

Waste or Resource:

A Policy Perspective on the Environmental Uses of Recycled Water

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Abstract

Amidst emerging water shortages and conflicts in the United States, the advancement of technology and the redevelopment of resource management policies are changing the way that we look at water resources. Water use efficiency and recycling are becoming essential parts of water quality protection and water use allocation at the federal and state levels. However, major barriers to the use of recycled water still exist in many forms.

Policy and regulation of recycled water vary tremendously between regions, states, and municipalities. One theme that stands out is the management of recycled water as a waste. With dwindling freshwater supplies resulting from quantity and quality issues, recycled water viewed as a resource may become a more viable and widely used option, allowing for broader uses. Major federal regulations including the Clean Water Act and Safe Drinking Water Act govern water quality, pollutant discharge, and source water protection and have important implications for the regulation of recycled water. By examining pertinent federal statutes, this paper identifies policy barriers to the environmental uses of recycled water, and proposes solutions to several of these issues based on relevant state case studies.

California, Florida, and Washington have made great strides in creating regulatory frameworks for water recycling. Specifically, these states have produced effective regulation for environmental uses of recycled water including stream and wetland augmentation and groundwater recharge. Finally, this paper provides a set of broad recommendations that may serve as steps to consider recycled water as a resource. These recommendations include using language and definitions of terms to make important distinctions, and considering exemptions and alternate permitting processes to avoid conflicting or duplicative regulatory practices.

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Introduction

North Carolina Project Green held a seminar in July of 2009 to discuss “The Role of Reclaimed Water in a Sustainable Approach.” Several local and state environmental officials, engineers, planners and utility directors were in attendance. A question was posed to a representative from the Division of Water Quality as to why environmental uses of recycled water such as stream augmentation and groundwater recharge are not specifically addressed under new state reclaimed water rules. His response was that in this instance these types of discharges are handled under the Clean Water Act’s National Pollution Discharge Elimination System permitting program (NC Project Green, 2009).

This response implied that in some cases regulations become a deterrent to the pursuit of environmental uses of reclaimed water which could be beneficial not only to ecosystems but to freshwater supplies for all purposes. The director added to his response, that in the development of current rules, the department was seeking a way to transition from a specific list of approved uses of recycled water to more broad language which would allow additional approved uses in the future (NC Project Green, 2009).

The discussion described above, serves as the basis of this project, and outlines the questions that are explored in this report. This paper examines the policies in place at the federal level that have some impact on regulating the use of recycled water, and how its current management as a waste could be improved by steps to consider it as a resource. The Federal Clean Water Act, Resource Conservation and Recovery Act, National Environmental Policy Act and Safe Drinking Water Act are the main federal statutes that are examined.

Following an analysis of these Acts, a discussion of the Environmental Protection Agency's Guidelines for Reuse, leads into three case studies from specific states that have been successful in the transition of management of reclaimed water. These case studies present innovative and forward thinking approaches to the management of recycled water as an environmental resource. The case studies examine three main questions which include:

1. How has the State developed their water reuse policy to reflect resource management goals?
2. How has the State come to manage recycled water as a resource?
3. How are environmental benefits considered in water reuse policy?

Finally, a set of recommendations taken from this analysis are presented. These recommendations are a set of policy steps and solutions to issues regulating water reuse. These policy steps outline a potential transition between management strategies for reclaimed water. The purpose of these policy recommendations is to allow for expanded uses of reclaimed water as a resource similar to surface water or groundwater. In addition, these recommendations promote the environmental uses of recycled water by identifying specific themes and ideas pertaining to resource management strategies, successful policy implementation, and environmental benefits resulting from progressive legislation. The potential audience for this report may include regulators, resource managers, utility directors and other groups and individuals with interests in water resource management and policy.

Multi-criteria policy analysis and program evaluation were the main methods used to identify potential opportunities for expanding uses of reclaimed water. Analysis was also applied to case studies to highlight successful policies that have been implemented in states

where reclaimed water has become widely accepted as a viable resource. Research includes a thorough literature review, an examination of federal laws and statutes, and evaluation of state programs. Attendance at applicable policy meetings, conferences and symposia provided supplemental information on current issues and important insights into policy development.

Background

Water Shortages and Conflicts

Water shortages across the United States are becoming common-place. An issue that was once reserved for the arid Southwest has now surfaced in the east with new conflicts arising each year. Rapid population growth and extensive droughts are at the root of many water shortage problems, creating both quality and quantity issues. Water rights conflicts and interstate issues have in many cases reached the point of federal litigation and Supreme Court jurisdiction, in the absence of interstate compacts agreeable to all parties. In addition to conflicts between states, disputes develop often between industries and municipalities, drawing in stakeholders and interest groups from a number of backgrounds. These “Water Wars” as they have sometimes been called, create extreme discord and tensions between all parties involved and are extremely costly in their resolution (Gleick, 1998). One well known example is described below.

On October 1, 2007, the United States Supreme Court granted South Carolina's motion for leave to file a bill of complaint against North Carolina. The case surrounds claims to the Catawba River watershed (State of SC v. State of NC, 2007). Both states rely heavily on the Catawba River for the generation of hydroelectric power, economic development, commerce and recreation. Recent droughts have put extreme pressures on the water supply of both states and have impacted stream flow in the watershed. North Carolina has issued multiple Interbasin

transfers which South Carolina claims "... exceed North Carolina's equitable share of the Catawba River" (State of SC v. State of NC, 2007). Negotiations were unsuccessful between the states and South Carolina seeks to enjoin North Carolina from authorizing these transfers. This is a case where the federal government plays a role in state water allocation and water rights. In the future, the use of reclaimed water may be able to mitigate similar situations by reducing withdrawals upstream.

Causes and Issues

Widespread scientific and sociological research clearly show that population growth in the United States will continue to increase. Studies on the impacts of climate change also indicate that in some areas drought conditions may become more frequent and more severe (Barnett, 2005). This could lead to inadequate safe drinking water, shortages of water for sanitation and waste disposal, groundwater overdraft, overuse and pollution, in addition to regional conflicts. It can be expected that conflicts over water will not only continue but greatly increase in the coming years (Postel, 2000).

Many disputes over water focus on economic and social impacts, specifically commercial and residential development, industrial growth, and agricultural production to name a few. Environmental concerns are often overlooked or set aside in the interests of economic development and municipal needs. Environmental impacts of water withdrawals and water quality degradation as a result of human activity can be extreme and far reaching. In addition to habitat destruction and the threat to aquatic species, the damage to freshwater resources can greatly exacerbate the shortages through severe contamination (Arnell, 1999).

Potential Solutions

Solutions to water shortages have come in many forms. The most common are water conservation and efficiency efforts implemented as part of integrated water management strategies at the state and local levels (Alliance for Water Efficiency, 2007). Wastewater reclamation and recycling can be described as the ultimate form of water use efficiency. Advancements in treatment technologies such as advanced membrane and disinfection processes, have made true water recycling more feasible (Corwin 2008). Permitting of interbasin water transfers, and allocation of withdrawals are at the center of most regulation. Water recycling has the potential to reduce the need for interbasin transfer and reduce withdrawal allocations.

