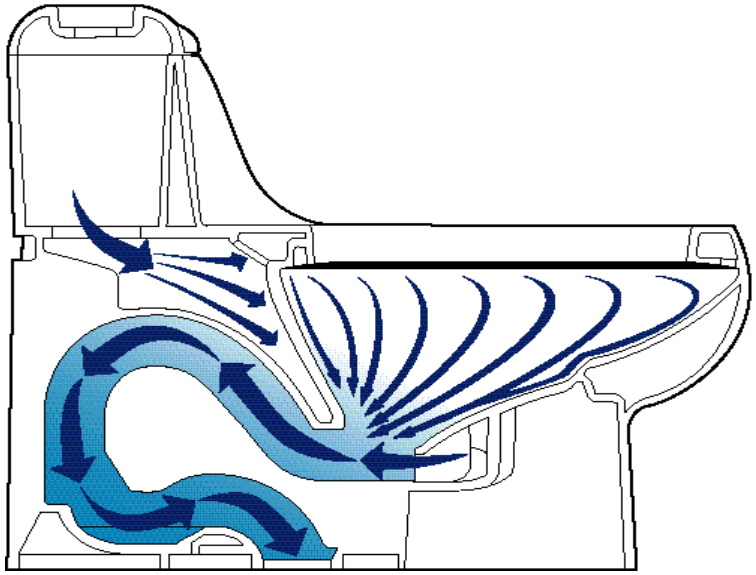
Vacuum Assist

Flushing Systems continued…

Dual Flush



Power Flush



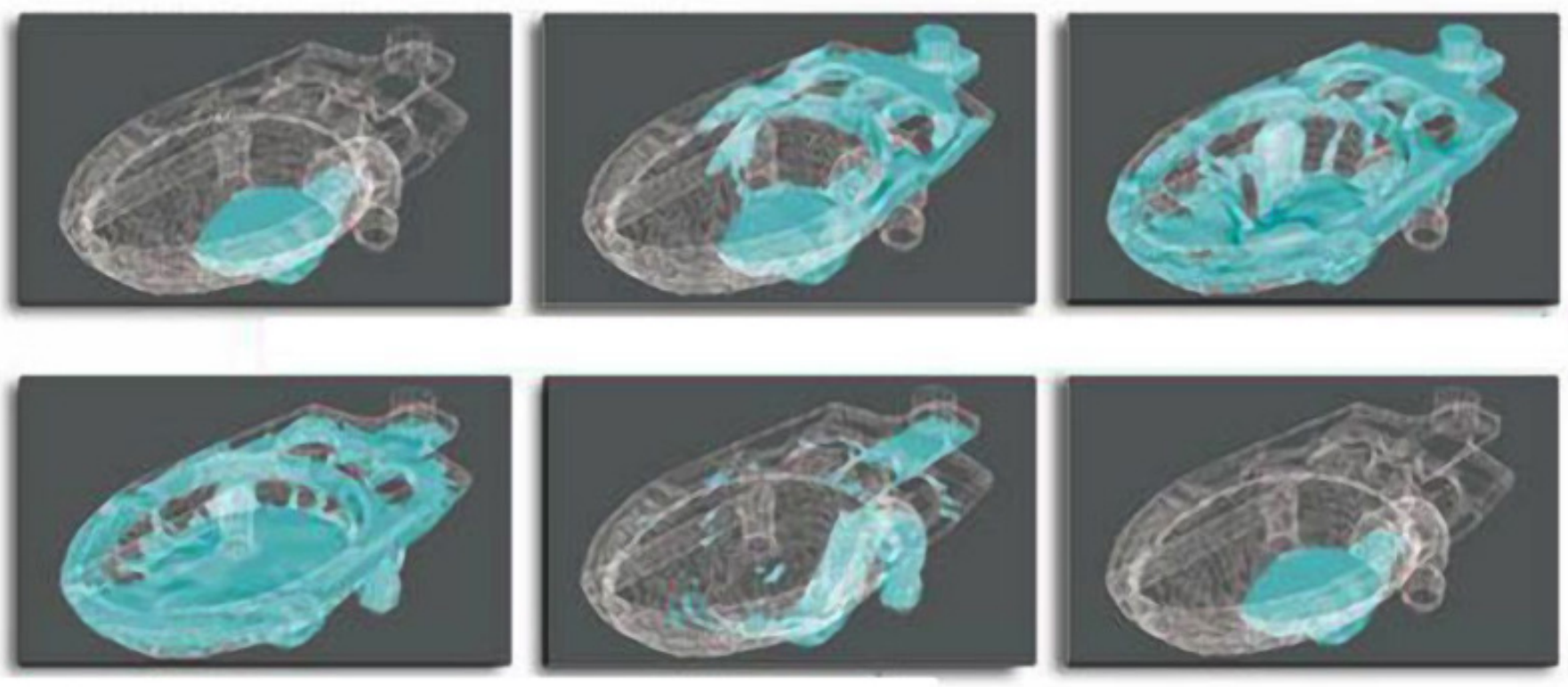
Enhanced Gravity

