Achieving Water Independence in Buildings

Navigating the challenges of water reuse in Oregon

Central City Concern
March, 2009

Achieving Water Independence In Buildings

www.cascadiagbc.org/lbc/resources/water/oregon

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EXECUTIVE SUMMARY

The majority of today's buildings are not taking advantage of free and available water resources – the rainwater that falls on-site and the wastewater that is generated by occupants. Rainwater and wastewater can be harvested and treated for beneficial uses including drinking, washing, bathing, toilet flushing and irrigation. Reusing water before sending it to a community wastewater treatment facility not only conserves water, but also reduces pollution and the need for extensive wastewater and stormwater infrastructure. Additionally, such water reuse systems consider the health and safety of the public in matching the source wastewater, and level of treatment necessary, to the intended use.

Now, imagine a building that met all water needs with captured rainwater and wastewater and ensured that no sewage or stormwater left a site. Such an audacious goal has inspired many building teams to think outside of the box as they pursue the **water independence** requirement of the **Living Building Challenge** – arguably the most rigorous green-building benchmark available today.

By pursuing the Challenge, building teams are pioneering new possibilities in sustainable building.

In Oregon, Central City Concern (CCC), a non-profit owner of affordable housing, believes the time for realizing more significant water savings in buildings has come. Its work, in collaboration with others, has contributed to new opportunities for water reuse in Oregon.

CCC's approach uncovered the regulatory, behavioral and technological barriers to water reuse in buildings by 'getting everybody in one room' and focusing on the issues that are important to people.

This work led to the realization that regulatory change has the most potential to dramatically impact water savings in buildings and could even be accelerated by adopting a statewide strategy to educate and develop support around water reuse opportunities.

Due in part to these efforts, **buildings in Oregon are now allowed to use rainwater and greywater**, reducing their need for municipal water, which in turn reduces their sewage and stormwater outflows. Now all buildings can come close to achieving water independence and some building types may even be able to meet such a goal entirely.

THE LIVING BUILDING CHALLENGE™

The Living Building Challenge is attempting to raise the bar and define a closer measure of true sustainability in the built environment, using a benchmark of what is currently possible and given the best knowledge available today. Projects that achieve this level of performance can claim to be the 'greenest' anywhere, and will serve as role models to others that follow. Although it may be difficult to achieve the Living Building Challenge, understanding the standard and documenting compliance with the requirements is inherently easy: Just 16 simple and profound requirements that must be met.

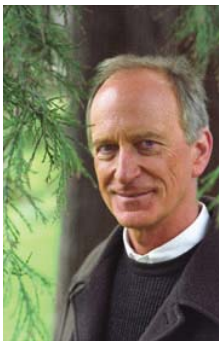
At the heart of the Living Building Challenge is the belief that our society needs to quickly find a state of balance between the natural and built environments. Cascadia views the release of the Living Building Challenge as an act of optimism and faith in the marketplace to reach high-level goals and project teams are already responding: In the short time since it was unveiled at Greenbuild in 2006, dozens of building owners, designers, developers and contractors throughout North America and around the world have embarked on the Challenge.

The race is on.

source: Cascadia Region Green Building Council. August 2008. Living Building Challenge, Version 1.3. http://www.cascadiagbc.org/lbc/about

FOREWORD

by Denis Hayes, President and CEO, the Bullitt Foundation



Environmental issues are sometimes described as middle class issues—issues of interest only to people who have escaped the more dire problems afflicting the very poor. There is some truth in that claim, but it ignores that clean water, healthy air, and non-toxic habitats are fundamental rights that are important to all.

I know few stories that reflect this truth more clearly than the extraordinary leadership of Central City Concern (CCC) in Portland, Oregon. This group's recent work—in coordination with a phalanx of other private and public sector organizations—has significantly broadened the array of urban water options available in Oregon.

CCC is a non-profit organization that serves single adults and families afflicted by homelessness, poverty and addictions. CCC's initial focus in 1979 was on alcoholism but its scope expanded to include other addictions like crack cocaine and heroin. The agency's goal is transformation, not warehousing, and its programs include employment training and work opportunity. It serves about 15,000 people annually and operates more than 1,400 units of affordable housing throughout the Portland area.

People who are ready to change their lives are moved off the street and into drug- and alcohol-free housing. Because CCC is responsible for all the utility bills in its housing units, the organization is acutely sensitive to rising rates for power and water. Seeing that it could do nothing to influence the utility rates, CCC set out to influence the size of its bills. This could be accomplished by increasing the efficiency of its buildings' use of energy and water, and by seeking ways to produce their own power and to harvest and recycle rainwater.

This report describes some of its pioneering work on water.

Portland has been supplied water by the Bull Run watershed since 1895. As a growing city entering an era of climate change, the city is looking for ways to encourage all buildings to boost their efficiency of water use. Change is already under way: Portland has one of the highest concentrations of LEED Silver, Gold and Platinum buildings in the country. But CCC decided to go further, responding to the Living Building Challenge of the Cascadia Region Green Building Council which requires a new building to be water self-sufficient. So CCC set out to be self-sufficient in water—harvesting rainwater, and treating and recycling greywater. But this was illegal under current Oregon regulations.

This report explores how CCC, which is not an environmental NGO or a green condo developer but a group committed to helping some of the poorest members of society get clean and sober and employed, went about changing Oregon's water rules and regulations to make sustainable development possible. It took the cooperation of advocates, experts and officialdom to change anachronistic legal constraints. Everyone benefited.

For example, harvesting rainwater and storing it in large cisterns not only keeps water from wet months for use in dry months but also keeps rainwater from running into the storm sewers when they are most gorged and overflowing, which sometimes forces untreated sewage directly into waterways.

Similarly, as long as public health officials ensure that no health threats are involved, reusing greywater for purposes that don't require potable water, e.g. for flushing toilets, is good for everyone.

This report is a tribute to true leadership—as wisely defined by Dwight Eisenhower: "Leadership is the art of getting someone else to do what you want done because he wants to do it." CCC's success will inspire other groups in other places to help make their own cities models of sustainability.

INTRODUCTION

Water, once thought to be readily abundant, and 'too cheap to meter' is now unaffordable for many Americans. The average household uses 400 gallons per day for indoor and outdoor domestic uses,[1] spending about $500 annually on water and sewage utility costs.[2] In 2009, a projected 22% of US households will spend more than 4% of their household income on water and wastewater fees.[3] As water utility rates continue to rise faster than household income, water conservation must increase to improve the economic situation for our nation's low-income households.

"When the well is dry, we learn the worth of water."
-Benjamin Franklin

Central City Concern (CCC), an affordable housing provider in Portland, Oregon is acutely aware of this situation – they house some of the lowest income people in the City's metropolitan area. To improve the health and economic situation of their tenants, they have decided to pursue the **Living Building Challenge (LBC)**[4] for their newest multifamily project under development. This green building benchmark has 16 straightforward, yet ambitious, requirements such as mandating the use of non-toxic materials and achieving energy independence (or more accurately, net-zero energy use on an annual basis). CCC's development team determined that the LBC's water independence requirement would be particularly challenging due to the complex regulatory environment that exists across the nation. As they delved into the challenge, they realized that statewide regulatory reform was possible.

A **water-independent building** is a building that harvests rainwater and recycles its own wastewater for reuse, eliminating the need for imported municipal water and exported sewage or stormwater.

The goal of water independence is not meant to suggest that buildings should secede from the municipal water and sewer treatment infrastructure. Even in energy independence, a connection to the utility grid can be desirable as an emergency back-up and to sell excess energy through net-metering. In the same way, a connection to a municipal water and sewer system may be desirable to fight fires and to take a water system offline for maintenance. Perhaps in the future, water net-metering will be available for buildings that produce excess water to supply other beneficial uses within a community! **Utilizing the goal of water independence allows a community to explore what is possible, then implement strategies that protect their water resource and eliminate water pollution while considering their unique water situation.**

Proven reuse strategies, such as utilizing wastewater from a shower for toilet flushing after on-site treatment, are not currently allowed in many states. In some cases, exceptions have been made on a building-by-building basis. However, special approvals can be difficult to obtain as confusion arises between overlapping state, county, and city authorities and requirements. A Oregon plumbing engineer described it this way:

> *"…in a commercial building, greywater from a shower drain is regulated by the plumbing code, but if discharged to the exterior of the building, it falls under the jurisdiction of the Oregon Department of Environmental Quality. Harvested rainwater is also regulated by the plumbing code unless you want to capture it for potable uses, which involves the Department of Health and Human Services"*[5]

a conceptual design for Central City Concern's Pearl Family Development, a mixed-use building with up to 175 affordable, family apartments

1 American Water Works Association Research Foundation. 1999. *Residential End Uses of Water*, p. 167.
2 United States Environmental Protection Agency. October 2003. *Water On Tap: what you need to know*, p. 11.
3 Water Infrastructure Network. 2000. *Clean & Safe Water for the 21st Century*. pp3-4 - 3-5. http://www.win-water.org/reports/winreport2000.pdf.
4 Cascadia Region Green Building Council. August 2008. *Living Building Challenge, Version 1.3*. http://www.cascadiagbc.org/lbc/about.
5 Jon Gray, Interface Engineering, e-mail message to author, March 16, 2009.