Water that is not consumed can be reused, assuming adequate treatment, by the same or a different user. Many downstream consumers of water have long depended on the “return flow” from upstream users. Today the U.S. is taking steps to ensure that municipal and industrial effluent is of extremely high quality capable of reuse. Use of reclaimed water in many parts of the country has been rising significantly over the past few decades (Sax et al., 2006, p.4).

Barriers to Water Recycling

Despite an increase in water efficiency and recycling strategies, major barriers to wastewater recycling still exist and are largely related to regulation, economics, public perception, and infrastructure. Currently, the United States is recycling only six percent of its water (WateReuse Conference Proceedings, Seattle 2009). This is a very small percentage when considering that consumption levels in the U.S. are extremely high, and somewhat unnecessarily high. Institutional barriers, as well as varying agency priorities, can make it difficult to implement water recycling projects. Laws, policies, rules, and regulations that affect

planning and implementation include water rights law, water use, and wastewater discharge regulations, as well as general laws designed to protect the environment.

Regulatory Barriers

This study focuses on environmental regulation and management as potential barriers to recycling. From a policy standpoint, the mere regulation of water recycling is not enough to promote its use and can inhibit project implementation. Recently, water use regulation has turned more to allocation and appropriation by state governments, even in eastern states that historically had no allocation regimes in place. Placing limits on freshwater withdrawals has become a necessary process in many places due to severe shortages. These limitations will require industries and municipalities to look elsewhere for water. Water reuse incentives and mandates are an extremely useful tool for promotion. A streamlined regulatory process can be particularly important to encourage recycled water projects.

Environmental Uses of Recycled Water

There are a number of environmental uses of recycled water recognized as beneficial by the Environmental Protection Agency (EPA), and by state and local governments. These uses include stream and wetland augmentation, surface flow augmentation, and groundwater recharge. The benefits of these uses include reducing diversions of freshwater from sensitive ecosystems, decreasing discharge to sensitive water bodies, enhancing and restoring wetlands and riparian habitats, recharging groundwater to serve as seawater barriers, augmenting drinking water supplies, and bolstering surface water and ecological flow requirements. In addition, these uses of recycled water can contribute to fisheries propagation, and can mitigate controversial Interbasin transfer issues (U.S. EPA, Water Recycling 1994). Reducing the quantity of

Interbasin transfers, or negating the need for them entirely could greatly reduce the costly legal and legislative processes that nearly always follow.

In many places drinking water facilities claim their source downstream from wastewater treatment plants. Larger rivers that receive substantial wastewater discharges have been the main source of drinking water for cities and municipalities for decades. In the past, these cities relied on the impression that standard filtration and disinfection would eliminate the pathogens responsible for waterborne infectious disease. These water sources were generally more affordable and accessible than upland supplies or groundwater. Large cities such as Philadelphia, Cincinnati, and New Orleans, drawing water from the Delaware, Ohio and Mississippi Rivers, respectively, are essentially practicing indirect potable water reuse (U.S. EPA 2004 Guidelines). Cities upstream of their intakes can be described as providing water reclamation in their wastewater treatment facilities, although they were not designed or operated as drinking water sources. National Pollutant Discharge Elimination System permits for these discharges are intended to make the rivers “fishable and swimmable,” and generally do not reflect potable water requirements downstream (U.S. EPA 2004 Guidelines, p.44).

These indirect potable reuse systems came about when the main concern for drinking water quality was the prevention of enteric infectious diseases and issues relating to chemical contaminants received lesser attention. Today, most cities provide water of acceptable quality that meets current drinking water regulations. Unplanned or incidental indirect potable reuse via surface water augmentation has been, and will continue to be, practiced widely (U.S. EPA Guidelines, Ch, 2). In many cases, the use of planned recycled water projects may take the place of these existing situations, and improve water quality for multiple uses.

Regulation of Environmental Uses

Most discharges that supply the source for indirect potable water reuse, especially through rivers and streams, are managed as wastewater disposal functions and are handled by the same means as all water pollution control efforts. The withdrawal and use of reclaimed water is usually the task of a water supply agency that is not related politically or governmentally to the wastewater disposal agency other than the fact that they are downstream. “Population growth and increasing scarcity of new water sources have prompted a small but growing number of areas to consider the use of highly-treated municipal wastewater to augment natural water supplies. This trend toward planned, indirect potable reuse is motivated by need, and is supported by advances in treatment technology” (U.S. EPA “Selected Readings...” 1991). These advances allow production of reclaimed water to almost any necessary quality. This type of planned, indirect potable reuse through surface water augmentation and groundwater recharge is being practiced in the United States and in many countries, especially in the Middle East (Okun 1995). While some planned, high profile, indirect potable reuse projects have been defeated in recent years due to public or political opposition to perceived health concerns, indirect potable reuse will most likely increase in the future, as technology continues to develop.

According to the EPA 2004 Guidelines for reuse “Stream augmentation is differentiated from a surface water discharge in that augmentation seeks to accomplish a beneficial end, whereas discharge is primarily for disposal”. Similarly, efforts to combat groundwater overdraft include aquifer storage and recovery projects, conjunctive use of ground and surface water resources, controlled groundwater pumping, conservation and reuse of water. In some cases

withdrawal and recharge rates have been balanced due to a combination of these strategies (Sax et al., 2006, p. 9).

Federal Regulations with Impacts on Recycled Water Policy

Due to the complicated nature of classifying recycled water as a waste or resource or some combination thereof, nearly all major federal environmental legislation has some impact on the overarching regulation of reclamation and reuse of water. From the permitting of discharges to source water management, recycled water fits into many different regulatory niches. The following section outlines many of these and highlights areas that pose conflicting goals.

The Federal Water Pollution Control Act Amendments of 1972 (Clean Water Act)

The Federal Water Pollution Control Act is the foundation of surface water quality protection in the United States. The main goals of the statute are to reduce direct discharge of pollutants into waterways, finance municipal wastewater treatment facilities, and manage non-point source pollution and polluted runoff. The overarching aim of the Act is “to restore and maintain the chemical, physical and biological integrity of the nation’s waters so that they can support the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water” (U.S. EPA CWA Watershed Academy). The major programs include water quality standards, anti-degradation policies, water body monitoring and assessment, total maximum daily loads, the National Permit Discharge Elimination System (NPDES) permit program for point sources, non-point source regulation, state water quality certification and the state revolving loan funds. The NPDES permit program and its related sections are the most relevant to water reuse and regulation (U.S. EPA NPDES Strategic Plan, 2001, pp. 3-9).

