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Louisiana's Water Innovation Cluster: Is it ready for global competition?

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Abstract

The rapid growth of Louisiana's coastal restoration science and technology assets is paralleled by the growth of business resources to fulfill myriad project needs. Many institutions and organizations in Louisiana seek to further develop the state's research, education, engineering and related restoration assets into a globally competitive set of industries with exportable expertise and products that help the state capitalize on its water challenges. Globally, similar efforts are identified (and often branded) as water technology innovation clusters (or more simply water clusters). This paper explores the phenomenon of the development of water clusters by public-private partnerships and initiatives, nationally and internationally, in a comparative analysis with Louisiana.

Keywords: Water Technology Innovation Cluster, water cluster, economic development, coastal restoration, Louisiana, infrastructure, innovation, entrepreneur, public policy, water management.

Preface

"…the typical response to a variety of threats and disasters is not to flee or attack but rather affiliation…" Anthony R. Mawson, *Understanding Mass Panic and Other Collective Responses to Threat and Disaster,* 2005

Water in Louisiana represents an immeasurable threat. Conversely it is an asset with equally unbound potential. This thesis, which examines that potential through the lens of ever-evolving economic cluster theory and chaotic physical realities, is bounded within a brief timeframe, but it aspires to illuminate opportunities, promote critical thinking, and open paths to a better future.

First, we must honor a sacrifice. When threat became reality in south Louisiana in 2005, the surge and floodwaters of Hurricane Katrina killed nearly 1600 people, the majority aged 60 or older. This tragedy, and the compassion it inspired, prompted our country to act quickly to help us rebuild and to shore-up our protection systems.

Today, the newly constructed Lake Borgne Surge Barrier, miles of levees, and dozens of gates and pumps represent some of the largest public works projects in U.S. history. But can these investments only become real after tragedy and catastrophe?

Globally, billions of people living near rising seas are just a category one storm[1] away from catastrophic flooding, destruction and death. And, as with population, catastrophe trends are on the upswing. Morbid as it may seem, Louisiana is fully engaged in the economics of catastrophe, and we can do much good for ourselves and the world by being

[1] Hurricane Isaac, a category one storm that did not prompt evacuation of New Orleans or most of the surrounding areas, on August 28, 2012 inundated parts of Louisiana with seventeen feet of water, causing catastrophic damage to communities and drowning two people in their home in Braithwaite. (Berg 2013)

effective at flood management, coastal and environmental adaptation, planning, hazard mitigation, disaster response, and many other water sectors related to disaster.

Louisiana has many lessons to share, but we also have more to learn. We are not managing water; we are using and abusing it. Every day in Louisiana we take, use, and waste water at the rate of 10,500 million gallons a day, more than half of that total just to produce electricity (American Society of Civil Engineers 2012).

At a time when water scarcity is increasingly the main driver of global crises impacting billions, in much of coastal Louisiana a perception of water abundance insulates us, giving us the latitude to shirk our responsibility to be better stewards of this vital resource. Further inland, Louisiana's cities and industries grapple with conflicting demands for increasingly constrained water supplies; in some cases, causing re-examination of public policy, a slow process yet to manifest as new laws.

Many departments, authorities, agencies, companies and individuals in Louisiana have power to take and use water; but there is no common connecting agency or organization coalescing the responsibility to effectively manage and harness the power of water to drive innovation in all our activities, to sustain a thriving state. This is the critical factor I contend is holding us back. We don't lack plans or the sense of urgency to implement them. But we do lack cohesion, leadership, funding, and systems-oriented actions needed to comprehensively manage our water-related activities and resources.

The more we recognize and cooperate with the power of water and how it works, the more successful we will be in fulfilling our responsibility to current and future generations. And with Louisiana's international renown opening hearts and minds, we can leverage our

water-related skills, experience, knowledge and lifestyles into economic engines to ensure a resilient, sustainable future for this unique and beloved place.

Louisiana's mix of challenges, resources and people represents a special combination of phenomena, settings and actors within which a growing number of us are working to restore degraded ecosystems, rebuild fraying coastal lands, and reinvigorate socioeconomic systems in education, urban development, business and lifestyles. Paramount among those challenges is improving our relationship with water by learning more about how it works and how our actions can transform from negative to positive.