Because of the difficulty in navigating all of the applicable statutes, regulations and agencies, many building development teams are unsure how to achieve water independence or additional water conservation. Regulatory clarification and reform is a necessary step toward the realization of advanced water conservation in buildings.

In this report, Central City Concern and their development team – SERA Architects, Interface Engineering and Gerding Edlen Development (a.k.a. the Water Team) – clarify the water systems and regulatory steps required to achieve a water-independent building in Oregon. The report illustrates the barriers to, and opportunities for water harvesting and reuse in commercial buildings, highlighting what is possible today and how any interested party might navigate future regulatory challenges. It is the Team's hope that this will help the Oregon building industry achieve advanced, water conserving buildings. For those outside of Oregon, the Water Team's approach, tools, and additional aspects of this report could be replicated or modified as appropriate to pursue water conservation in other jurisdictions.

The Water Team's work and approach has contributed to a transformation of the regulatory environment in Oregon by pursuing changes statewide. Up until now, commercial buildings in Oregon could expect to achieve 30% - 40% water savings by incorporating water efficient fixtures. As a result of the Water Team's efforts, in collaboration with regulatory officials and other leaders in the industry, a building like CCC's conceptual multifamily high-rise development can achieve an astounding 60% to 70% water savings by implementing rain and greywater harvesting together with efficient fixtures[6]. **Oregon residential and commercial buildings are now allowed to use rainwater for irrigation, toilet flushing and clothes washing, and treated greywater (from sinks, bathtubs, showers, and washing machines) to flush toilets and urinals** (see *Regulatory Change Update* on Page 26). For the average Portland household, these changes could save over $500 per year in water-related utility costs[7].

6 For the Pearl Family Development concept with 175 units, the projected water savings is 66%. The savings is achieved through fixture efficiency (34%), rainwater harvesting (2%) and greywater harvesting (30%). To achieve true water independence, blackwater harvesting and/or significant occupant behavior change would have to be implemented. Water usage and savings will differ among other building types, densities, and uses. source: calculation by SERA Architects. December 2008.

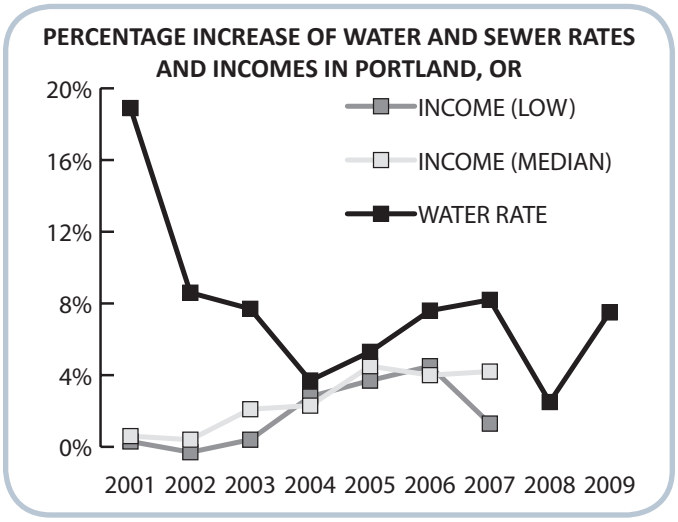
7 Water, stormwater, and sewer utility cost based on average household use reduced by by 70%. sources: 1) City of Portland Bureau of Environmental Services. *Fiscal Year 2008/2009 Sewer Rates*; and 2) City of Portland Water Bureau. *Fiscal Year 2008/2009 Water Rates*.

WHY SHOULD WE BE CONCERNED ABOUT WATER?

Economic Sustainability

Water rates are increasing faster than household income

The cost of water-related utilities is rising nationwide, due to increasing demand, decreasing supply, and the high cost of supplying water, conveying stormwater, and treating wastewater. In the City of Portland, Oregon, water and sewer rates recently increased by 8%[1] and a recent City report forecasted a 10% annual increase over the next 5 years.[2]



water rates in Portland, OR are rising faster than household income

Water is becoming increasingly unaffordable to low-income people. The average Portland household spends over $800 annually on water and sewer utility costs.[3] For a family earning minimum wage, this represents more than 5% of their disposable income.[4] Fortunately, in the City of Portland, as in other jurisdictions, there are programs that work directly with low-income people to help improve water efficiency and mitigate utility costs.[5] However, with water rates increasing faster than household income, this financial may become greater in future years. Water conservation has the potential to reduce this economic hardship on low-income people.

Environmental Sustainability

There is increasing demand and declining availability of water

In the last five years, nearly every region in the United States has experienced water shortages. At least 36 states are anticipating local, regional, or statewide water shortages by 2013, even under non-drought conditions.[6] Population growth, climate change[7] and water use habits are placing significant demands on limited water supplies and wastewater treatment systems.

To many people's surprise, the state of Oregon shares this supply challenge. Surface waters in most of the state during non-winter months are fully appropriated by existing uses. Additionally, groundwater resources are showing signs of overuse and are becoming unstable in many areas. A lack of surface water resources has increased the reliance on groundwater which, in turn, can further deplete surface water.[8] Adding to this pressure is an expected 30% population increase over the next 20 years.[9]

Pollution due to water use habits, inadequate stormwater management and wastewater treatment is further reducing the availability of fresh water. When wastewater is treated, there is always something left over. Sludge, a by-product of treatment, may contain unwanted elements such as heavy metals and persistent organic compounds. These contaminants can leach into groundwater

1 Water rate increase between Fiscal Year 2008/2009 and Fiscal Year 2008/2009. source: City of Portland Water Bureau.

2 City of Portland Water Bureau. July 29, 2008. *Official Statement of the City of Portland Multnomah, Washington, and Clackamas Counties Relating to $79,680,000 First Lien Water System Revenue Bonds 2008 Series A*, p. 61, Table 20. http://www.portlandonline.com/omf/index.cfm?&c=31438&a=206733 (accessed February 9, 2009).

3 Water and sewer utility cost based on average household use (includes stormwater and other fees). sources: 1) City of Portland Bureau of Environmental Services. *Fiscal Year 2008/2009 Sewer Rates*; and 2) City of Portland Water Bureau. *Fiscal Year 2008/2009 Water Rates*.

4 United States Department of Labor: Wage and Hour Division. *Minimum Wage Laws in the States - January 1, 2009*.http://www.dol.gov/esa/minwage/america.htm (accessed February 26, 2009).

5 City of Portland. *Need help paying your water and sewer bill?* http://www.portlandonline.com/water/index.cfm?c=48894&a=217441 (accessed February 13, 2009).

6 United States Environmental Protection Agency. 2008. *Water Supply and Use in the United States*. http://www.epa.gov/watersense/docs/ws_supply508.pdf (retrieved on February 23, 2009).

7 Climate change is affecting water supply as drought increases, snowmelt accelerates, and glaciers recede. source: United States National Academies. 2008. *Drinking Water: Understanding the Science and Policy behind a Critical Resource*. http://dels.nas.edu/dels/rpt_briefs/drinking_water.pdf (retrieved on February 13, 2009).

8 State of Oregon Progress Board. 2000. *State of the Environment Report*. http://www.oregon.gov/DAS/OPB/soer2000index.shtml (accessed February 20, 2009).

9 State of Oregon Office of Economic Analysis. April, 2004. *Forecasts of Oregon's County Populations and Components of Change, 2000 - 2040*. http://www.oregon.gov/DAS/OEA/docs/demographic/pop_components.xls (retrieved February 20, 2009).

Bull Run Lake from Hiyu Mountain (credit: US Forest Service)

PORTLAND WATER

Portland, Oregon is among only a handful of large cities in the United States who do not need to treat their surface water beyond disinfection. The source is located in the upper reaches of the protected Bull Run Watershed and thus is naturally very pure. Groundwater from Columbia South Shore Well Field acts as a backup to the Bull Run.[1] When Bull Run water is low during dry summers, Portland extracts water from the Columbia aquifer at additional expense to the city.

Combined sewer overflows (CSOs) occur nearly every time it rains in Portland. Combined sewers carry sewage from homes and businesses as well as stormwater runoff from streets and buildings when it rains. During a CSO event, stormwater quickly fills the combined sewers and they overflow, carrying bacteria from untreated sewage and pollutants in the stormwater to the Willamette River. The combined sewer system serves about half of Portland's neighborhoods, most of them built before the 1960s. The City estimates that CSOs to the Willamette River will be reduced by 94% when the Bureau of Environmental Services finishes thier CSO reduction projects in 2011.[2]

1 Portland Water Bureau. *Portland's Water Sources*. http://www.portlandonline.com/water/index.cfm?c=48909 (accessed on February 19, 2009).
2 City of Portland. *Combined Sewer Overflow*. http://www.portlandonline.com/cso/ (accessed on February 25, 2009).

or can be picked up by stormwater and conveyed to surface water sources.[10] In a similar way, when a buildings' stormwater is not managed on-site it can pick up contaminates as it flows across impervious surfaces towards bodies of water. Furthermore, in many communities like Portland, Oregon, stormwater can overwhelm a sewer system's capacity and discharge pollution directly to surface water without treatment. There are about 772 communities in the United States with combined sewer systems, serving about 40 million people.[11]

Water used for drinking, bathing, cooking, sanitation, gardening and irrigation represents an opportunity for conservation and pollution reduction. Management of stormwater, together with a reduction in a building's demand for potable water and wastewater expelled for treatment would conserve our fresh water supply, reduce pollution and decrease the demand on conveying and treatment infrastructure.