Federal Policy Sections 201, 214, 301 and 402 of the Clean Water Act address some issues surrounding reclaimed water. Wastewater regulations under the Clean Water Act and permitted by NPDES standards have been the primary means to regulate water quality at the federal level. Following are excerpts of relevant statutes and analysis of their influence on water recycling regulation.

- “SEC. 201. (a) It is the purpose of this title to require and to assist the development and implementation of waste treatment management plans and practices which will achieve the goals of this Act. (b) Waste treatment management plans and practices shall provide for the application of the best practicable waste treatment technology before any discharge into receiving waters, including reclaiming and recycling of water, and confined disposal of pollutants so they will not migrate to cause water or other environmental pollution and shall provide for consideration of advanced waste treatment techniques.”

Section 201 is relevant to recycled water and is important because it highlights the statutory connection between discharge and water reclamation and recycling. Here reclamation and recycling of wastewater are considered potential advanced waste treatment techniques; however, the provision allows that following this level of treatment, the end result is still a waste discharge. By definition, recycled water is of higher quality than treated wastewater, as its function is to serve a purpose other than discharge to surface water. This title outlines the requirement of waste treatment management plans, and could instead separate the management of recycled water from the management of wastewater.

- “SEC. 214. The Administrator shall develop and operate within one year of the date of enactment of this section, a continuing program of public information and education on recycling and reuse of wastewater (including sludge), the use of land treatment, and methods for the reduction of wastewater volume. (33 U.S.C. 1294) FEDERAL FACILITIES POLLUTION CONTROL”

Section 214 is related to the beneficial practice of recycling water and requires continuation of education and public outreach programs designed to promote reuse of wastewater. This section has the potential for further development, and could outline potential incentives for implementing pilot programs and water reuse projects.

Section 301 of the Act prohibits discharges to waters of the U.S. except with a permit (CWA 301(a), 33 U.S.C. § 1311a). The NPDES permit program is authorized by CWA section 402. NPDES permitting for surface water discharge creates problems for environmental uses of recycled water by creating an automatic and mandatory permitting process for all discharges to surface water. While this is designed to protect source water for the environment and for public health, certain aspects of the system do not allow for flow augmentations to be discerned from discharges. Stream and wetland augmentation vary from surface water discharge in that augmentation is designed to achieve environmental improvements, whereas discharge is mainly for disposal. This distinction is extremely important because often water quality requirements for stream augmentation are based on the designated use of the stream. This concept of matching intended use with expected treatment quality is potentially extremely useful, and could be considered for possible exemption from discharge permitting processes. Exemption from a

“waste status” opens many regulatory doors for recycling water. A relevant example of exemption falls under the Resource Conservation and Recovery Act.

Resource Conservation and Recovery Act

Natural resource conservation is achieved by managing materials more efficiently. While the Resource Conservation and Recovery Act focuses on solid wastes and hazardous wastes, it has a significant role to play in wastewater management. This role is achieved primarily by providing exemptions designed to avoid overlapping or conflicting regulations as stated below by a response from the EPA Director of Solid Waste on exemptions from permitting processes (Lowrance, 1992).

- The primary reason for the waste water treatment exemption is to avoid imposing duplicative requirements pursuant to both a NPDES permit and a RCRA permit for the same unit. In order for a unit to qualify for this exemption contained in 40 CFR §264.1(g)(6), it must:
 - Be part of a waste water treatment facility that is subject to regulation under either Section 402 or 307(b) of the Clean Water Act;
 - Receive, treat, or store influent waste water; or generate, accumulate, treat, or store a waste water treatment sludge; and,
 - Meet the definition of tank or tank system in 40 CFR §260.10.
 - "the wastewater treatment unit exemption is intended to cover only tank systems that are part of a wastewater treatment facility that (1) produces a treated wastewater

effluent which is discharged into surface waters or into a POTW sewer system and therefore is subject to the NPDES or pretreatment requirements of the Clean Water Act, or (2) produces no treated wastewater effluent as a direct result of such requirements"(RCRA Online Reference 13526).

When examining exemption status or requirements for exemption, it is clear that without exemption a dual permitting system would be required and an unnecessary burden could be placed on municipalities and private utilities attempting to follow legal requirements for discharge. The permitting of surface and groundwater augmentation as waste discharges may impose similar burdens. There are few incentives to create reclamation and reuse programs to improve treatment when the outcome falls under previously defined jurisdictions for discharge and disposal.

In addition to exemptions, there are several other regulatory tools at the federal level to regulate water reclamation and reuse. One act in particular stands out, and provides structure for research, funding, and separate rule development.

Reclamation Projects Authorization Act

The Reclamation Projects Authorization and Adjustment Act of 1992, Public Law 102-575, reauthorizes appropriations for various reclamation projects, amends the conditions of several projects, and authorizes new projects throughout the west (U.S. Fish and Wildlife, 2008). Title XVI Section 1602 makes provisions for the investigation of opportunities for reclamation and reuse of various types of wastewater, and naturally impaired ground and surface waters. Section 1603, directs the Secretary of Fish and Wildlife to undertake appraisal investigations in

compliance with the National Environmental Policy Act, and to include the potential uses of reclaimed water for fish and wildlife, environmental restoration, groundwater recharge, and other specified purposes. The remainder of the title authorizes or directs several studies, including treatment research, water reclamation and reuse, and feasibility studies (U.S. Fish and Wildlife, 2008).

A specific example of these studies is outlined Under Title XXXVIII. The San Francisco Water Reclamation and Reuse Demonstration Projects, is designed to examine the feasibility and effectiveness of new water reclamation technology. California State and local governments share the costs with the Federal Government, and the Bureau of Reclamation is responsible for administering these authorities (Reclamation Projects Authorization Act Title XXXVIII).

Sections 1602 and 1603 of this act are important for environmental use of recycled water. These sections make investigations and study a required action of the Secretary to examine in detail the potential environmental uses of recycled water and further to research treatment through feasibility studies. The Act also ties study projects to compliance with the National Environmental Policy Act (NEPA), which is already a regulatory tool for which to manage recycled water used for surface water augmentation and ground water recharge. Certain aspects of NEPA have interesting implications for water recycling projects. Environmental assessments and impact statements may serve as supplements or replacements for discharge permits for recycled water.

National Environmental Policy Act

The National Environmental Policy Act requires federal agencies to consider environmental impacts of proposed actions and reasonable alternatives to those actions. Under

NEPA federal agencies must conduct environmental assessments or more in depth environmental impact statements that describe potential effects of actions in detail. The EPA then reviews these documents and makes comments based on findings (U.S. EPA, NEPA Facts page). These requirements only apply to federal agencies; however, a similar process could be applied to state agencies, municipalities, or utilities seeking to create water reuse projects. These types of assessments could be useful in addressing potential health and safety concerns. These concerns over source water protection are considered under the Safe Drinking Water Act. Water quality monitoring as well as source water assessments are tools highlighted under this section.