The challenges inherent in resolving the impacts of exponential growth of the human species are daunting. We are constrained by what we fail to do because of what we fail to understand. My prayer is for our ignorance to be washed away by waters held sacred by all humanity, waters better understood, waters respected, and waters revered.

Introduction

This paper describes the regional aggregation of water technologies and resources into the economic (and marketing) phenomenon called *water technology innovation clusters* (water clusters) by researching existing clusters in a comparative analysis with Louisiana.

It is a reflexive exploration of active phenomena involving government, academia, business, and non-governmental organizations (NGOs) interacting in collaborative ways to create positive change in socioeconomic and environmental systems and settings within the context of dynamic and increasing global water crises.

The purpose of this thesis is to examine Louisiana's nascent water cluster efforts to provide insights and ideas, stimulate further research and critical thinking, and encourage relevant agencies and organizations to more formally pursue the potential of water clusters in Louisiana.

After a brief description of economic cluster theory and the recent history of water technology innovation cluster development, I review literature on the state of water globally and how water crises and infrastructure needs are driving activities connected to cluster development. I then analyze two clusters and examine factors that led to their creation, focusing on the vision and goals the clusters pursue, with an overview of certain accomplished objectives and milestones.

In exploring Louisiana's water potential, I examine the state's water-related strengths and weaknesses, pose questions regarding leadership and funding, and define Louisiana's water sectors and water-related social, economic and environmental assets. I compare

some of these assets to the cases via a narrative analysis, and then propose a framework for connecting the state's many water assets and issues across all possible sectors and age groups.

Defining Water Clusters: A Review of Theory and Literature

A large body of research and literature is available on the subject of cluster theory (Elola et al. 2012, Jun 2005, Kelton, Pasquale, and Rebelein 2008, McDonald, Tsagdis, and Huang 2006, Nolan et al. 2011, Porter 2003, 2000, Titze, Brachert, and Kubis 2011).

Harvard professor Michael E. Porter, whose 1990 book "The Competitive Advantage of Nations" marked the rise of the cluster as an economic phenomenon, is cited frequently for defining contemporary economic cluster theory. Writing in *Economic Development Quarterly* in 2000, Porter described clusters as:

> *Geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (e.g., universities, standards agencies, trade associations) in a particular field that compete but also cooperate* (Porter 2000).

The widespread application of cluster models by regional economic development organizations was criticized by some as merely "branding strategy" (Rosenfeld 2005), and for today's water clusters, branding is a defining characteristic. Many studies provide tools for identifying and building industry clusters (Hill and Brennan 2000, Yoo 2003, Rosenfeld 2005, Fieldsteel 2013, Aziz and Norhashim 2008, EPA 2014a), and there is much disparity in scholars' attempts to define clusters precisely (Yoo 2003, Aziz and Norhashim 2008). As a relatively new phenomenon, water technology innovation clusters exist in a research gap

that provides scant literature, so criteria used in this paper are based on a combination of factors, including personal experiences and observation.

In the literature, clusters typically are described as concentrated in a specific field in a business sector. What distinguishes many of today's water clusters is a broader, multidisciplinary approach that reflects the complex and pervasive nature of water in relation to human activities and all life.

Building a cluster requires cooperation, support and networking across public and private sectors, between business, government, academia and NGOs. It requires large companies to participate with the cluster in growing new companies, and for supportive actors to assist in commercializing research and ideas generated in universities. (Fieldsteel 2013, Aziz and Norhashim 2008, Rosenfeld 2005, EPA 2014d)

Working from the premise that clusters are based on assets, strengths and challenges recognized by local, regional or state private and public sector leaders and organizations, this research describes and compares Louisiana's nascent *de facto* water cluster to common aspirational factors of established water clusters. These factors include (but are not limited to) efforts to: develop and commercialize technologies including patent development; discover and accelerate nascent businesses; and support initiatives to promote regional business and research assets to international markets ("globally competitive" is a near-universal self-descriptive).

In the literature, Cluster Initiatives (CI) are endeavors that work to build clusters by fostering regional collaboration between public and private entities in business, government, academia, and NGOs to provide the supportive networks needed to establish a formal cluster (Rosenfeld 2005, Aziz and Norhashim 2008, Solvell, Lindqvist, and Ketels

2003). However, as Rosenfeld (2005) argues, clusters can be tools to boost effective public intervention, but when ineffective, are merely promotional tools attempting to justify poorly planned efforts.