And….Of Course!

Computer Assisted

Innovations in Technology

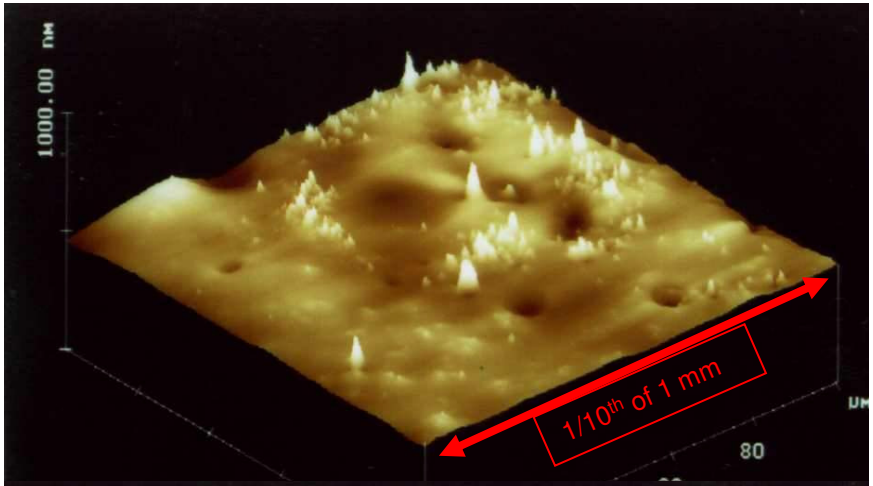
Computer Modeling and Optimization of Hydraulic Performance