Safe Drinking Water Act: Source Water Protection

The Safe Drinking Water Act provides provisions for the protection of source water supplies. Environmental uses of recycled water directly relate to source water, but as opposed to imposing threats they are intended to augment supplies and improve quality by helping to meet minimum stream flow requirements.

EPA's 1996 Safe Drinking Water Act Amendments require that states develop approved Source Water Assessments, in order to protect sources of drinking water from potential contamination from major sources. The assessments are required to delineate source water assessment areas, list potential sources of contamination, and determine the vulnerability of the water supply to contamination (U.S. EPA, EPA 816-F-04-030 June 2004)

These assessments pertain to non-point source pollution. Source water is untreated water from streams, rivers, lakes and underground aquifers. These sources are treated for drinking water; however, the quality of the supplies before treatment can reduce costs and risks to public

health. Recycled water while often seen as a permitted discharge, could be deemed as a method for source water protection when treated to extremely high standards and used as source water augmentation supplies.

The EPA Ground Water Rule provides for increased protection of public water systems that use ground water, and more specifically is designed to add disinfection to protect against microbial pathogens. The EPA also provides regulation on analytical methods for drinking water, laboratory certification, drinking water contaminant candidate list, and an unregulated contaminant monitoring program. Under EPA's National Primary Drinking Water Standards, the list of contaminants for drinking water can be applied to most highly-treated reclaimed water (U.S. EPA, EPA 816-F-04-030, June 2004).

In addition, the Safe Water Drinking Act regulates groundwater protection through the Underground Injection Control Program. This is directly related to groundwater recharge using reclaimed water and its regulation based on water quality.

The previous sections have provided a brief walkthrough of federal statutes that are relevant to the regulation of recycled water. While many of these statutes create barriers to water reclamation and reuse, they also highlight potential tools for improved regulation in the future. Over the last several decades, the EPA has recognized the need for further guidance on water reuse. The result is a collection of general information, including some broad regulatory guidelines for states to follow when creating or adapting water recycling rules.

EPA Water Reuse Guidelines

The US Environmental Protection Agency regulates many aspects of wastewater treatment and drinking water quality, and in addition the majority of states in the US have

established some criteria or guidelines for the beneficial use of recycled water, although in many cases these are limited. In addition, EPA developed a technical document entitled "Guidelines for Water Reuse," which contains information including a summary of state requirements, and guidelines for the treatment and uses of recycled water. State and Federal regulatory oversight has successfully provided a framework to ensure the safety of the many water recycling projects that have been developed in the United States." (USEPA Region 9 Water Program; Water Recycling and Reuse: The Environmental Benefits)

The 2004 Guidelines for Water Reuse outline recommended guidelines for water reuse and contains supporting information on a number of issues from project costs, construction and implementation to a brief summary of existing state regulatory frameworks. The purpose of the guidelines is to provide information useful to states that are developing water reuse standards or revising existing regulations.

Water Reuse Symposium – EPA Forum; History and input for the next water reuse guidelines

The current guidelines were developed as a result of a consulting contract between CDM and EPA. The existing document is an update of 1992 guidelines. There are forty members on the technical review committee responsible for the development and synthesis of these guidelines. Another update of the 2004 rules is proposed and is being discussed in public meetings to determine needs. A few of the major themes that have emerged from these meetings include defining potable reuse (is it indirect potable reuse or simply potable reuse?), making terminology clarifications, i.e., grey water is not reclaimed water, inclusions and exclusions

under the definition of recycled water, and separation of types of reuse in order to make the scope clear and easy to work with (WateReuse Conference Proceedings, Seattle 2009).

Environmental uses, agricultural uses, industrial uses, and domestic uses need to be addressed in further detail. Reclaimed water used to create manmade wetlands, enhance natural wetlands, and sustain or augment stream flows, wildlife habitat, and stream augmentation is considered environmental reuse. The EPA recognizes that there are both planned and unplanned uses of recycled water for environmental purposes. Unplanned reuse results from domestic wastewater treatment plants discharging treated effluent to surface water upstream of intakes for domestic water supply treatment plants. Unplanned reuse involves the use of reclaimed water to augment surface water sources that are used or will be used for public water supplies or to recharge groundwater used as a source of domestic water supply, and is designed as part of a water supply management system .

Only three states currently have regulations directly concerning environmental reuse on a broad scale. Florida and Washington have regulations regarding wetlands, and Florida, specifically, has a comprehensive set of rules governing the discharge of reclaimed water to wetlands. California, Florida, and Washington have regulations or guidelines for reuse with the specific intent of groundwater recharge of aquifers, and Washington alone has regulations specific to surface water augmentation (USEPA Guidelines, 2004, p. 150).

The following sections highlight rules and regulations for recycled water management, created in California, Florida, and Washington. These regulations are progressive in nature and distinctive in design. These case studies emphasize the issues unique to each state and how successful solutions have been implemented.

State Case Studies

Florida – Discharge permitting issues, wetland augmentation

Florida's regulatory structure with regard to waste discharge and water resource management comes from a long history of issues with coastal water quality. Recycled water regulations have developed in the state from a need to limit surface water discharge, instead of water quantity problems. Florida's surface and groundwater systems are extremely unique and provide essential ecological and anthropological functions. Florida's unique ecology, especially in areas like the Everglades, is in constant competition with increasing demands of a growing population.

The Conflict over the Apalachicola-Chattahoochee-Flint River Basin between Florida, Georgia and Alabama began in the early 1980s and was fueled by a series of severe droughts in the southeast, as well as Atlanta's growing demand for municipal supply. Holding more water for Atlanta meant that supplies for downstream use and the natural flow to the Apalachicola Bay could be negatively impacted (Ruhl 2005).

This case signaled the end of water abundance in the east. There is simply not enough water in the basin to accommodate the needs of all parties. While litigation continues in the absence of a successful negotiation, it is likely that the court will decide how water will be allocated in the future and whether environmental flows can be considered a legitimate claim (Ruhl 2005).

Interstate allocation often favors economic development, putting Florida at a disadvantage. This case is a clear example of a situation that could greatly benefit from the use

of recycled water. Florida has the potential to set an example for Alabama and Georgia, through its successful regulation of recycled water, and its implementation in the state.

The state of Florida has very restrictive regulations essentially preventing discharge to surface water in many places. The state promotes reuse as an alternative and as a solution to water quality problems associated with polluted discharge. This motivation for water recycling is somewhat unique to Florida, as many states regulating the reclamation and reuse of wastewater do so from the point of view of source water shortages (Florida DEP).

The Florida Department of Environmental Protection regulates the “Reuse of Reclaimed Water and Land Application” under Chapter 62-610, F.A.C. Rule 62-610.810, F.A.C. distinguishes reuse projects from effluent disposal. This is an important distinction, which should be noted when considering the “waste” or “resource” status of recycled water.

62-610.810 Classification of Projects as “Reuse” or “Disposal”.