The European Cluster Observatory periodically conducts a Global Cluster Initiative Survey online to collect data on the status and general characteristics of clusters. In the latest survey, more than four hundred entities responded to the nearly six hundred questionnaires, indicating that clusters continue to be a popular economic development milieu (European Cluster Observatory 2012).

Water clusters are not markedly different from other clusters, they simply fall into a research gap partially caused by a lack of standard business codes (Amhaus 2014) and by their relative newness in the marketplace.

Water Technology Innovation Cluster Development in the United States

EPA and the Water Technology Innovation Cluster Program

Though economic cluster theory and phenomena achieved a significant level of recognition in the late 1990s, with regards to economic development specifically for water the widespread use of the word *cluster* is fairly recent.

In 2011, the U.S. Environmental Protection Agency (EPA) launched the Water Technology Innovation Cluster (WTIC) in Cincinnati, where the agency operates significant water research facilities. Serving the region overlapping Ohio, Kentucky and Indiana, and in collaboration with the Small Business Administration (SBA), the initiative launched a public-private partnership called *Confluence,* that links academia, government, businesses and non-governmental organizations in a plan "to develop and commercialize innovative

technologies to solve environmental and public health challenges, encourage sustainable economic development, and create jobs." EPA and other federal agencies provide "technical assistance and expertise" that includes support for meetings and planning (Bufe 2012, Confluence 2014, EPA 2011a, b). Since the formation of *Confluence* and the WTIC in 2011, EPA identified more than a dozen water clusters (EPA 2014b).

A key supporter of the EPA WTIC is the Water Environment Federation (WEF), the world's largest international water quality organization with more than 36,000 members (Water Environment Federation 2014). WEF is a major partner, and their annual WEFTEC conference serves as a focal point for water technology innovation. They are a large and complex organization whose work includes education, policy, research, advocacy, and business development programs, including a strong emphasis on cultivating innovation. At the October 2013 WEFTEC in Chicago, WEF, working with Imagine H2O, an organization that manages a major, international entrepreneurial competition and business accelerator program, and EPA staged an invitation-only "Water Clusters Round Robin Private Networking Meeting" in which I was a participant.

The WTIC has roots in fundamental changes at EPA that began under the direction of former Assistant Administrator Paul Anastas in 2009. Anastas, considered to be "the father of green chemistry" (Wolfe 2012), instituted guidelines via a memorandum titled "The Path Forward" that introduced a new set of six principles and five key characteristics for the agency's Office of Research and Development. Those principles, as Anastas noted in a subsequent article in *Environmental Science & Technology,* were a radical departure from EPA's previous guidelines that emphasized a "risk assessment and risk management approach." Instead, EPA's Path Forward focused on "the need for systematic incorporation

by realigning EPA's entire research enterprise around the concept of sustainability," as defined "by the Bruntland commission in 1987: meeting the needs of the current generation while preserving the ability of future generations to meet their own needs." This significant shift underpins subsequent actions to improve the efficiency and efficacy of the EPA, and the collaborative, "transagency" work that currently guides the Water Technology Innovation Cluster efforts (Anastas 2012).

The US EPA's technology innovation cluster program was also supported by a key document, *Building a Successful Technology Cluster* (Fieldsteel 2013, Theroux 2014) that examines cases and identifies key steps to cluster formation. The program is itself a type of cluster, agglomerating federal support systems to focus on interventions that support economic growth. In establishing the WTIC, the EPA defined technology clusters this way:

> *A regional technology cluster is a geographic concentration of interconnected firms—businesses, suppliers, service providers—and supporting institutions such as local government, business chambers, universities, investors, and others that work together in an organized manner to promote economic growth and technological innovation* (EPA 2011a).