Education and Equity

Tools and knowledge should be accessible so that everyone can live with less

Those with limited resources are often unaware of, or unable to afford, the tools to achieve water conservation. Low-income people as well as owners and developers of residential and commercial buildings can benefit from the implementation of water conservation and reuse measures.

10 United States Environmental Protection Agency. September, 2004. *Primer for Municipal Wastewater Treatment Systems*. http://www.epa.gov/owm/primer.pdf (retrieved on February 20, 2009).
11 United States Environmental Protection Agency. August 2004. *Report to Congress: Impacts and Control of CSOs and SSOs*. http://cfpub.epa.gov/npdes/cso/cpolicy_report2004.cfm (accessed on February 20, 2009).

Impact

More widespread adoption and reform is necessary

Benchmarks in the field of green building continue to push the building industry toward higher levels of water efficiency. The US Green Building Council's (USGBC) popular LEED Rating System[12] awards points for achieving reductions in a building's water use. The Cascadia Region Green Building Council (the Northwest chapter of the USGBC) recently introduced a new green building performance standard, the Living Building Challenge,[13] which requires an even greater reduction – 100% conservation and reuse (a.k.a water independence). A water-independent building would harvest rainwater and treat its own wastewater for reuse so that no municipal water is used and no stormwater or sewage is produced. This ambitious requirement has highlighted the need for regulatory reform in order to achieve more significant conservation through water reuse strategies.

Effective water harvesting and reuse systems have been incorporated into select projects in Oregon and throughout the country by formally requesting permission to install a system that is believed to meet the intent of regulations. However, some regulations unknowingly prevent systems or are confusing enough to thwart good intentions. Removing regulatory barriers may lead to more widespread adoption of innovative water systems as building owners, developers, architects, engineers and contractors will be better able to navigate the regulatory environment.

12 Leadership in Energy and Environmental Design (LEED) awards one point for achieving a 20% reduction in a building's water use, an additional point for a 30% reduction and an innovation point for achieving a 40% reduction. The rating system also provides credits for reducing water used for irrigation, awarding one point for a 50% reduction in water used for landscaping, and two points for 100%. In addition, there are two points available for 'innovative wastewater technologies' which rewards on-site water reuse. sources: 1) US Green Building Council. October 2005. LEED for New Construction & Major Renovations, v2.2. http://www.usgbc.org/ShowFile.aspx?DocumentID=1095 (retrieved on February 23, 2009); and 2) US Green Building Council. April 8, 2004. *Guidance on Innovation & Design (ID) Credits*. http://www.usgbc.org/Docs/LEEDdocs/IDcredit_guidance_final.pdf.

13 The Living Building Challenge (LBC) awards buildings that achieve 'Net Zero Water' where "100% of the occupant's water use must come from captured or closed loop water systems that account for downstream ecosystem impacts and that are appropriately purified without the use of chemicals" and buildings that achieve 'Sustainable Water Discharge' where "one hundred percent of storm water and building water discharge must be managed on-site and integrated into a comprehensive system to feed the projects demands" source: Cascadia Region Green Building Council. August 2008. *Living Building Challenge, Version 1.3*. http://www.cascadiagbc.org/lbc/about.

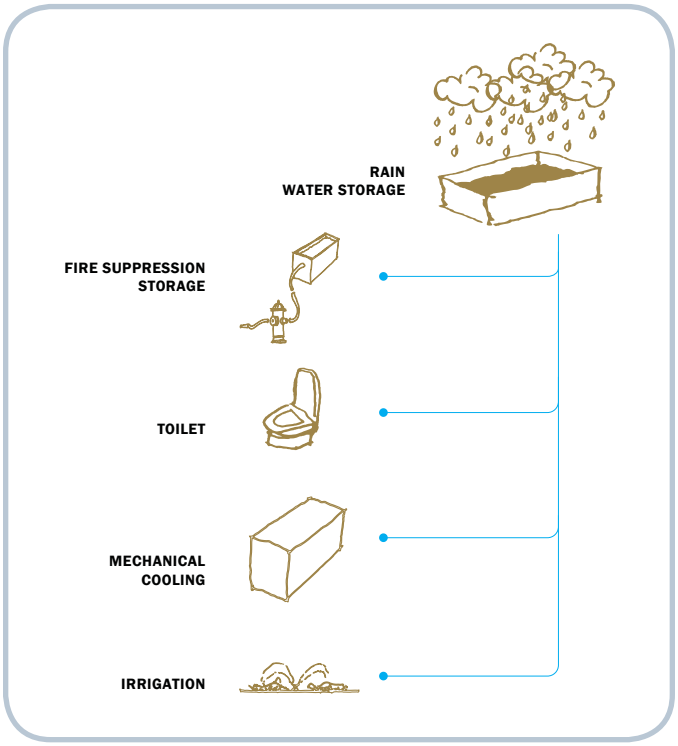
WATER SYSTEMS OVERVIEW

an introduction to the systems in a water-independent building

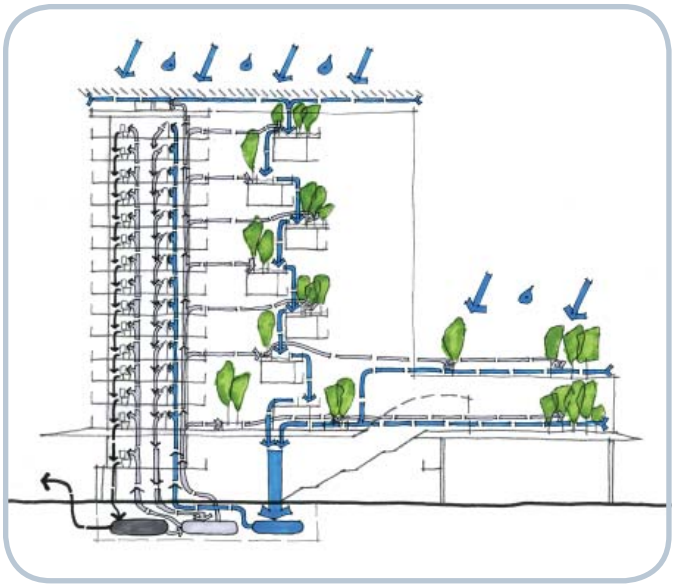
Water-independent buildings do not rely upon a municipal source of water. Instead they harvest rainwater and wastewater on-site.[1] Harvested wastewater is either greywater (as in bath and lavatory wastewater) or blackwater (as in toilet wastewater). The following water types can be utilized in a water-independent building.

Potable Water, often referred to as 'fresh', 'tap', or 'drinking' water, typically comes from a municipal source or well and is widely thought to be the only source available to a household. It is generally used for everything – drinking, bathing, toilet flushing and irrigation.

In a water-independent building, potable water may be produced through the harvesting and purification of rainwater, without the use of chemicals, or by the treatment of greywater when rainwater is unavailable.



options for rainwater use



A water-independent Pearl Family Development concept with 175 units could be achieved through fixture efficiency (a 34% water savings), rainwater harvesting (a 2% water savings), greywater harvesting (a 30% water savings) and blackwater harvesting (a 34% savings). Water harvesting allocations and savings will differ among other building types, densities and uses. source: SERA Architects. December 2008.

Rainwater is a product of the condensation of atmospheric water vapor that is returned to the Earth's surface though precipitation. Rainwater is the primary sources of fresh water for most areas of the world.

In a water-independent building, rainwater is harvested from impervious surfaces such as roofs and conveyed via gutters and downspouts to a storage tank or cistern for reuse. Filtered and lightly treated rainwater is acceptable for non-potable uses such as irrigation, toilet flushing and laundry while further treatment is required for reuse as potable water. Typically, such treatment involves filtration combined with disinfection from ultraviolet light or ozone treatment. Rainwater generally requires a large storage system for year-round use, if wastewater is not utilized.

Greywater is wastewater generated from domestic processes such as hand washing, clothes washing and bathing. Greywater gets its name from its cloudy appearance and from its status as being neither fresh (as in potable water) nor heavily contaminated (as in blackwater).

1 In addition to rainwater, a water-independent building can be supplied with other closed loop water sources. In a hot and humid environment, water vapor can be harvested through condensation. In a hot, arid climate, water can be extracted from an aquifer if treated wastewater is used to recharge the aquifer in an amount equal to that extracted. With Oregon's abundant rainfall, this report does go into detail about other water sources. See the Living Building Challenge v1.3 for more information.