(1) This section contains criteria to be used by the Department in classifying projects or portions of projects as “reuse” or “effluent disposal”. This section lists projects qualifying as reuse and includes groundwater recharge projects as well as “wetlands creation, restoration, and enhancement projects, if the applicant provides an affirmative demonstration that reclaimed water will be used to create, restore, or enhance wetlands.” “In addition the rule provides for specific uses not addressed, provided the applicant provides sufficient documentation that the use of reclaimed water will be beneficial and that it will eliminate the need for use of potable water.”

This rule section highlights several important aspects of recycled water management by not only separating “reuse” from “effluent disposal,” but by providing for the “beneficial” use of reclaimed water as a resource to replace potable water for other uses.

“The Florida Legislature has established "The encouragement and promotion of reuse of reclaimed water and water conservation..." as formal state objectives in Section 403.064(1), Florida Statutes (F.S.), and Section 373.250, F.S.” (Florida DEP).

Rule 62-40-310(d), F.A.C., establishes a mandatory reuse program and requires water management programs to “Advocate and direct the reuse of reclaimed water as an integral part of water and wastewater management programs.” This rule is implemented through the use of “water resource caution areas” or areas with critical water supply problems.

In Florida, the Department of Environmental Protection encourages and promotes reuse. Florida is reusing approximately six hundred sixty million gallons of reclaimed water a day. The Reuse Program has received the EPA Water Efficiency Leader Award. The state is divided into five water management districts. Reuse is planned for and regulated by Florida Water Policy and the Florida Water Plan. In addition, the state keeps a detailed reuse inventory. Florida also has a mandatory reuse program where reuse is compulsory in Water Resource Caution Areas where there are critical water supply problems (Florida DEP, 2008).

The state has a number of Reuse Feasibility Studies which are overseen by the Reuse Coordinating Committee made up of DEP, DOH, Department of Community Affairs, and Florida Department of Agriculture, five water management districts, and the Public Service Commission (PSC). The Water management districts may impose reuse requirements in

consumptive use permits for facilities in water resource caution areas. Currently, the state has taken steps to create reuse conventions to promote consistency and uniformity among the water management districts, as well as definitions of reuse, reclaimed water, feasible, effluent reuse feasibility study, and water resource caution areas. These definitions are extremely important to creating clear and universal rules and regulations (Florida DEP, 2008).

Florida statutes require one hundred percent of reclamation plant costs to be recovered, from a utility's potable water, wastewater, or reclaimed water customers. The state also has an anti-degradation policy which prohibits new or expanded surface water discharges from domestic wastewater treatment facilities (Florida DOH). Reuse is preferred over surface water discharges which have proven to be an effective means to encourage reuse of reclaimed water, while discouraging discharge and disposal of effluent. Lessons that can be learned from Florida include the advantage of a standing committee such as the reuse coordinating committee, facilitation of seasonal storage of reclaimed water, the development of integrated water education programs, the use of reclaimed water at government facilities, and an overall government statement of support.

Water reuse in Florida began over twenty years ago primarily as a result of the difficulty of obtaining a permit to discharge on the western coast. Reuse became the effective alternative to discharge, primarily for agricultural irrigation and land application. Early on, St. Petersburg operated a large reuse system which provided irrigation water to homes for residential and urban reuse (Houmis, 2005). This was one of the pioneering projects of its kind in the state and in the country.

In Tallahassee, the city had been discharging to surface waters, and then developed a large agricultural spray field which became a model for land application in the area. The City of Orlando and Orange County were also discharging to surface waters, and eventually the Department of Environmental Protection sought to end these practices. Reuse became the alternative and was first used to irrigate citrus crops.

In Southwest Florida, including Tampa Bay, recycled water is widely used now. The Water Management Districts were not involved with this until fairly recently. Now, many of the water districts are advocating mandatory reuse, due to fear of future shortages in densely populated and growing urban areas. Over the last ten years the water management districts looked to ground water as their cheapest source. However, draw downs began to effect wetlands and surface water flows. Reclaimed water became the go to alternative, and was regulated primarily by consumptive use permits (Houmis, et al. 2005).

In 1989 most of the state moved from a land application oriented view to a reuse oriented view. The main champion for reuse in the state was David York who worked for DEP at the time. Rules were constructed in 1989 and underwent several major revisions in 1996 by a technical advisory committee. Revisions were designed to open the door to reuse more widely. The revisions received a lot of opposition from the Department of Health and others.

Reuse permitting in the state attempts to make reuse a relatively easy option by providing a straightforward regulatory process. Permit holders are allowed to designate reclaimed water service areas, so that individual recipients do not have to be permitted. They also allow representative reuse sites for groundwater, which allows for easier monitoring and a reduction in sampling. In addition the regulations offer limited discharges each year when reuse is used the

rest of the time. This deals with storage issues in the rainy seasons. In conjunction with storage needs, Florida widely practices the use of recycled water for wetland restoration and enhancement. Currently there are 17 natural recycled water wetlands comprising roughly 6,200 acres and a total of 21 constructed wetland sites comprising roughly 4,000 acres across Florida (Florida DEP, 2009).

Florida is not currently widely practicing groundwater injection because there are concerns over dissolved oxygen and its impact of freeing arsenic into groundwater with the use of Aquifer Storage and Recovery systems (ASRs). Typically ASRs are used to store water during times of excess supply for use when supplies are limited. Water injected into ASR wells must meet Florida's drinking water quality standards. Injection wells are regulated under the Underground Injection Control Program with the goal of protecting Florida's underground sources of drinking water. The DEP has continued efforts to further these practices, while providing protection for source water (Florida DEP, Stakeholders Meetings, 2009) .

Overall, reclaimed water has gained familiarity as a resource and is accepted widely throughout the state. Education is targeted at the source. Reuse is being discussed with large water users, and those who understand water as a resource. The main selling point for reclaimed water in the state is increased reliability for all purposes including in-stream and ecological flows.

Florida has had a long history of recycled water use, and has become reliant on its flexibility and reliability. Water reclamation and reuse will continue to be a growing part of the state's resource management plans and will play a major role in Florida's economic and environmental future.

California – Ground water recharge, salt water intrusion barriers, indirect potable reuse

California leads the way among states with regard to the use of recycled water. Unlike in Florida, recycled water has become an absolute necessity due to severe long-term shortages. California has made major leaps and is the only state that widely promotes indirect potable reuse and direct groundwater recharge. There are over 250 recycled water plants in the state with countless more in various planning stages. In addition, California has expanded its use of recycled water for groundwater recharge to create salt water intrusion barriers to protect freshwater supplies (Association of CA Water Agencies, 2010).

The West Basin Municipal Water District and the Orange County Water District are leaders in reclaimed water projects. The West Basin Municipal Water District has developed recycled water for industrial uses. The Orange County Water District has developed the Groundwater Replenishment System and currently uses reclaimed water for indirect potable reuse, groundwater aquifer storage, and groundwater recharge. They have also implemented systems using recycled water for salt water intrusion barriers. In addition the City of Los Angeles and the Los Angeles County Sanitation District are involved in many of these projects (Association of CA Water Agencies, 2010).