An exploration of the many factors contributing to the WTIC must also include the Small Business Innovation Research (SBIR) program, authorized and launched by Congress in 1982 and re-authorized numerous times, with the most current bill maintaining the program through 2017. The SBIR engages federal agencies in the development of entrepreneurs and businesses. According to the program's website the SBIR is:

> *A highly competitive program that encourages domestic small businesses to engage in Federal Research/Research and Development (R/R&D) that has the potential for commercialization. Through a competitive awards-based program, SBIR enables small businesses to explore their technological potential and provides the incentive to profit from its commercialization. By including qualified small businesses in the nation's R&D*

arena, high-tech innovation is stimulated and the United States gains entrepreneurial spirit as it meets its specific research and development needs (SBIR/STTR 2014).

Federal agencies with research budgets exceeding $100 million are mandated to set aside 2.8 percent of their research and development budgets for the program. Currently, eleven agencies participate. The Department of Defense SBIR budget is more than one billion dollars[2]. In 2013, EPA's SBIR budget was less than four million dollars. The program operates in partnership with the Small Business Administration.

Though the EPA's SBIR program is modest, between 2007 and 2013 more than eighty businesses participated. Because the WTIC exists to develop and commercialize innovative technologies, SBA and the SBIR program are integral to the WTIC initiative. Note: this paper will not extend its research into the effectiveness of the EPA's SBIR program (though research exists), or the SBIR in general, but seeks to sufficiently explain some of the major components of the WTIC program to paint a clear picture of a complicated and active endeavor that evolves with the rise and fall of government budgets and resource allocation (SBIR/STTR 2014).

Water Cluster Fundamentals

Water clusters are built around regional assets, strengths, demands and, as is the case in Louisiana, challenges. Foci include (but are not limited to) agriculture, energy, wastewater treatment, maritime interests, flow technologies, research, financing and investment, business and municipal services, testing and modeling, information

[2] Using the keyword "water," a review of DoD programs in Louisiana finds only seven between the years 1993 and 2004, none since. Most of the grants were under one hundred thousand dollars, only one was higher, but substantially so, at more than seven hundred fifty thousand dollars. Water research dollars connected to military bases and activities represent an under-tapped potential for Louisiana.

technology, desalination, ecological restoration, and various combinations. A common word used by water clusters to describe their missions is *global*, a reflection of the universal nature of water issues and of the desire of regional economic and water leaders to participate in international markets relating to water (Colorado Water Innovation Cluster 2014, Water Council 2014).

The act of describing water sectors is itself fluid and changing; terms evolve. One of the issues I observed while meeting with planners at WEFTEC 2013 in Chicago was a frustration among a committee of engineers and biologists that the phrase *water quality* seemed to be losing favor to the phrase *stormwater*. Two trade magazines now use the word in their titles, and though it can easily be argued that water quality is the ultimate goal of much of the work in water infrastructure and regulations—including stormwater technologies—the management of stormwater is a rapidly growing sector as urban planning and policies shift from traditional *gray* infrastructure to *green* infrastructure that utilizes strategically designed landscapes features and innovative technologies to work more harmoniously with natural systems (EPA 2014c).

The dominant theme of cluster development—and in the ongoing efforts to aggregate clusters into more effective and resource-efficient dynamos of positive change—is simply collaboration (Smith and Brown 2009). Clusters are collaborative groups, and the WTIC is a larger collaborative of a growing number of clusters. The WTIC seeks to build relationships and share resources to reduce duplication of effort. At the WTIC roundtable at WEFTEC Chicago in 2013, emphasis was placed on sharing information and related facilities as a way to accelerate urgently needed research, leverage investment, and reduce redundancy (Liner 2013). The urgency of global water crises was frequently referenced as a motivating

factor to accelerate collaborative efforts. Whether such *coopetition* (a word combining *competitive* industries in a *cooperative* model, hence the phrase) will strengthen the WTIC is still to be determined.

Clusters commonly begin with visionary leadership recognizing the sector, assessment of business, academic, government, job creation, economic impact, and NGO potential in the context of relevant market opportunities, and the development of an organizational structure to facilitate networking, convening, communication, marketing and business development. An important step in launching a cluster is to assess regional resources, identify dominant themes based on strengths and challenges, and to determine the ability of the potential cluster to coalesce effectively based on a combination of those strengths and the potential of support systems (Amhaus 2014, Aziz and Norhashim 2008, Rosenfeld 2005, EPA 2014a). Though government can be the leader, and should be a partner, some firmly believe clusters should be led by the private sector, a factor emphasized in Milwaukee and reflected by the long-term success of Kinrot Ventures in Israel (Amhaus 2014, Ankor 2012, Rosenfeld 2005). Water clusters also frequently utilize entrepreneurial competitions and business accelerator programs as key components to engage communities, attract business, create jobs, and play an active role in developing related patents and innovative solutions to vexing water challenges (Ankor 2012, Bufe 2012, ImagineH2O 2014).