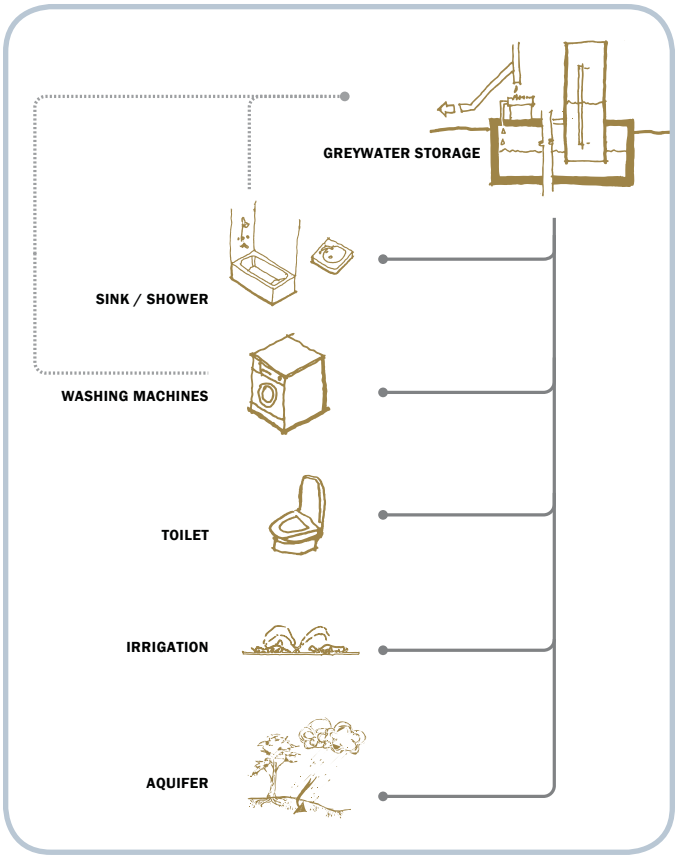
Not all states have a definition for greywater and where they do, definitions differ.[2] The definition generally preferred by the green building industry is the most broad where greywater comprises all wastewater except from toilets and urinals. Such greywater would include wastewater from the shower, bath, lavatory, kitchen sink, dishwasher, and laundry.

In the state of Oregon, the adoption of Oregon House Bill 2080 would define greywater broadly as "shower and bath waste water, kitchen waste water, laundry wastes and any other domestic sewage" except "toilet and garbage wastes."[3]

Kitchen wastewater from sinks and dishwashers is sometimes not classified as greywater because of the potential contamination from food residue or toxic chemicals such as those found in some household cleaners and dishwashing detergents. However, such a exclusion may be best regulated not by state law or definition, but by those agencies who have the authority to place restrictions or requirements on certain wastewater uses to protect the health of the public.

In a water-independent building, greywater should be treated to the level that is required for its intended use. For example, greywater used for toilet flushing would require minimal treatment while additional primary and secondary filtering with disinfectant would be necessary before it could be used for potable water uses. Greywater can be harvested year-round and requires minimal storage.

Blackwater, also known as sewage, refers to water contaminated by human body waste, food residue, chemicals (including those found in many household cleansers) and solvents (often found in paints). Blackwater originates from toilets, urinals, kitchen and janitorial sinks.[4] In some jurisdictions, kitchen wastewater is classified as blackwater.



options for greywater use

A Note on Water Definitions

The terms 'blackwater' and 'greywater' are preferred over 'sewage' when referring to their status in a building where water is reused. It is important to note the absence of a universally accepted definition for greywater and blackwater within the United States. A majority of states refer to all wastewater as sewage and have yet to adopt definitions for greywater and blackwater which complicates the prospects for water reuse.

See the Oasis Design Greywater Policy Center for more information on greywater laws and regulations throughout the United States http://www.oasisdesign.net/greywater/law/index.htm

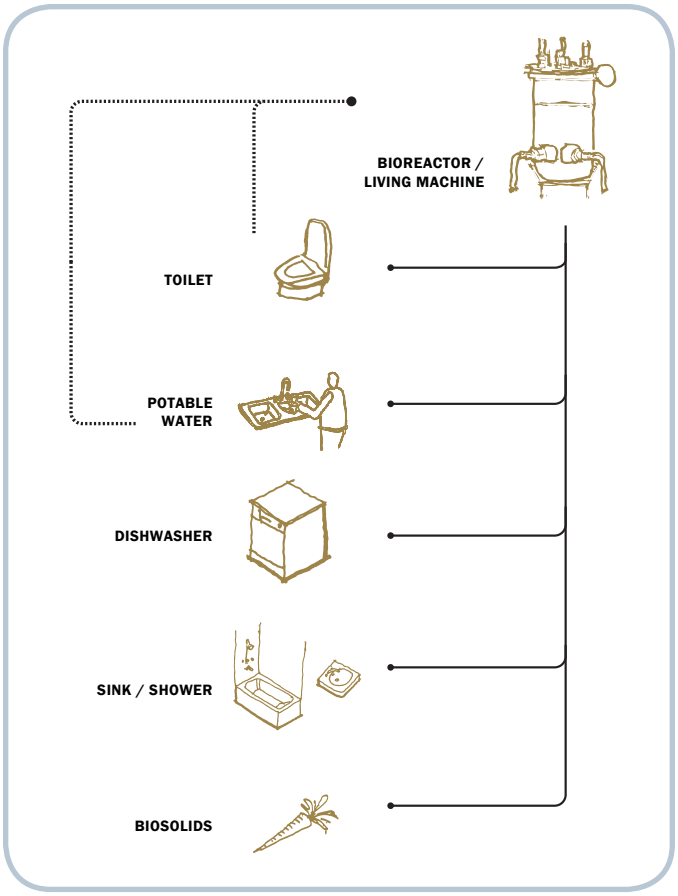
2 Reference the Oasis Design Greywater Policy Center for information on greywater laws and regulations throughout the United States. http://www.oasisdesign.net/greywater/law/index.htm (accessed on February 25, 2009).

3 State of Oregon. House Bill 2080. HB 2080 (17-19). http://www.leg.state.or.us/09reg/measpdf/hb2000.dir/hb2080.intro.pdf (retrieved on February 22, 2009).

4 State of Oregon, Oregon Administrative Rules. January 15, 2009. Department of Environmental Quality, Division 71, Onsite Wastewater Treatment Systems. OAR 340-071-0100 (20) (143) (177). http://arcweb.sos.state.or.us/rules/OARs_300/OAR_340/340_071.html (accessed on February 22, 2009).

In a water-independent building, blackwater should be reused for the lowest level usage such as irrigation and toilet flushing. Blackwater should not be harvested for potable needs where rainwater is abundant. However, in very dry locations such as the desert southwest, it may be necessary to treat blackwater to potable standards in order to achieve water independence.

Blackwater contains pathogens that must be handled appropriately if it is to be reused safely. For treatment, organic matter is separated from the liquid. Harmful pathogens are destroyed through composting and water treatment respectively. The compost may be used as a fertilizer for non-food crops. The liquid components can be treated though a membrane bioreactor or a living machine, both of which utilize a form of biological treatment. A living machine mimics the cleansing functions of wetlands and typically requires more space than a membrane bioreactor which relies on advanced filtration together with a smaller vessel that supports a biologically active environment.



options for blackwater use

APPROACH

understanding water reuse systems and regulations for a water-independent building

The Water Team embarked on a two year project to learn about water harvesting and reuse systems in buildings and to understand a complex regulatory environment. They undertook this project in order to maximize water conservation in their potential project, the Pearl Family Development, and to help promote broad adoption of water conservation, harvesting and reuse strategies in buildings. Along the way they learned of regulatory barriers which prevented water harvesting and reuse, and how these obstacles could be navigated to have a more broad reaching impact than initially envisioned. Below is an outline of the process that led to the Water Team's understanding and success in navigating water harvesting and reuse issues in Oregon. The Water Team's approach, challenges and successes may offer ideas, which could help the continued advancement of water issues in Oregon and in other jurisdictions.

1) FORM A QUALIFIED TEAM

Central City Concern's pursuit of water independence has benefited from having a mixed-use, multifamily project in the pre-development stage with a goal of meeting the Living Building Challenge. To realize the Pearl Family Development, Central City Concern assembled a team of sustainable design leaders including Gerding Edlen Development, SERA Architects and Interface Engineering. Together they embraced the challenge of achieving water independence and embarked on this water project to pursue regulatory clarification and reform. In the future, they will be seeking funding to incorporate pioneering water systems into this and other multi-family developments that may be built.

2) SET A 'B-HAG' (BIG HAIRY AUDACIOUS GOAL)

Sometimes to achieve great things (like market transformation), one must undertake that which is very difficult, or even that which seems impossible – this is the 'B-HAG' approach. The Pearl Family Development team adopted the Big Hairy Audacious Goal of meeting the Living Building Challenge, the highest benchmark for green building. Water harvesting and reuse strategies can be one of the most challenging aspects for a commercial building of this type because of the building's large water demands and a complex regulatory environment. The team recognized that

TIMELINE

March, 2007
PROJECT CONCEIVED
project concept formulated by development team

May 23, 2007
SEEKING SUPPORT
initial meeting with local foundation to generate interest

September 12, 2007
SEEKING FUNDING
first grant application submitted to interested foundation

November 30, 2007
PROJECT UNDERWAY
official kick-off after core funding commitment received

January 24, 2008
INTRODUCTION TO OFFICIALS
meeting with City of Portland agency directors

February 12, 2008
BRAINSTORMING CHALLENGES AND OPPORTUNITIES
water charrette

April 8, 2008
CONNECTING WITH OTHER ADVOCATES
participation in a greywater reuse forum

April 9, 2008
CLARIFYING REGULATIONS AND METHODS FOR CHANGE
group meeting with building and plumbing code officials

April 18, 2008
OUTREACH
presentation at Living Future 08

May 9, 2008
CLARIFYING REGULATORY ENVIRONMENT
follow-up meeting with officials to confirm understanding

May 27, 2008
COMPARING NOTES WITH A NATIONAL EXPERT
meeting with greywater expert Art Ludwig

May 28, 2008
CONFIRMING APPROACH FOR REGULATORY CHANGE
meeting with State of Oregon Building Codes Division

June 20, 2008
RAINWATER AND GREYWATER PROVISIONS PRESENTED
reviewed by State of Oregon Plumbing Board

August 15, 2008
ADDITIONAL PROVISIONS FOR GREYWATER USE PRESENTED
reviewed by State of Oregon Plumbing Board

July 2, 2008
RAINWATER AND GREYWATER USES APPROVED STATEWIDE
adopted by State of Oregon Building Codes Division

September 15, 2008
ADDITIONAL GREYWATER USES APPROVED STATEWIDE
adopted by State of Oregon Building Codes Division

March 16, 2009
GREYWATER LEGISLATION PASSES HOUSE
State of Oregon House of Representatives

significant up-front work would be required to understand and navigate the jurisdictional landscape associated with water-independent buildings. With the audacious goal of achieving water independence, the Water Team expects to realize additional water savings with pioneering strategies, even if true water independence proves to not be achievable at this time in Oregon's current regulatory environment.