In California, reclaimed water is regulated under Titles 17 and 22 of the California Code of Regulations. The State Water Resources Control Board and the Department of Health Services oversee regulation and permitting of projects as well. California has integrated reclaimed water into the codes and policies that govern water resources in general. Under California Article 7, Water Reuse from the California Code of Regulations, Section 13550,

Legislative Findings and Declarations, “the use of potable water for nonpotable uses is prohibited.”

“The legislature hereby finds and declares that the use of potable domestic water for nonpotable uses, including, but not limited to, cemeteries, golf courses, parks, highway landscaped areas, and industrial and irrigation uses, is a waste or an unreasonable use of the water within the meaning of Section 2 of Article X of the California Constitution...”

Recently, California has adopted the term recycled water to replace varying terminology, and to emphasize the characterization of recycled water as a resource. The Water Code specifically states that, “Recycled water means water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource” (Water Code § 13050).

It is California State policy to promote the use of recycled water to the maximum extent in order to supplement existing surface and ground water supplies to help meet water needs (CWC sections 13510-13512). One of the primary conditions on the use of recycled water is protection of public health (CWC sections 13521, 13522, 13550(a)(3)).

All persons who recycle or propose to recycle water, and who use or propose to use recycled water, must file a report with the appropriate regional water board (CWC section 13522.5). If a regional water board determines that it is necessary to protect public health, safety, or welfare, it may prescribe water recycling requirements where recycled water is used or proposed to be used (CWC section 13523).

The regional water boards are required to consult with and consider recommendations of the Department of Health Services (DHS) when issuing waste discharge or water recycling

requirements (CWC section 13523). The DHS is statutorily required to establish uniform statewide recycling criteria for the various uses of recycled water to assure protection of public health where recycled water use is involved (CWC section 13521). DHS has promulgated regulatory criteria in Title 22, Division 4, Chapter 3, section 60301 et seq. of the CCR. DHS regulatory criteria include specified approved uses of recycled water, numerical limitations and requirements, treatment method requirements and performance standards. DHS regulations allow use of alternate methods of treatment in some cases, so long as the alternate methods are determined by DHS to provide equivalent treatment and reliability (California Department of Public Health, 2009).

The 1996 Memorandum of Agreement (MOA) between the Department of Health Services (DHS), State Water Resources Control Board, and the regional water boards on the use of recycled water allocates primary areas of responsibility and authority between these agencies. “The MOA provides methods and mechanisms necessary to assure ongoing and continuous future coordination of activities relative to the use of recycled water in California”(CA Memorandum of Agreement).

Several agencies in southern California are evaluating the process in which reclaimed water would be delivered to streams in order to maintain a constant flow of high-quality water for the enhancement of aquatic and wildlife habitat.

Washington – Surface water augmentation, water rights, and management as a resource

The State of Washington has a long history recycled water use, particularly for augmentation of surface water supplies to accommodate appropriative water rights, ecological

flows, and irrigation needs. “State law encourages reclaimed water use, requiring consideration in both wastewater and water supply planning (RCW 90.48.112 and 90.46.120).”

In 1992 the Washington State Legislature passed the Reclaimed Water Act, Chapter 90.46 RCW, and directed Ecology and the Department of Health to develop standards for reclaimed water use and to jointly administer a reclaimed water program. The Reclaimed Water Act was designed with goals including the encouragement and facilitation of recycled water use, provision of new water supplies to meet future needs, protection of public health, and enhancement of the environment (Washington State Department of Ecology).

In 1995 the Substitute Senate Bill 5605, “Reclaimed Water Act,” passed in the State of Washington. It states that “reclaimed water is no longer considered wastewater” (Van Riper et al, 1998). “The water reuse regulations for the state of Washington have recently been expanded to include discharge of reclaimed water to wetlands and direct injection of reclaimed water to groundwater,” (Van Riper et al., 1998).

“The 2006 law directed the Department of Ecology to develop and adopt rules on all aspects of reclaimed water use by December 31, 2010. The law also directs Ecology to coordinate with the Department of Health and form a rule advisory committee with a broad range of interested individuals”(Washington State Department of Ecology, November 2008). The goal of these rule adoptions is to eliminate conflicting regulations that hinder the approval of recycled water projects.

More recently, Washington is looking to amend the Reclaimed Water Use Act, Ch 90.46 RCW, to stand on its own authority, emphasize the value of reclaimed water, remove potentially conflicting requirements and facilitate rule development. The proposed legislation is designed to

remove administrative barriers to reclaimed water projects so that more projects can proceed.

The state is proposing statutory amendments (Department of Ecology 2009).

Washington recognizes many important benefits to the promotion and use of recycled water. It is considered a “consistent, reliable water supply as Washington faces climate change challenges... In addition recycled water reduces discharge of treated wastewater into Puget Sound, and provides more water in our rivers and streams for salmon recovery, and allows for more effective management of the Columbia River's water” (Washington State Department of Ecology, 2009).

House Bill 1482 and its Senate Companion Bill 5504 first presented on January 21, 2009 concern reclaimed water permitting. The bill is designed to streamline the reclaimed water permitting process and went into effect on July 26, 2009. Stream flow augmentation is regulated under section 1, Article 5, entitled “Other uses of Reclaimed Water”. The regulation stipulates:

- “Reclaimed water intended for beneficial reuse may be discharged for stream flow augmentation provided the reclaimed water meets the requirements of the federal water pollution control act, chapter 90.48 RCW and is incorporated within a sewer or water comprehensive plan as applicable, adopted by the applicable local government and approved by the departments of Health and Ecology as applicable.”
- “For the purposes of these standards, stream flow augmentation projects must identify a beneficial purpose that includes but is not limited to in-stream flow enhancement, irrigation supplies, water right replenishment or transfer and fisheries propagation”(Washington State Legislature 2009).

This article is an example of a regulatory distinction between discharge and surface water augmentation for beneficial use. The application of beneficial use for environmental enhancement designates a separate condition for discharges of this kind. One beneficial use of recycled water that has been widely addressed in Washington is the supplementation of appropriative water rights.

The majority of water in Washington State has been previously allocated, and therefore new water rights are becoming more difficult to obtain. Changes to existing water rights have been the primary means of water reallocation (Washington State Department of Ecology, 2009 State Water Rights). Recycled water is another means of supplementing existing water rights, and accommodating new users and needs. Several reuse projects in the state exist for exactly this reason, and have been effective in solving multiple water supply issues.