To summarize, water clusters are a recent phenomenon. The EPA is actively working to catalyze and assist the formation of clusters by providing technical assistance by staging and supporting meetings of WTIC participants. Since 2011 the WTIC has grown to include more than a dozen organizations and clusters. The largest WTIC meeting to date took place

in October 2013 at WEFTEC in Chicago[3]. Many of the participants represented nascent cluster initiatives. Clusters work to aggregate regional resources in business, academia, government and NGOs, and typically are based on regional assets, strengths or urgent challenges in agriculture, industry, and natural resources. Challenges such as water scarcity or quality are an impetus for research and efforts to cultivate innovation, and can be incorporated into cluster models as drivers. Similarly, global water challenges and crises are seen as job creators and market opportunities to be utilized as part of overall economic strategies to develop a cluster's potential to compete for international business.

[3] The EPA WTIC will convene at WEFTEC 2014 in New Orleans, September 27 to October 1.

Table 1: EPA Identified Water Clusters May 2014

Cluster	Location	Year Formed	Focus
Blue Tech Alliance	Chicago	2012 (?)	International investment opportunities
California International Center for Water Technology	Fresno, CA	2001	Agriculture and efficiency; research & business development
Colorado Water Innovation Cluster	Fort Collins, CO	2010	Agriculture, efficiency, research, commercialization
Confluence	Cincinnati, OH	2011	Water/wastewater treatment and conveyance
New England Water Innovation Network	Boston, MA	2011	Research and testing of water technologies
Michigan Water Technologies Initiative	Lansing, MI	2013 (?)	Water research and testing
NorTech Water	Cleveland, OH	2011	Energy, technology and water, accelerator
Southern Ontario Water Consortium	Multiple locations in Ontario, Canada	2011	Research, development and testing
The Water Council and Global Water Center	Milwaukee, WI	2009	Research, education and economic development
Water Economy Network	Pittsburgh, PA	2012	Energy, industry, navigation, green infrastructure, treatment
Center for Urban Waters	Tacoma, WA	2002	Research, stormwater, industry, treatment, restoration
WaterTAP Ontario	Toronto, Ontario	2011	Business support, connector, advocacy
SurgeAccelerator	Houston, TX	2013	Water and energy
Water Resources Research Center	Tucson, AZ	2013	Urban water management, policy, education, research
Nevada Center of Excellence	Las Vegas, NV	2012	Technology, conservation, planning, pumping, treatment, storage, reuse

(EPA 2014b)

Global Water Crises Drive Economic Development

Water is more than four billion years old. The amount of water is fixed; there is no readily available "new" water or ways to make more of it. It exists as liquid, ice or vapor and continually cycles through those states. But the water that sustains us, the fresh water that fuels us and nearly every aspect of human activity and industry, is rare, comprising .007 percent of all the water on Earth (Water.org 2014, World Water Council n.d.-b, Maxwell 2012, U.S. Geological Survey 2013).

Over the past century, water demand increased at a rate more than double that of population growth, prompting numerous urgent initiatives and collaborations across the planet as the world faces another steep increase from 7 billion to nearly 9 billion people by 2050 (Water.org 2014).

In 2009, IBM released *Water: A Global Innovation Outlook Report* that describes water and our relationship with it this way: "water is the lifeblood of the planet; every time a good is bought or sold there is a virtual exchange of water; every time we interact with water, we change it, redirect it, or otherwise alter its state; we have never learned how to efficiently manage water." (IBM 2009, P. 2-5)

The need for abundant, clean water is challenging humanity to develop innovative solutions. This phenomenon of crises combined with awareness of economic potential causes many observers to muse that "water is the new oil," a statement meant to connect the value of fresh water and its related industries to the economic power of the oil industry. All is not business, though. Dire predictions of water scarcity causing unrest and wars are common themes as countries, states and corporations attempt to better position themselves to not only survive, but in many cases, capitalize on the situation (Office of the

Director of National Intelligence 2012). Demand for water, anticipated spending on infrastructure, along with myriad endeavors to solve issues of security, supply, efficiency and quality are leading to new investment vehicles in the world of finance and banking in what some are defining as "hydrocommerce" (Maxwell 2012).