3) CREATE A ROADMAP (PRELIMINARY INVESTIGATION)

The Team started with a diagram of all the possible water harvesting and reuse strategies and their associated regulatory relationships. This water strategy and regulation analysis helped identify many of the challenges and barriers to water independence. This formed the basis for a preliminary 'Water Roadmap' (see pages 22 & 23).

4) IDENTIFY PARTNERS, GET SUPPORT AND INPUT

The Water Team identified partners and allies which included all of the associated regulatory officials together with green building experts from across the region.

Central City Concern received support from the Bullitt Foundation, an enthusiastic early sponsor of this project. Support from this leading Northwest foundation helped secure other support for the project. In addition, all members of the project team made in-kind contributions toward the development of this project, recognizing that other projects and the green building movement in general would benefit from an in-depth understanding of these water issues.

Early estimates concluded that developing a water-independent, mixed-use commercial building would involve five city and state agencies and require eleven permits and appeals. The first jurisdictional meeting was held with the City of Portland Bureau of Environmental Services which recognized the potential value in clarifying the regulatory landscape for water. The agency staff were appreciative that the entire development team – owner, developer, architect and engineer – attended to discuss the project. Agency staff believed that public health and safety could be best protected if the property owner was invested in the long-term operation and maintenance a building's water systems. For this dialogue, they were particularly appreciative that Central City Concern, an owner, was at the table. The agency director agreed to help advance the Water Team's efforts by inviting the team to attend a meeting of the city's agency directors. The early version of the Water Roadmap was instrumental in introducing the project to city agencies. Members of these agencies continued to play a key role as the project progressed.

the technology group presents their findings to the attendees of the water charrette

Many state and city officials participated wholeheartedly in this work. The Team worked closely with these regulatory agencies to address their concerns about the health, safety and welfare of the public related to the implementation of certain strategies of water collection and reuse. There was great interest and enthusiasm about this work as it continued to clarify each agency's particular concerns and regulatory purview.

The Team found that in certain jurisdictions, there were some areas where there was a lack of clarity as to who regulates what. Utilizing the Water Roadmap as a constantly evolving communication tool proved to be invaluable in creating productive discussions with each agency. Its graphic and linear nature proved to be rapidly accessible for a broad cross-section of people, while also being provocative – eliciting quick and clear reactions (and corrections) from each reviewer who saw it.

5) CONVENE A CHARRETTE

Armed with a developing understanding of the regulatory environment for water harvesting and reuse systems and the Water Roadmap, the Team held a 'water charrette' (a large group brainstorming session) to explore water conservation, harvesting and reuse issues for a conceptual Pearl Family Development to capture the expertise of a broad and diverse gathering of regulatory officials, green building experts, affordable housing experts, developers and property managers. The goal of the charrette was to understand the opportunities and challenges associated with achieving a water-independent building. After an introduction and discussion about the concept, attendees split into three groups according to their expertise and interests – policy, technology or behavior. Brainstorming in these groups helped to clarify challenges and opportunities to change or navigate Oregon's water policy, while being mindful of the health, safety and welfare of a building's occupants. The Water Team catalogued the examples and ideas generated in each brainstorming group to both inform the Water Team's growing regulatory understanding of water policy and to be applied in the planning and design of the actual development.

6) CONFIRM ISSUES AND REFINE SOLUTION

Understanding the regulatory environment proved to be an iterative process. At the water charrette, the Roadmap was already in its fourteenth iteration. With the charrette information in hand, the Water Team held follow-up meetings with regulatory officials to verify the accuracy of the documentation, using the ever-improving version of the Water Roadmap as the primary discussion vehicle. A larger meeting was then convened which included representatives from almost all of the related agencies. This meeting not only resulted in substantial consensus about the jurisdictional requirements for each component of water harvesting and reuse, but it also proved to be catalytic for those same regulators to see opportunities for progressive policy change. The agency participants realized that there were existing mechanisms in place to pursue regulatory change – change that would allow water harvesting and reuse strategies for all building in Oregon. This large meeting was the pivotal moment for the project – the moment when simple analysis and documentation of water regulation became a catalyst for policy action and change in Oregon.

Following this gathering, the team conducted numerous follow-up meetings with other code officials, water experts and policy makers to further test and refine the Water Roadmap. This resulted in the summary of Oregon's regulatory environment for water harvesting and reuse as illustrated in the most current version of the *Roadmap to Water Reuse in Oregon* (see pages 22 & 23).

the behavior group presents their findings to the attendees of the water workshop

Presentation: How to Achieve Water-Independent Buildings

April 18, 2008

At the Living Future Conference in Vancouver British Columbia, the Water Team presented their findings on how to achieve water-independent buildings. The conference, sponsored by Cascadia Region Green Building Council, was attended by 400 building design, development and construction professionals, 80 of whom attended the water session. The format of the session was modeled on the February water charrette (see *Convene a Charrette* on page 17). After an introduction to the issues, the participants divided into three groups to once again brainstorm policy, technology and behavioral changes needed to achieve water independence in buildings.

For an overview of presentation and material visit: http://www.cascadiagbc.org/living-future/08/programs/sessions/day-1/pm-track-1/

7) ENGAGE IN OUTREACH

The Team's growing understanding of water issues in commercial buildings led to its participation in additional advocacy, code reform, and educational efforts. This allowed the Water Team to further educate and engage the expertise of others. Ultimately, the Water Team was able to achieve some of the needed regulatory reform in collaboration with regulatory officials, advocates and other leaders in the industry without having to pass new legislation. This is an exciting model which could be replicated in jurisdictions across the country.

There are currently a number of efforts underway to reform the water-related Oregon regulatory environment by agencies, advisory boards, grassroot advocates and government task forces. The Water Team's outreach efforts are summarized here to illustrate the variety of ways interested parties are participating in Oregon's regulatory changes around water.

Oregon Greywater Reuse Forum

April 8, 2008

ReCode Portland and the City of Portland's Office of Sustainable Development cosponsored a forum on greywater reuse where the Water Team connected with a larger group of greywater advocates. The Team helped the group identify the challenges to greywater reuse and where the best opportunity for change might be pursued – the Oregon Legislature. The group formed a greywater legislation task force to further understand the regulatory barriers to greywater reuse in commercial and residential buildings and work toward regulatory reform.

9) SHARE (REPORT)

This report has been produced to summarize the Water Team's process and findings with the hopes of encouraging others to incorporate advanced water conservation within and outside of Oregon. The report details water conservation strategies and the associated Oregon regulations to illustrate how water systems can be designed and used today. For those pursuing regulatory changes in another jurisdiction, this report, the Water Roadmap and the Water Team's approach can be adapted as appropriate.

Greywater and Rainwater Systems Approved for Statewide

July 2, 2008

A Water Team member, serving as Vice Chair of the Oregon State Plumbing Board, worked with the Plumbing Board and Oregon State Building Codes Division to remove barriers to rainwater and greywater use in Oregon. Through the 'statewide alternate method' process, the Oregon State Building Codes Division approved a series of recommendations from the State Plumbing Board for the installation of rainwater and greywater harvesting and treatment systems for residential and commercial building. For allowed uses see *Regulatory Change Update* on page 26.

Oregon Representative Ben Cannon, chair of the House Committee on Environment and Water and *sponsor of House Bill 2080, introducing it to the House on May 16, 2009 where it passes (49-10)*

Statewide Greywater Reform

2009 Oregon Legislative Session

In April 2008, members of the Water Team collaborated with a coalition of individuals, organizations, and agencies to propose a bill that could allow for the exterior reuse of greywater.

Working closely with the Chair of the Oregon House of Representatives Committee on Environment and Water, the Oregon Building Codes Division, and other stakeholders, the group helped propose language and review House Bill 2080, which was drafted by the Oregon Department of Environmental Quality.

The Bill was reviewed and amended by the House Committee on Energy and Environment, and successfully passed the House of Representative with a majority vote on March 16, 2009. As of the publishing of this report, the Bill is being forwarded as HB2080A to the Senate for review in committee and is expected to be presented to the Oregon Senate for a final vote within two months.