In the City of Walla Walla, The United States Army Corps of Engineers with recommendations from the Washington Department of Ecology diverts most of the Mill Creek flows upstream of the Walla Walla WRP, into Yellowhawk and Garrison Creeks to satisfy senior water rights. A 1927 court-ordered water rights agreement obligates Walla Walla to provide reclaimed water to the irrigation Districts (Cupps, 2005). This is a clear example of where stream flow augmentation can alleviate water rights tensions and accommodate the needs of multiple users

Another example also in Walla Walla County is the City of College Place which uses recycled water to augment summertime stream flows as part of a watershed enhancement program. The City hopes to achieve improved water quality for the health of aquatic life, through the use of highly treated reclaimed water. In 2003, a private party filed a citizen lawsuit

(authorized under the provisions of the federal Clean Water Act) for National Pollution Discharge Elimination System (NPDES) permit violations. The lawsuit included violations of reclaimed water reliability criteria established in the permit (Cupps, 2005).

Four major themes stand out in the analysis of recycled water policy in Washington. The first theme relates to specific language and terminology. The most important example of this is the transition from the use of “discharge” with the terms “intentional use” or “beneficial use”. The second is a broader version of language, which takes it to the next step by actually using language to create a regulatory distinction. Regulations state that “Reclaimed water is no longer considered a wastewater.” The third theme ties two distinct concepts back together by emphasizing the importance of “closer coordination between water and wastewater management.” Finally, the fourth theme is somewhat separate, but useful. It is related to motivations and incentives for recycled water use in the state. Washington is looking at the potential use of tax incentives for private utilities or municipalities.

Conclusions and Recommendations

Solving Multiple Problems with Fewer Steps

Environmental uses of recycled water can solve multiple problems with fewer steps. Recycled water can be used to achieve minimum stream flows, ecological flows, habitat protection and restoration, supplement potable water supplies, and supplies for recreation. In addition, as seen by regulation in the state of Washington, recycled water can provide a solution to water rights conflicts by supplying the need of senior appropriators and supplementing the subsequent needs of “downstream” users. As seen in Florida, recycled water can be a highly effective strategy for the reduction or elimination of surface water discharge from wastewater

treatment facilities, and other discharging industries. In California, groundwater recharge projects can simultaneously augment potable water supplies while providing ecological protection in the form of saltwater intrusion barriers and land subsidence prevention.

Assessments and Monitoring as Tools

Recycled water can be managed similarly to source water by using assessments and monitoring. Recycled water when applied to a beneficial environmental use and when discharged to source water must meet drinking water standards in most cases. Drinking water taken from surface and ground water is reliant on water quality monitoring and testing to meet these standards. The use of recycled water for surface and groundwater augmentation could be considered source water protection due to its high quality, and not classified as a discharge that is harmful to source water.

Matching Intended Use with Expected Quality of Treatment

The next step is for the federal government to look at broadening the allowed uses of reclaimed water by shifting the focus to water quality monitoring. Matching the intended use of recycled water to the expected quality of water required is instrumental. The previous case studies have shown that recycled water has many environmental uses and that each of these uses is unique. Standards developed for discharge permits are similar in that they are designed to prevent source water degradation. Standards for recycled water can achieve much higher goals, even improve polluted waterways. In Washington, multiple municipal plants have achieved treatment levels that may achieve some level of restoration for impaired water bodies, and enhance drinking water supplies. Many states are developing classes of recycled water which are of varying high qualities and are paired with intended uses. This technique is very useful

from a regulatory standpoint. Creating subcategories and classes narrows the scope of individual projects, which can make permitting or monitoring processes more efficient.

Distinction from Discharge

The distinction between discharge and surface and ground water augmentation is important. Reclaimed water is of better quality than treated wastewater effluent. Using reclaimed water for stream and wetland augmentation and for groundwater discharge is constructive because it greatly improves the quality of water that would be discharged to surface water and groundwater anyway. Indirect potable reuse is no different in essentials than using “freshwater” sources for drinking water.

Drinking water plants are removing many of the same contaminants that advanced wastewater treatment plants are removing. Under the safe water drinking act every community water supplier must issue an annual report to its customers, updating them on their drinking water quality. Many reclaimed facilities produce water that meets or exceeds drinking water standards. This water is safe to put back into our environment, and is treated at drinking water plants just the same as freshwater sources are.

Universal glossary of terms

The creation of a universal glossary of terms is needed to clarify important distinctions. Creating a universal glossary of terms for all things recycled water would prevent confusion. Some issues with terminology include the use of “direct” vs. “indirect” potable drinking water, the use of the term grey water and its recent tendency to be used synonymously with recycled wastewater. The interchangeable use of “reclaimed water”, “recycled water”, and “water reuse”

becomes confusing, and hinders the regulatory process. Discharge must also be defined in the context of recycled water. Because of the interstate and trans-boundary nature of water resources, definitions should be universal from a federal regulation standpoint. While this finding may be somewhat obvious, it is important for successful policy analysis and program evaluation. Language and terminology are crucial in the writing and interpretation of laws and regulations. Statutory interpretation is often at the center of legal and judicial processes.

A clear universal language for recycled water regulation will allow states to move away from approved lists of uses for recycled water in regulations, and to use more descriptive language and match intended use with expected treatment quality.

Potential Exemption Status

Water treated and intended for reclamation and reuse should be considered for exemptions based on a set of predetermined standards, or should be subject to an individualized permitting process. The NPDES permitting process for point source pollution creates major policy barriers to recycled water management. It creates disincentives for environmental uses of recycled water by requiring discharge permits regardless of water quality. If a wastewater treatment facility must apply and receive a permit for discharge, and can receive that permit for a lower treatment quality, there is little motivation to treat to a higher quality.

As outlined in several federal statutes examined in this paper, there are already tools that may facilitate potential exemptions or alternative processes. The Resource Conservation and Recovery Act describes qualifications for exemptions of waste disposal for wastewater treatment facilities. A similar exemption process for recycled water from the NPDES permitting process would allow for a new regulatory perspective, and introduce the need for a new rule structure.

This structure could be built into statutes such as the Reclamation Projects Authorization Act using tools similar to Environmental Assessments or Impact Statements.

Flexibility for the Future

Recycled water has the potential to help us solve major environmental and resource problems in the future. Along with advancements in treatment technologies, we must make advancements in our regulatory frameworks. Additional flexibility in many of our major federal environmental regulations will be necessary in the future in order to keep up with increasing demands of a growing population and a changing climate. We must consider alternative resources not only on the energy front but on the water front as well. Recycled water should be considered a valuable resource with tremendous potential in the future.