Nearly a billion people lack access to clean, safe drinking water and more than two billion live without basic sanitation (Water.org 2014, Maxwell 2012, World Water Council n.d.-b). According to the World Health Organization, contaminated water causes eighty percent of all sickness and disease worldwide; the majority are children under the age of five who die at the rate of more than 750,000 per year, or the equivalent of "90 school busses of kindergarteners" per day (World Health Organization 2014, UNICEF 2013, Gleick 2002). Statistics reveal massive disparities between countries and continents. But issues of access, quality and scarcity affect every continent, creating a truly global crisis unprecedented in human history.

Water crises threaten not only the health and wellbeing of billions of people in poor countries who lack access to clean water and sanitation, but also large numbers of people in wealthy, highly developed countries (Hoekstra 2014). Crises, such as severe droughts that impact food supplies and exacerbate fire hazards; flooding; pollution; and aging infrastructure are amplified and exacerbated by climate change, rising population and environmental degradation, compelling humanity to respond collectively.

According to a study published in September 2013, one in ten watersheds in the United States is defined as "stressed," a situation where demand exceeds supply. Produced by the Cooperative Institute for Research in Environmental Sciences at the University of Colorado-Boulder, the research noted that stressed watersheds are a "new normal," that threatens

agriculture and communities, mostly in western states (Averyt et al. 2013). According to a recent study of risk perception by the World Economic Forum, water scarcity is one of three "systemic risks" (Hoekstra 2014) presenting new challenges to the global economy.

Because it impacts so many aspects of business and is vital to every living thing on Earth, the true market value of water is difficult to quantify; statistics vary. One measure puts the current annual global market for water infrastructure at approximately $600 billion (Muller 2013). However this number does not factor the value of water taken from the environment without payment. When that aspect is measured, the "true cost" of water is estimated to be more than $1 trillion annually (Bernick 2013).

In Louisiana, a study of the value of the Mississippi Delta ecosystem arrived at annual benefits to people of between $12 billion and $47 billion, which translates to an asset value of between $300 billion and $1.2 trillion (Batker et al. 2010). Such calculations of "natural capital" are increasingly recognized as vital to guiding long-term planning, setting resource efficiency standards, and developing sustainable communities and business models.

International agencies and organizations addressing water crises consistently call for "concerted actions" (World Water Council n.d.-a) by multidisciplinary groups (Chan 2013) and investment in research, innovation and technologies focused on reducing impacts.

This combination of existential crisis and economic opportunity challenges humanity to be more innovative and resourceful. In the 1990s, Israel, motivated by its lack of fresh water and abundance of salt water, invested in research to discover efficient methods to desalinate seawater. The country's Chief Scientist developed an innovation challenge, inviting entrepreneurs, inventors and scientists to participate in a formal competition, with winners offered startup capital to locate their companies in Israel. This program was

privatized and named Kinrot Ventures, and achieved international renown as a successful challenge competition and water cluster (Ankor 2012). It continues to be a model for countries and localities such as Massachusetts, which sent 40 people to Israel in 2011 to learn about the program and replicate many of its most successful aspects via the Massachusetts Israel Innovation Partnership (MASSCEC 2014).

Water Market Opportunities: Infrastructure Leading the Way

Infrastructure, as evaluated by the American Society of Civil Engineers (ASCE) includes: aviation, bridges, dams, drinking water, energy, hazardous wastes, inland waterways, levees, ports, public parks and recreation, rail, roads, schools, solid waste, transit, and wastewater. The ASCE overall grade for that infrastructure in the United States in 2012 is D+, a slight improvement of the previous grade of D (American Society of Civil Engineers n.d.). Of the 144 countries whose infrastructure is ranked by the World Economic Forum, the United States placed 14th overall, with our roads ranked 20th and ports at number 19. This not-so-flattering news is counterbalanced by the fact that the U.S. is the world's largest water market (White et al. 2010), and water sector infrastructure spending is on an upswing (Gasson 2013, Maxwell 2012, Moore et al. 2013), creating opportunities water clusters seek to leverage.