If approved as currently drafted, this legislation is expected to pave the way for the appropriate exterior reuse of greywater by establishing a permitting process for greywater reuse and disposal outside of buildings. For additional implications of this bill see *Regulatory Overview* on page 20 and *Navigating Regulation* on page 24.

REGULATORY OVERVIEW

an introduction to the regulatory environment of water reuse in buildings

An overview of the regulatory environment is best performed by breaking water use options into smaller, more manageable issues (i.e. "I want to use greywater from a shower/bathtub for irrigation in a commercial building", or "I want to use greywater from a lavatory to flush a toilet"). A Roadmap to Water Reuse is provided (pages 22 & 23) to help communicate these options for commercial buildings in Oregon and could be modified for residential buildings. Next, one should explore local building codes to determine allowed and prohibited uses. Where special conditions exist, consult local regulations and law (including statutes and rulings). The Roadmap illustrates which reuse strategies are allowed outright, allowed with conditions (i.e. permit) or prohibited in Oregon. The Roadmap can be modified to suit other jurisdictions.

In Oregon, water use standards vary depending on if a building is being designed and constructed to the residential building code (one or two dwelling units) or commercial building code (all other buildings). This report deals mainly with the regulation of water use in Oregon's commercial buildings[1] as defined by the Oregon edition of the International Building Code; a mixed-use apartment building is considered a commercial building. The regulatory environment of residential (one and two-family) dwellings[2] is not fully discussed in this report although water reuse issues and opportunities can be similar to those highlighted in this report.

Regulations are generally associated with protecting the health, safety and welfare of the public – the prime concern of building codes. In Oregon, the following regulations apply to each water type:

Rainwater Regulation

Because rainwater has few contaminants, its use in buildings is only moderately regulated (especially in residential one and two-family dwellings). Reuse standards vary depending on if the rainwater will be used for a potable or non-potable use. In Oregon, rainwater harvesting is allowed for non-potable use in commercial buildings and both potable and non-potable use in residential buildings (see *Regulatory Change Update* on page 26).

Historically in Oregon, rainwater harvesting has been approved on a case-by-case basis through a 'site-specific method', commonly known as a 'building appeal'. The recent approval of statewide alternate methods for rainwater harvesting means that a site-specific or building appeal is no longer required. However, if rainwater is harvested for potable uses, a building appeal is still required and will be reviewed by the State Department of Health. According to provisions in the plumbing code,[3] "Any potable water serving four or more residential units or any public establishment shall be reviewed, approved, and regularly monitored by the Oregon Department of Human Services Drinking Water Program."

Greywater Regulation

Greywater reuse standards vary depending on if the greywater will be used for a potable or non-potable use and whether the greywater will be used inside or outside of the building (as in irrigation). In Oregon, greywater harvesting is allowed for non-potable uses in commercial and residential buildings (see *Regulatory Change Update* on page 26).

1 As defined by Oregon's commercial building code. Source: State of Oregon Building Codes Division. *2007 Oregon Structural Specialty Code*. http://www.bcd.oregon.gov/programs/codes_in_oregon.html (accessed on March 16, 2009)

2 As defined by Oregon's residential building code. Source: State of Oregon Building Codes Division. *2008 Oregon Residential Specialty Code*. http://www.bcd.oregon.gov/programs/codes_in_oregon.html (accessed on March 16, 2009)

3 State of Oregon Building Codes Division. 2008 *Oregon Plumbing Specialty Code*, Appendix M. http://www.cbs.state.or.us/bcd/programs/plumbing/2008opsc.html (accessed on March 2, 2009).

The Oregon Department of Environmental Quality regulates the potable use of greywater and its use outside of a building for non-potable uses. Since Oregon law does not currently recognize grey wastewater (it is considered sewage), regulatory agencies have applied more restrictive sewage treatment requirements on proposed greywater systems. Non-potable uses of greywater outside of a building must receive a Water Pollution Control Facility permit from the Oregon Department of Environmental Quality, the same permit required by a sewage treatment facilities. Legislation is being proposed for the 2009 session to clarify the definition of greywater and simplify greywater reuse. It is expected that such legislation will lead to allowances for irrigation outside of buildings and possibly non-potable uses inside of buildings through a less restrictive permitting process.

Blackwater Regulation

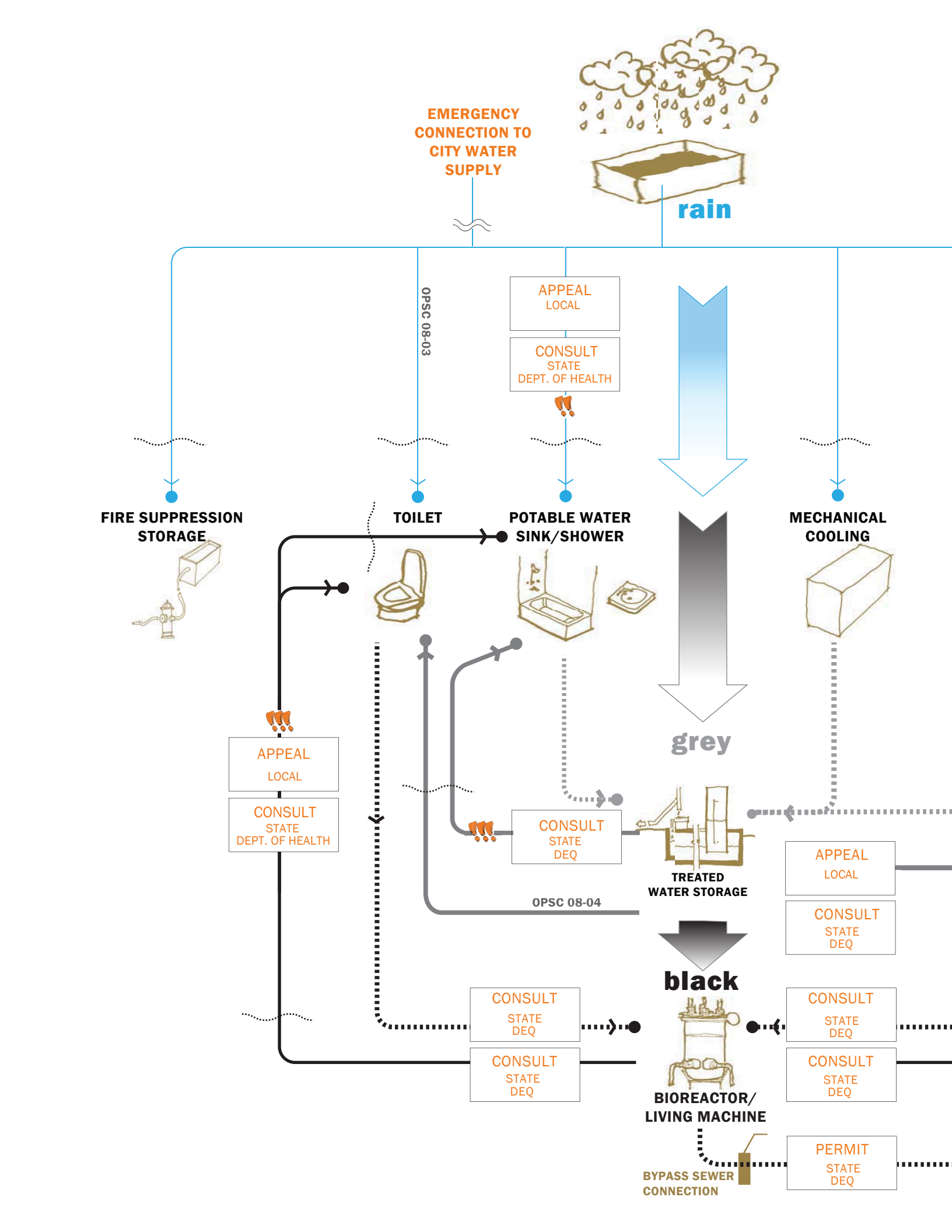
Blackwater use is regulated by the Oregon Department of Environmental Quality. Harvesting and using blackwater in a building currently requires a building appeal. Through the building appeal process, the Oregon Health Science University was ultimately successful in incorporating a membrane bioreactor into their building allowing the treatment and reuse of blackwater (see sidebar about their Center for Heath and Healing). The greywater legislation mentioned previously may help pave the way for blackwater use in buildings.

Water Reuse at the Center for Health and Healing

Portland, Oregon

At the Center for Health and Healing, Oregon Health Science University (OHSU) achieved a 56% reduction in potable water use by harvesting rainwater and treating 100% of wastewater on-site for use in toilet flushing and irrigation. The building saves 15,000 gallons of water a day, reducing the water and sewer bills, saving wastewater system development charges, and eliminating any impact on the city's overburdened combined sewer system (see *Portland Water* on page 10).

To treat wastewater through an on-site bioreactor (a small-scale filtration and biological treatment system), OHSU was required to obtain a Water Pollution Control Facility Permit (WPCF) from the state's Department of Environmental Quality (DEQ). This is the same permit required for a large-scale sewage treatment plant. Considerable expense and time was devoted to obtaining such a permit, and compliance standards to maintain it are strict. Less onerous requirements should appear in the near future, as the DEQ is expected to establish a separate permitting process for greywater systems (see *House Bill 2080* on page 19).