References

- Alliance for Water Efficiency. 2007 Annual Report.
<http://www.allianceforwaterefficiency.org/uploadedFiles/AWE-2007-Annual-Report-FINAL.pdf>
- Arnell, Nigel W. "Climate change and global water resources." Global Environmental Change. Volume 9, Supplement 1. October 1999, pp S31-S49.
- Barnett, T.P., Adam, J. C., & Lettenmaier, D.P. "Potential impacts of warming climate on water availability in snow-dominated regions." Nature 438, 303-309 (17 November 2005).
- Bruvold, William H., Olson, Betty H., Rigby, Martin. "Public Policy for the use of reclaimed water." Environmental Management. Volume 5, Number 2. March, 1981. Pp. 95-107.
- California Department of Public Health. Statutes Related to the California Department of Public Health and Recycled Water; Excerpts from the Health and Safety Code and the Water Code. January 2009.
- California Department of Public Health: Regulations Related to Recycled Water. Title 17 Code of Regulations. January 2009.
- California Department of Public Health: Regulations Related to Recycled Water. Title 22 Code of Regulations. January 2009.
- California Department of Public Health, Drinking Water Program. Groundwater Recharge Reuse DRAFT Regulation. August 5, 2008.
- California Memorandum of Agreement Between The Department of Health Services and The State Water Resources Control Board on Use of Reclaimed Water.
- California Water Code § 13510-13512
- California Water Code § 13050
- California Water Code § 13523
- California Water Code § 13521
- Corwin, D. L. a. B., Scott A. (2008). "Environmental Impacts and Sustainability of Degraded Water Reuse." Journal of Environmental Quality **Volume 37**(September-October [Supplement] 2008).
- Cupps, K., Morris, Emily, (2005). Case Studies in Reclaimed Water Use: Creating New Water Supplies Across Washington State. Washington State Department of Ecology. **05-10-013**: 30-34.

Cupps, Katharine, Gaffney, Tim, Emmett, Kathleen, Jim, McCauley, Coleman, Lynn, and Geller, Lynne. Implementation of Reclaimed Water Use: 2008 Report to the Governor and State Legislature. Washington State Department of Ecology. 08-10-098. January 2009.

CWA 301(a), 33 U.S.C. § 1311(a), Federal Clean Water Act

CWA 313, 33 U.S.C. § 1323, Federal Clean Water Act

CWA 402 33 U.S.C. § 1342, Federal Clean Water Act

CWA 214 22 U.S.C § 1294, Federal Clean Water Act

Florida Department of Environmental Protection. Chapter 62-610, F.A.C. Reuse of Reclaimed Water and Land Application

Florida Department of Environmental Protection. Connecting Reuse and Water Use: A Report of the Reuse Stakeholders Meetings. February 23, 2009.

Gleick, Peter H. "Water in Crisis: Paths to Sustainable Water Use." Ecological Applications, Vol. 8, No. 3. August 1998. Pp. 571-579.

Houmis, Nicholas, Hagan, David, and Norman, Daniel. Tampa Bay Regional Reclaimed Water & Downstream Augmentation Project: A Regional Partnership. Florida Water Resources Journal, August 2005. Pp. 65-70.

NC Project Green, 2009. The Role of Reclaimed Water in a Sustainable Approach. North Carolina Project Green. Raleigh.

Okun, D. A. (1995). "Water Reclamation and Nonpotable Reuse: An Option for Meeting Urban Water Supply Needs." Elsevier Desalination **106**(1996): 205-212.

Postel, Sandra L. "Entering an Era of Water Scarcity: The Challenges Ahead." Ecological Applications, Vol. 10, No. 4. August 2000. Pp. 941-948.

RCRA Online Reference 13526. Exemption From Permitting Requirements for Wastewater Treatment Units. 01/16/1992. USEPA Office of Solid Waste and Emergency Response. Addressed to Mr. Thomas Cervino from Sylvia K. Lowrance, Director of Solid Waste.

Reuse Coordinating Committee: Water Reuse Work Group. Water Conservation Initiative. Water Reuse for Florida: Strategies for Effective Use of Reclaimed Water. June 2003.

Ruhl, J.B. Water Wars, Eastern Style: Divvying Up the Apalachicola-Chattahoochee-Flint River Basin. Universities Council on Water Resources: Journal of Contemporary Water Research & Education. Florida State University College of Law. Issue 131, Pages 47-54, June 2005.

- Sax, Joseph L., Thompson, Barton H., Leshy, John D., Abrams, Robert H. Legal Control of Water Resources; Cases and Materials. Fourth Edition. American Casebook Series. © 2006 Thompson/West, St. Paul, MN.
- Supreme Court Case State of South Carolina v. State of North Carolina, Submitted by the Special Counsel to the State of South Carolina June 7, 2007
<http://www.scattorneygeneral.org/currentcases/waterwar/sc%20cmplaint.pdf>
- U.S. EPA Guidelines for Water Reuse. US EPA Office of Technology Transfer and Regulatory Support. EPA/625/R-92/004. September 1992.
- U.S. EPA (2004). Guidelines for Water Reuse. U.S. Environmental Protection Agency Municipal Support Division Office of Wastewater Management and Technology Transfer and Support Division Office of Research and Development, Camp Dresser & McKee, Inc. EPA/625/R-04/108. September 2004.
- U.S. EPA National Pollutant Discharge Elimination System (NPDES) Program. Protecting the Nation's Waters Through Effective NPDES Permits: Strategic Plan. US EPA Office of Water, EPA-833-R-01-001. June 2001. Pp. 3-16.
- U.S. EPA National Environmental Policy Act. <http://www.epa.gov/compliance/nepa/index.html>
Accessed June 2, 2009.
- U.S. EPA Office of Water. Municipal Wastewater Reuse: Selected Readings on Water Reuse. Office of Water (WH-595) EPA 430/09-91-002. September 1991.
- U.S. EPA Safe Drinking Water Act Summary Laws and Statutes, EPA 816-F-04-030 June 2004
- U.S. EPA Water Division Region IX. Water Recycling and Reuse: The Environmental Benefits. EPA 909-F-98-001. September 1994.
- U.S. Fish and Wildlife Service (2008). "Digest of Federal Resource Laws of Interest to the U.S. Fish and Wildlife Service." from <http://www.fws.gov/laws/lawsdigest/RECPROJ.HTML>.
- Van Riper, C., G. Schlender, and M. Walther (1998). Evolution of Water Reuse Regulations in Washington State. WateReuse Conference Proceedings, Denver, CO.
- Washington State Department of Ecology (2009). "State Water Rights." Water Rights Changes. Retrieved February 24, 2010, from <http://www.ecy.wa.gov/programs/WR/rights/water-right-home.html>.
- Washington State Department of Ecology. Focus on Reclaimed Water. Water Quality Program. 08-10-095. November 2008.
- Washington State Department of Ecology. Water Quality, Reclaimed Water. ©Washington State Department of Ecology. <http://www.ecy.wa.gov/programs/wq/reclaim/index.html>

Washington State Legislature. Reclaimed Water Use. Title 90. Chapter 90.46 RCW.

Washington State Legislature. Substitute Senate Bill 5504. Chapter 456, Laws of 2009: Reclaimed Water Permitting. State of Washington , 61st Legislature. Passed by the Senate April 19, 2009.

Washington State Department of Ecology. History of the Reclaimed Water Use Act. 2007.

Washington State Legislature. House Bill 1482. State of Washington 61st Legislature, 2009 Regular Session. First Reading January 21, 2009.

WateReuse Symposium Conference Proceedings, Seattle, 2009.