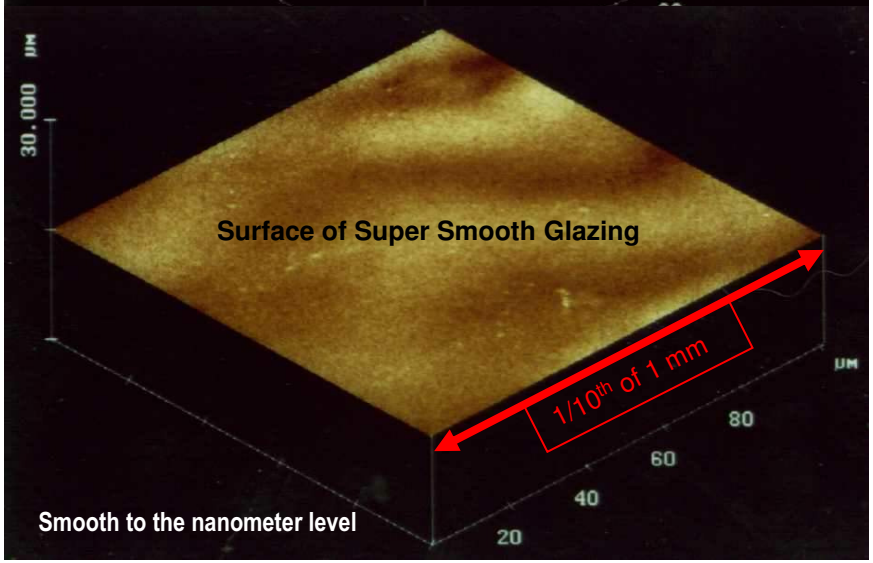
Innovations in Technology

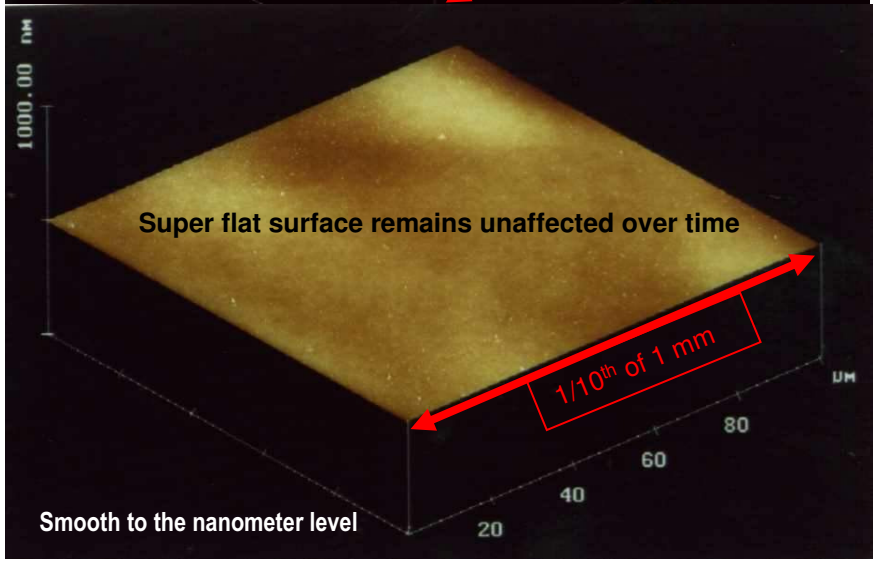
Super smooth glaze

Surface of typical glazed china under magnification



Surface of typical glazed china under magnification after 2 to 3 years of use





Part 6

Commercial Toilet Technology

Wall hung bowl with manual flush valve

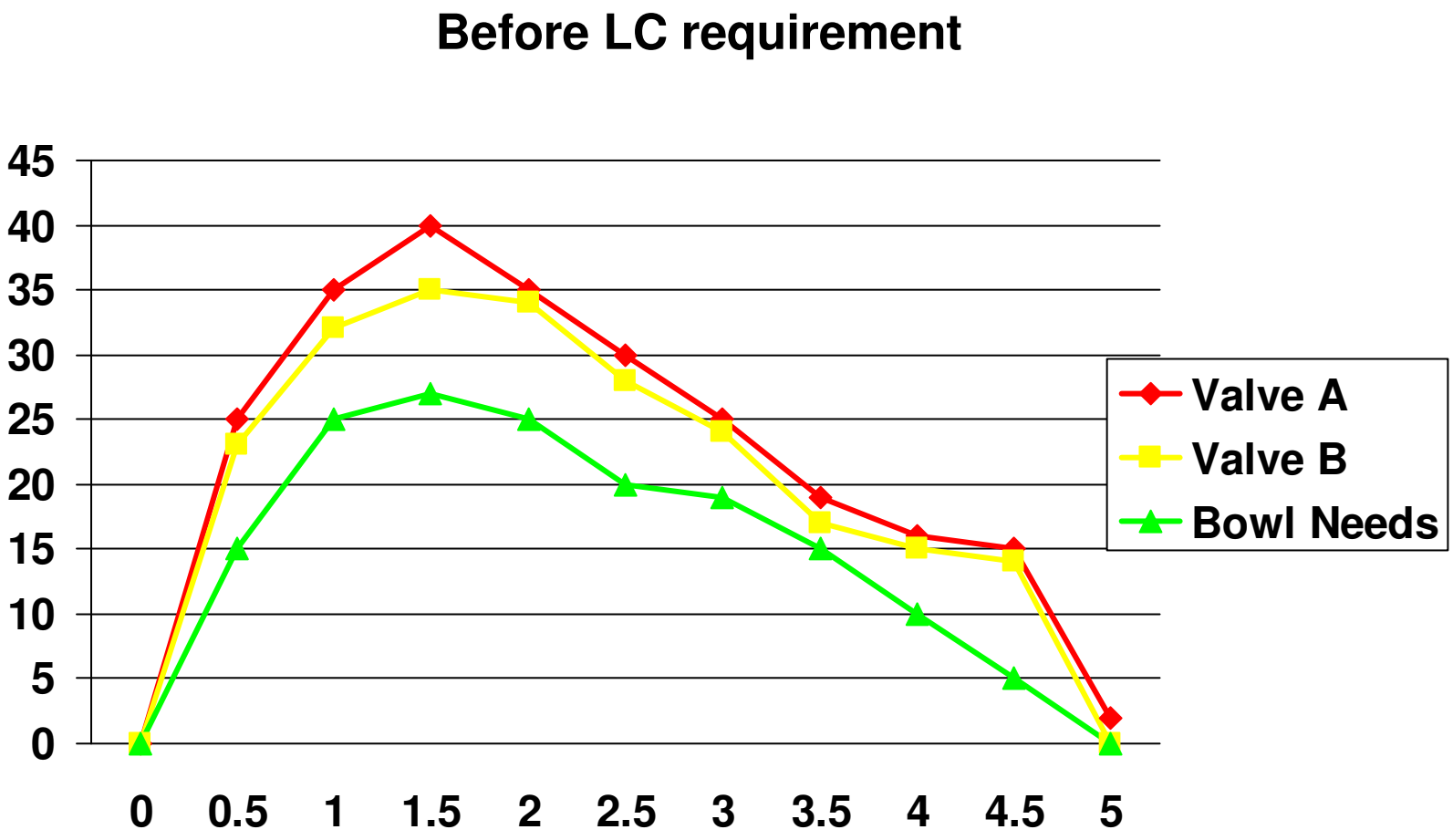
Wall hung with exposed flush valve

With concealed accessible flush valve

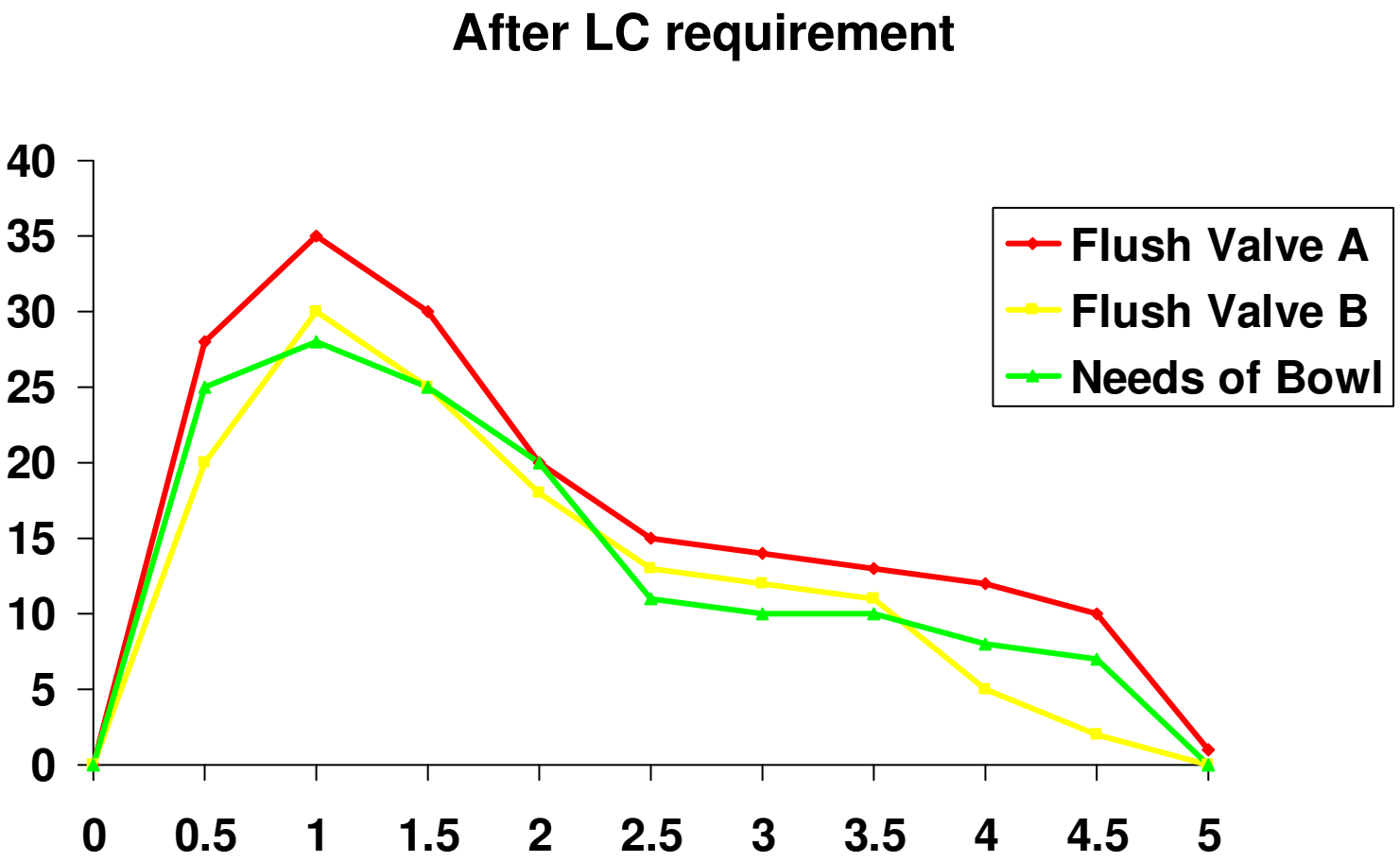
Flush Valve/Bowl Combinations

- **Two separate products** make up a commercial toilet:
- A **flush valve**:
  - Each flush valve has a discharge curve at each given water supply pressure.
- And a **bowl**:
  - Each bowl has a minimum needs curve independent of water pressure.

Flush Valve Discharge vs. Bowl Needs



Flush Valve Discharge vs. Bowl Needs



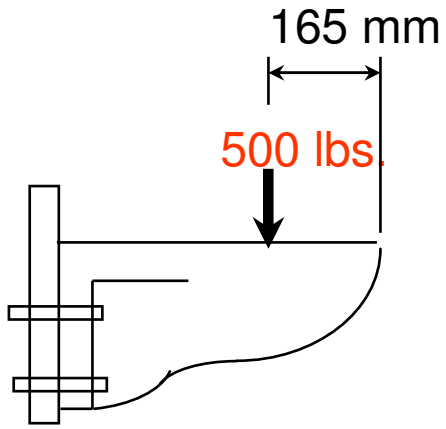
WaterSense™ specification not yet ready

- The Commercial combination of flush valve and bowl does not have a WaterSense™ Label for High Efficiency combinations yet. This should be done sometime in 2011-2012.
- Commercial toilets are held to a higher performance standard. They need to flush items such as toilet seat covers and other unexpected items of trash.
- The label will be on combinations that are engineered as a system and perform well together just like WaterSense™ tank and bowl combinations.

While we are talking about toilets…

Maximum Loading Tests are now being conducted by test labs for manufacturers. Ask for them!

US ANSI Loading Test



Part 7

The other EPACT fixtures and fittings

Urinals

Urinal with concealed valve

Flush free Urinal

What is a Green Urinal?