EMERGENCY CONNECTION TO CITY WATER SUPPLY
rain
OPSC 08-03
APPEAL
LOCAL
CONSULT
STATE
DEPT. OF HEALTH
FIRE SUPPRESSION STORAGE
TOILET
POTABLE WATER SINK/SHOWER
MECHANICAL COOLING
grey
APPEAL
LOCAL
CONSULT
STATE
DEPT. OF HEALTH
CONSULT
STATE
DEQ
TREATED WATER STORAGE
APPEAL
LOCAL
CONSULT
STATE
DEQ
OPSC 08-04
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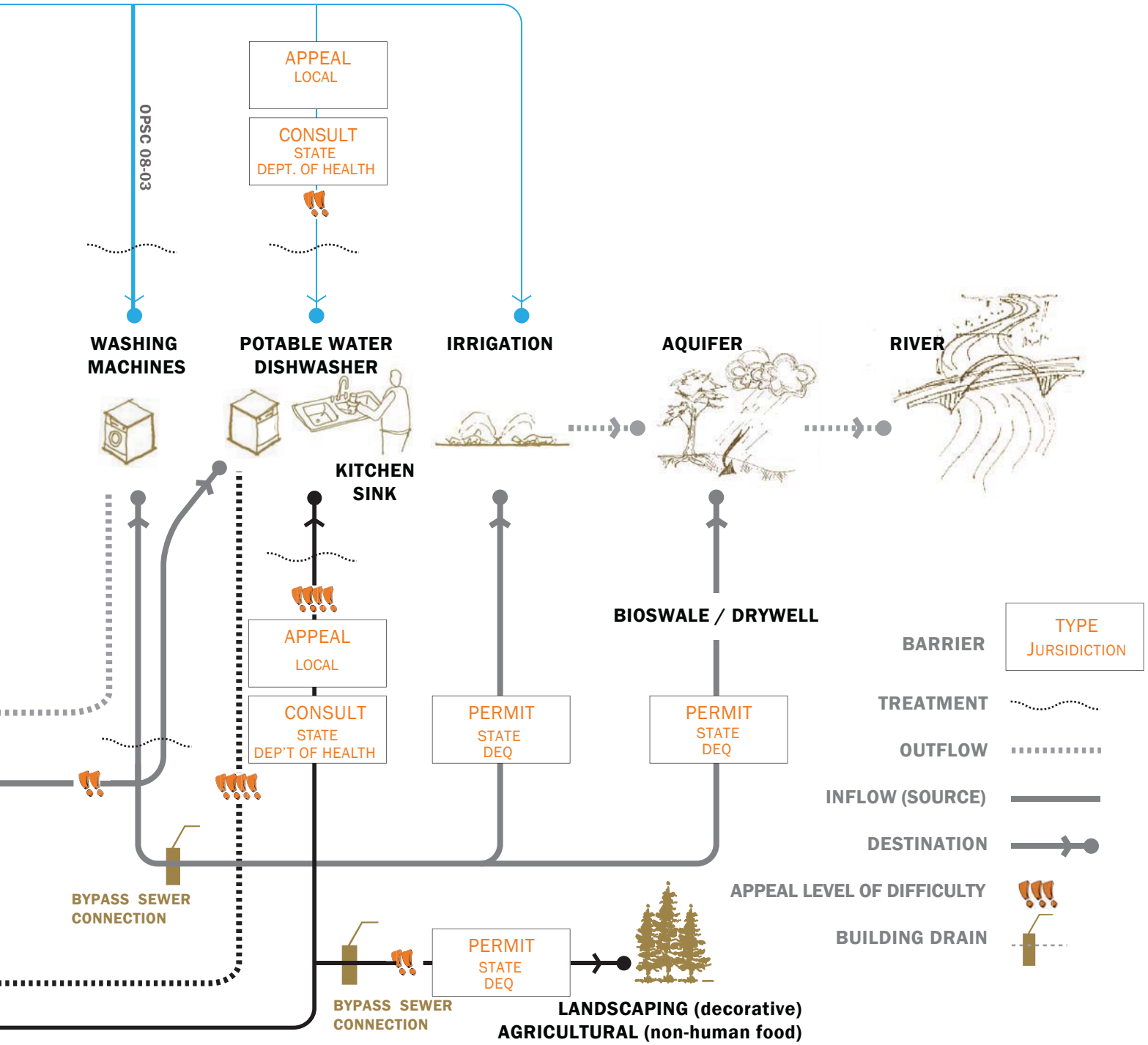
BYPASS SEWER CONNECTION



Achieving Water Independence In Buildings

March 2009

OREGON ROADMAP

NAVIGATING REGULATION

how to navigate the regulatory challenges to water reuse in buildings

Any building team contemplating water independence or even advanced water conservation systems must have a thorough understanding of the regulatory environment in the local jurisdiction. It is important to:

- identify the system(s) to be incorporated in the proposed building (i.e. rainwater harvesting for potable use)
- review the building code to understand if the system is allowed outright, allowed with conditions (i.e. permit) or prohibited.

If a strategy is allowed in a building code, then the requirements for design and construction should be relatively straightforward. A permit may require additional conditions to be met for a particular strategy and necessitate a review and approval by a regulatory agency. If the building code requirements are unusually restrictive or outdated (with today's available technology and practices), or if a strategy is not allowed, there are other pathways to consider in pursuit of the individual water system. In Oregon, development teams are familiar with the most common tool, a 'site-specific alternative method' request. This building appeal allows non-standard strategies to be reviewed, approved and adopted on a building-by-building basis. However, there are other methods available to those who wish to see more broad-reaching adoption of water harvesting and reuse systems as outlined below.

First, whether pursuing a building appeal or more broad-reaching reform, it is important to begin by answering the following questions:

- Is there precedence for the proposed system(s) within the jurisdiction or region?
- Which agencies regulate the water system(s) in question?
- What are the concerns of the involved agencies?
- Are there current laws that prevent the agency from allowing the system in question?

The following pathways are available to anyone considering water systems that are not allowed by existing code or regulations:

1) Site-Specific Alternate Method (Building Appeal)

impact: one building

Individual buildings may apply for an exception to any section of the building, electrical, mechanical or plumbing codes provided the proposed design meets the intent of the applicable section of the building code. This is a tool which allows jurisdictions to consider a proposed system design or method of construction and determine whether or not it meets the intent of the code or provides the same or better level of safety. The level of documentation required can vary depending on jurisdictional requirements. In Oregon, a formalized appeal process requires applicants to cite the code provision being appealed, describe the proposed design, and explain how the proposed design meets the intent of the code. Past approvals, such as using rainwater to flush toilets, may provide a precedent for the approval of future, similar appeals.

2) Local Amendment

impact: city- or county-wide

Local amendments are ordinances or resolutions that address matters related to the construction of buildings which may not be addressed in the statewide building code. Portland has several local amendments that are applicable to the entire City, but do not apply to buildings outside City boundaries. Proposed local amendments which modify a state building code must be first approved by the city or county council, then approved by the State of Oregon's Building Codes Division, and finally must be ratified by the city or county council prior to adoption. The City of Portland recently created a Green Building Technical Advisory Group to create building code amendments that incorporate green building technologies, practices, or standards into code format.[1] Such local code amendments have the potential to influence future revisions of the statewide code.

1 City of Portland Bureau of Development Services. *Green Building Local Code Amendment*. http://www.portlandonline.com/bds/index.cfm?c=46751 (accessed on February 22, 2009).

3) Statewide Alternate Method

impact: statewide

Oregon's alternate method approach allows for the statewide adoption of new and innovative strategies into the building code. An approved statewide alternate method creates an accepted alternate path to the regular building code. The decision to utilize an approved statewide alternate method is at the discretion of the project design team, and is not required by code. A statewide alternate method is approved by the administrator of the State of Oregon Building Code Division in consultation with the appropriate advisory boards. The seven Oregon advisory boards review the merits of proposed alternate methods and may forward their recommendation for approval. Recently, alternative methods for rain and greywater harvesting were drafted by the State Plumbing Board and Residential Structures Board and approved by the State Building Codes Division. Those wishing to pursue a different alternate method for an already approved water system, can always propose a different method for statewide adoption or may consider a site-specific method request.

4) Building Code Modifications

impact: national or statewide

A modification can be made to either the national building code (i.e., the Uniform Building Code, the International Building Code, the International Fire Code, etc.) or the version of building code adopted at the state level (i.e. the Oregon Structural Specialty Code, Oregon Plumbing Code, etc.). National code updates occur at regular intervals and involve the input of various councils, committees and ad hoc committees. [2] In Oregon, the State Building Codes Division oversees regular code updates with input from seven boards. Any interested person may propose to 1) change an existing Oregon amendment; 2) add an amendment to the proposed base model code; or 3) make recommendations to incorporate statewide code interpretations, and alternate method rulings into the newly adopted code. If adopted, such an amendment would affect all buildings in the state.