- A WaterSense™ specification is out for review at www.epa.gov.
- High Efficiency Urinals (HEUs) use an average of 0.5 gpf or less. This is a 50% reduction from the EPACT requirement.
  - There **are** performance sacrifices.
  - Reducing water use this far raises some questions:
    - Do the drain lines get choked with salts?
  - **Flush free** urinals raise even more questions:
    - Where does one dispose of the cartridges?
    - What is the cost of replaced cartridges?
    - How does the oil going downstream effect sewage treatment?
    - Why do directions say to pour hot water down the drain when changing seals?
    - Why do directions suggest using acid to clear drains?
- A solution: **Occasional** larger flushes to clean the drains with lower **average** flush volumes.

The Problem is Downstream

Flush free urinal drain after one year

Green Faucets

- **WaterSense™ Labeled high efficiency lav faucets (HEFs) flow at 1.5 gpm max.**
  - These will save 32% of the water used by conventional faucets
  - **1.5 gpm feels little different than 2.2 gpm**

- **EPACT requirements:**
  - Residential Lav Faucets
    - Flow must be controlled by aerators or laminators to 2.2 gpm
  - Kitchen Faucets
    - Flow rate limited to 2.5 gpm

Remote control on/off

Green Kitchen Faucets

- **No WaterSense™ specification yet**
- Residential Kitchen Faucets need to fill pots, 2.5 gpm is minimum to satisfy this function
- BUT there are ways to save water other than by using lower flow rates:
  - Foot pedal operation for rinsing
  - Sensor operation
  - Remote wireless on/off
  - Spray controls are important for effective performance
- They are only **water efficient** if they do their job with less water!
- We should be looking at total consumption not “flow rate.”

Remote Controlled Kitchen Faucet

Foot Pedal Remote control

Volume = flow rate X time

Showerheads

- **There WaterSense™ specification is out for review at the www.epa.gov/watersense website**
- EPAct: 2.5 gpm. LEED baseline =2.5 gpm
- Although lower flow rate showerheads are available, long term savings are dependent on user acceptance as well as how long it takes them to

- Flow restrictors are easily and often removed if flow is not satisfactory. The result is usually a 4-6 gallon flow rate!
- Flows below 2.5 gpm can lead to failure of certain types of thermostatic mixing valves leading to scalding or thermal shock. **Get valve manufacturer's approval before going below 2.5 gpm!**
- A performance test for rinsing is needed!
- The multiple showerhead EPAct loophole being exploited is soon to be closed!

Part 8
Water Efficiency Credits in LEED™ for homes

LEED for Homes Indoor Water credits

- High Efficiency Fittings & Fixtures (1 Point each)
  - All toilets must have ave. flow ≤1.3 gpf or be WaterSense labeled
  - Faucets must have ave. flow ≤2.0 gpm
  - Showers with Ave. flow ≤ 2.0 gpm **per stall**

LEED for Homes Indoor Water credits cont.

- Very High Efficiency Fittings and Fixtures (2 pts. each)
  - Very High Efficiency toilets using ≤ 1.1gpf
  - Very High Efficiency Showers using ≤ 1.75 gpm **per stall**
  - Very High Efficiency Faucets shall be **WaterSense labeled** using ≤ 1.5 gpm

Cautions

- High efficiency toilets (HETs) are well tested and perform well enough to meet the WaterSense™ specification.
- Very high efficiency toilets have a short history and may not.
- What goes into a green home should be able to **stay there** for the life of the home and not just be put there temporarily to earn LEED points!

LEED® New Construction Credit 3: Water Use Reduction

Water Efficiency (WE) **Prerequisite 1**: Water Use Reduction

- Employ strategies that in aggregate use 20% less water use than the baseline calculated for the building.