5) Passage of Legislation

impact: national or statewide

National or state legislation can help pave the way for water harvesting and reuse in buildings. This is the case in Oregon, where existing wastewater statutes need to be evaluated in light of today's technology and needs. House Bill 2080, which as of press time, being considered by Oregon's 2009 Legislative Session, would remove barriers to greywater reuse and instruct the Department of Environmental Quality to make rules regulating its use. Such rules could allow an alternative to the prohibitively extensive and expensive Water Pollution Control Facility permit. The success of legislation is largely dependent on developing consensus and support and requires significant homework. In Oregon, work to draft proposals typically begins 12-18 months in advance of a legislative session. A lack of consensus can scuttle well-meaning legislation, or even transform simple goals into complicated hurdles as a bill seeks to accommodate opposing viewpoints. According to Mark Long, Administrator of the State of Oregon Building Codes Division, a legislative approach is often best accomplished by "pulling the sticks individually out of the logjam." Keeping it simple avoids unintended consequences. See *House Bill 2080* on page 19 for an example of reform though legislation.

2 International Code Council. *Code Development*. http://www.iccsafe.org/cs/codes/ (accessed on February 22, 2009).

REGULATORY CHANGE UPDATE

Two Oregon statewide alternate method rulings were approved in June 2008. The first addressed water conservation systems for residential non-potable use (flushing toilets and urinals). The ruling allows water from bathtubs, showers, bathroom washbasins, washing machines and laundry tubs to be reused, and specifically excludes water from kitchen sinks and dishwashers. A second approved ruling allows rainwater harvesting systems for irrigation, gardens, hose bibbs, toilets, urinals, washing machines and makeup water for HVAC systems. This ruling applied to both single family residential and commercial buildings, with the exception of apartments and commercial buildings used for childcare or schools. In August 2008, the reuse of treated greywater for non-potable uses was expanded to include commercial structures.

A City of Portland Bureau of Development Services chart below summarizes allowed water uses throughout Oregon.[1]

Commercial Structures	
Use of rainwater for non-potable uses (irrigation, toilet flushing, washing machines, heating and cooling)	Allowed through State rule OPSC 08-03
Use of treated rainwater for potable uses	Not allowed, but could be considered through a building code appeal
Use of harvested, treated wastewater for non-potable uses inside the building (toilet and urinal flushing only)	Allowed through State rule OPSC 08-04
Use of harvested, treated wastewater for non-potable uses outside the building (irrigation)	Not allowed unless approved through the State DEQ
Use of harvested, treated wastewater for potable uses.	Not allowed unless approved through the State DEQ
Residential Structures (Houses, Duplexes and Row houses)	
Use of rainwater for non-potable uses (irrigation, toilet flushing, washing machines, heating and cooling)	Allowed through State rule OPSC 08-03
Use of treated rainwater for potable uses	Allowed through State rule OPSC 08-01
Use of harvested, treated wastewater for non-potable uses inside the building (toilet and urinal flushing only)	Allowed through State rule OPSC 08-02
Use of harvested, treated wastewater for non-potable uses outside the building (irrigation)	Not allowed unless approved through the State DEQ
Use of harvested, treated wastewater for potable uses.	Not allowed unless approved through the State DEQ

1 State of Oregon Building Codes Division. 2008. Alternative method Rulings No. OPSC 08-01, 08-02, 08-03, and 08-04. http://www.cbs.state.or.us/external/bcd/programs/plumbing/alt_methods.html (accessed February 9, 2009).

SUMMARY OF FINDINGS

Regulatory change that allows rainwater and greywater reuse has the most potential to dramatically impact water savings in buildings

Finding ways to allow the harvesting and reuse of rainwater and greywater will save enormous amounts of water, and benefit communities across the country. Recently, Oregon has joined a small number of states that allow the reuse of greywater in buildings. Previously, Oregon commercial buildings (including residential and mixed-use) were able to achieve 30% - 40% water savings by utilizing efficient fixtures. Now they can apply the recently approved 'statewide alternate methods' to incorporate rainwater and greywater systems to achieve an estimated 60% - 70% water savings. A new statute may be ratified by the Oregon Senate during the 2009 Legislative Session, which could pave the way for water reuse outside of buildings.

Regulatory understanding is the first step towards change

The regulatory landscape of water reuse in buildings is complex and often confusing. Understanding which jurisdiction has purview over which type(s) of water and addressing each agency's concerns are essential steps towards regulatory change.

Get everybody in one room

A discussion of the regulatory environment and water saving strategies with all of the stakeholders, including a diverse group of experts and interested individuals can lead to a more comprehensive understanding of the challenges and opportunities around water reuse. The Water Team held multiple meetings with various code officials and groups in order to better understand the jurisdictional authority for each step of the water usage process. The water charrette, proved to be an invaluable tool in this process and ultimately, the all-code official meeting was the breakthrough event which facilitated the recent changes to Oregon's water reuse policies.

Focus on the issues that are important to people

The Water Team focused on the issues that are important to people – those in which they have interest, expertise and/or control. During the water charrette, participants chose their conservation topic of interest among technology, behavior and policy subgroups resulting in greater input and involvement. By having policy makers in the room and in each group, concerns about the public's health were always being considered and addressed directly.

Regulatory change may be accelerated by adopting statewide strategies

Initially, the Water Team planned to draft building appeal templates that might aid in the approval of water reuse strategies on a building-by-building basis. They discovered that a more effective and broad-reaching strategy was to work with all of the impacted agencies to adopt 'statewide alternative methods' so that all of the buildings in the state would be affected. For example, as a result of this Team's work, the Oregon State Plumbing Board has adopted three alternate method rules that allow greywater harvesting for toilet flushing and specific uses of rainwater. Site specific alternate methods or building appeals are no longer necessary for these specific strategies.

Maximum conservation is only achieved by focusing on regulation, behavior *and* technology

This report is primarily concerned with the regulatory environment but adjustments to behavior and technology are equally important areas for conservation potential. Individual behavior, such as taking long showers or leaving the sink running while brushing one's teeth impacts the effectiveness of any particular water conservation strategy. In addition, the availability, cost and effectiveness of existing and new technologies will constantly be impacting water conservation. One example of this is that greywater systems have become increasingly available and economical in specific response to the rising market demand for green buildings.

Water reuse must be appropriate to the source

Buildings that use less water (e.g. offices and classroom buildings in low rise configurations) can potentially meet all of their water needs through rainwater harvesting alone. Dense buildings with increased water demands, such as high-rise multi-family buildings will require greywater harvesting to meet most, if not all of its demands. In this case, blackwater harvesting is likely to be required to achieve a truly water-independent building. Treatment costs increase from rain, to grey, to black so in each case it is important to consider how to limit treatment for the quantities and uses of water. An example of a comprehensive strategy might include: reuse of rainwater for drinking, greywater for flushing toilets and washing clothes, and treated blackwater where no human contact occurs and lower water quality is acceptable, as in toilet flushing and sub-surface irrigation of landscaping.

Water conservation's time has come

The Water Team expected significant resistance to water independence strategies, but found all involved to be open and supportive of water regulation reform, once everyone's positions were understood and documented and concerns raised were addressed. Existing regulations need to be examined in light of a growing urgency around conservation while still addressing the primary regulatory concern for people's health, safety and welfare.

A SPECIAL THANKS

The Water Team would like to thank all who participated in this work. Your interest and contributions have helped accelerate the adoption of water reuse in buildings.

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Clark Brockman	SERA Architects
Kent Buhl	Enterprise Community Partners, Inc.
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Ben Gates	Central City Concern
Nathan Good	Nathan Good Architects
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Leah Greenwood	Portland Development Commission
Chuck Halling	Walsh Construction
Stephanie Hallock	State of Oregon Department of Environmental Quality
Richard Harris	Central City Concern
Denis Hayes	The Bullitt Foundation
Clark Hays	Central City Concern
Sean Hubert	Central City Concern
Paul Jeffreys	SERA Architects
Judy Johndohl	State of Oregon Department of Environmental Quality
Alisa Kane	City of Portland Bureau of Planning and Sustainability
Ken Kauffman	State of Oregon Department of Human Services
Jim Kean	The Metolius
Craig Kelley	Housing Development Center
Chad Kirkpatrick	Witness to Beauty
Doris Koo	Enterprise Community Partners, Inc.
Pat Lando	Lando Associates
Tom Liptan	City of Portland Bureau of Environmental Services
Mark Long	State of Oregon Building Codes Division
Art Ludwig	Oasis Design
Traci Manning	Central City Concern
Dean Marriott	City of Portland Bureau of Environmental Services
Hank McDonald	City of Portland Bureau of Development Services
Jason McLennan	Cascadia Region Green Building Council
Ed McNamara	Turtle Island Development
Scott Miller	Resource Media
Omid Nabipoor	Interface Engineering
Mike O'Brian	City of Portland Bureau of Planning and Sustainability
Jessy Olson	Farmworker Housing Development Corporation
Kathy Pape	Central City Concern
Beth Patrino	State of Oregon Legislative Committee Services
Melissa Peterson	Enterprise Community Partners, Inc.
Lisa Petterson	SERA Architects
Joe Pinzone	SERA Architects
Joseph Readdy	SERA Architects
Carole Romm	Central City Concern
Bill Ryan	City of Portland Bureau of Environmental Services
Paul Scarlett	City of Portland Bureau of Development Services
Jill Sherman	Gerding Edlen Development
Andrea Simmons	State of Oregon Building Codes Division
Brandon Smith	Cascadia Region Green Building Council
Mike Steffen	Walsh Construction
Katie Swenson	Frederick P. Rose Architectural Fellowship
Terry Swisher	State of Oregon Building Codes Division
Zach Warnow	Resource Media
Dennis Wilde	Gerding Edlen Development
Rene Worme	Gerding Edlen Development