We Requirement

- Employ strategies that in aggregate use less water than the water use baseline calculated for the building (not including irrigation). The minimum water savings percentage for each point threshold is as follows:

Percentage Reduction	Points
30%	2
35%	3
40%	4

LEED® Existing Buildings

WE **Prerequisite 1**: Minimum Indoor Plumbing Fixture and Fitting Efficiency

- 1.6 Gallons per flush (GPM) minimum for toilets

Credit Number	% reduction	Credit Point(s)
2.1	10 %	1
2.2	20%	2
2.3	30%	3

HETs

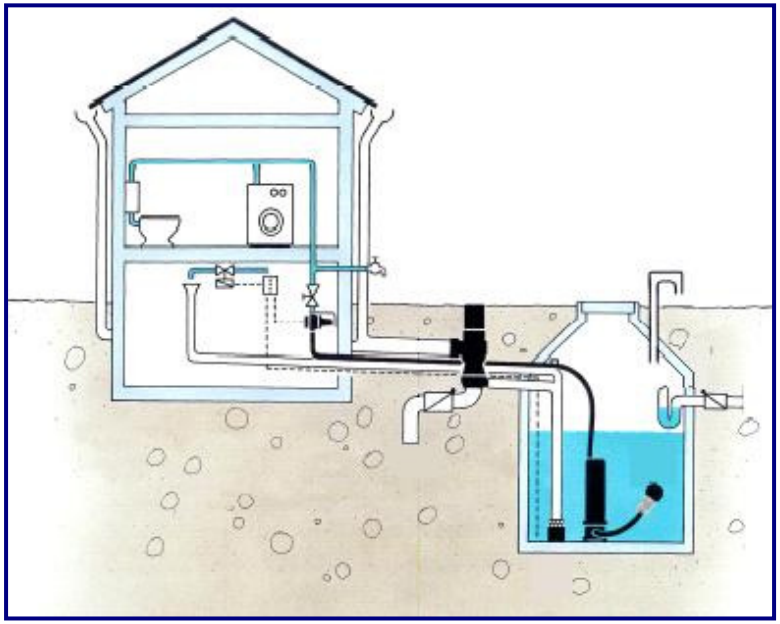
- High Efficiency Toilets (HETs) offer the most conventional, well tested toilet option to contribute to reducing the potable water use by 30% for LEED™ WE Credit 3.1
- Should bear a WaterSense™ label

Though there are many new technologies, of these the most proven are the class of toilets falling into the definition of HETs which use 20% less than the baseline 1.6 gpf. More aggressive designs using significantly less than 1.28gpf have very little history from which to predict their performance success and therefore involve some risk. It is important that the building occupants are comfortable with these products for them to be successful. There are those who would rather not and make excuses to go elsewhere where they can feel comfortable. Efficient toilets only save water if they are used and not avoided.

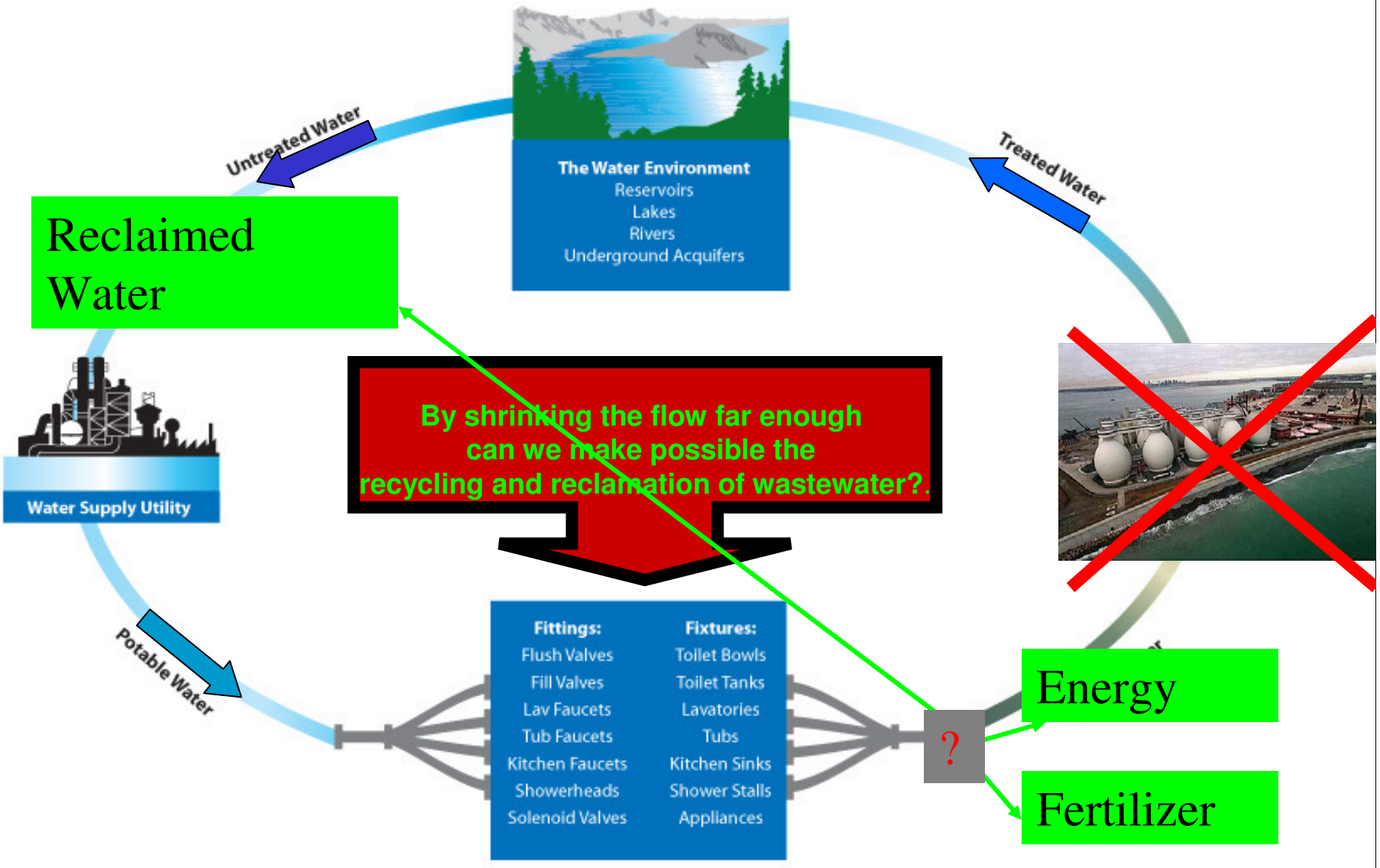
Part 9
Future Solutions

Other Promising Future Alternatives:

Using less potable water can be accomplished by utilizing water from rainwater collection systems. It can also be accomplished by recycling properly treated water from alternative sources for flushing. Care must be given to ensuring that the quality of either of these sources will not degrade the toilets being used causing leaks or excessive maintenance. Both of these systems offer great promise in relieving the demand on our potable water supply when needed standards for water quality exist.



What does our Distant Future look like?



The Sewerless City of the future

- All buildings or building clusters with similar use will have independent waste treatment systems having no off site discharge.
- Human waste will be recycled safely as energy, fertilizer or water and become a marketable resource..
- “Gray” water will be used for irrigation.
- Storm water will be filtered, used or returned to the underlying aquifer.
- Potable water will be expensive!
- **Large** central sewer systems will gradually become obsolete.

Learning Objectives

By now you should be able to:

- **List reasons for water efficiency requirements and incentives**
- **Describe "Voluntary" Toilet Performance Standards in North America**
- **Explain:**
  - **The need for realistic media tests**
  - **The emerging consumer based standard: UNAR**
  - **The EPA's WaterSense program**
- **Compare Modern Toilet Technology to traditional plumbing and how other EPACT fixtures and fittings work in this regard**
- **Apply knowledgably the Indoor Water Efficiency Credits for LEED™**
- **Explain what "sustainable" plumbing means in the future**