A survey conducted by EPA in 2012 ranks wastewater treatment as "the technological area that is of most importance to cluster focus" (EPA 2012). Sanitation in developing countries, and human health and well-being are key issues addressed by large international NGOs and in the public sector; but in the developed world, EPA notes that demand is from manufacturing and municipal water sectors.

A growing body of research is guiding water spending, and two recently released studies produced strong data supporting investment in infrastructure and in coastal ecosystem restoration. In the case of public infrastructure, a May 2014 report from Standard & Poor's titled *U.S. Infrastructure Investment: A Chance To Reap More Than We Sow*, states that spending on infrastructure, particularly "transportation and water systems…would foster economic expansion," and when compared to the initial investments, produce a return of approximately double in subsequent GDP growth (Bovino and Maguire 2014, p.10). Several water clusters in the U.S. emphasize sewer and water infrastructure as key industries, including Confluence, WaterTAP, the Water Council, and the Water Economy Network.

In April 2014, the Center for American Progress and Oxfam America released *The Economic Case for Restoring Coastal Ecosystems* that found a fifteen-to-one benefit-cost ratio for dollars invested in well-designed coastal ecosystems restoration projects (Conathan, Buchanan, and Shiva 2014). Other studies confirm the potential for job creation, and expansion of ecosystems services. In *Rebuilding Our Economy, Restoring Our Environment* the authors state that coastal ecosystem restoration "reflects a growing opportunity for Gulf firms to develop new markets, promote innovation and become leaders in the growing sectors of ecosystem restoration design, construction and technology" (Mather 2012, p.2). Recognition of these opportunities in infrastructure and water are a common trait of research done by water clusters in other states (FourthEconomy 2011, Austin 2013, NorTech 2014).

Assessment of regional assets and the potential of global, regional or local markets is an important step in the cluster-building process. Based on the results of such research,

clusters address their own strengths and weaknesses in building the organizational support systems that constitute a cluster initiative (EPA 2014a). With global water markets predicted to grow to more than one trillion dollars annually by 2020, there are ample incentives to build water clusters (Merrill Lynch 2013).

Two Cases

To better understand the water cluster phenomenon, two well-established programs: the Water Technology Acceleration Project (WaterTAP) in Toronto, Ontario, and the Milwaukee Water Council and Global Water Center (MWC) are analyzed, then compared to Louisiana 's nascent water clusters. Both cases are participants in the WTIC cooperative network facilitated by the EPA and assisted by Imagine H2O and WEF[4]. These clusters were formed to capitalize on existing water assets across industry, academia, government, and the environment, to create a dynamic system for collaboration and promotion, and to foster innovation and job growth.

These cases represent two approaches to the founding and funding of water technology innovation clusters. WaterTAP was legislatively established and publicly funded, though it is incorporated as a NGO. The Milwaukee Water Council was created by a private sector economic development initiative, and raised public and private funds in near equal amounts in its first two years. MWC has a membership structure that contributes a quarter of its operating revenue (Milwaukee Water Council 2013).

[4] I am an invited and active participant representing Louisiana, but I officially represent no particular organization.

Water Technology Acceleration Project (WaterTAP) Toronto, Ontario

WaterTAP is an initiative created by the Canadian government in 2010 and opened for business as a nonprofit economic development entity in 2011. WaterTAP calls itself "Ontario's water technology champion;" the organization states that its "sole focus is on the growth and prosperity of Ontario's water sector." Funded by the Ontario government via a five year $5 million commitment, WaterTAP's mission:

> *is to accelerate Ontario's water technology success by: connecting early commercial stage Ontario companies with the resources they need to successfully market their water technologies to utilities and other large users; celebrating and sharing the successes of Ontario water utilities that are finding innovative and sustainable solutions; advocating with provincial and municipal governments to foster innovation-friendly water management policies; and introducing water entrepreneurs, businesses, investors and advisors worldwide to the Ontario water community.* (WaterTAP 2014)

One of the many tools available on the WaterTAP website is an Asset Map which functions as a portal for connecting to Ontario's utilities, businesses, research facilities and entrepreneurs. The Asset Map is a directory featuring information on four hundred Ontario companies (the website also states there are more than nine hundred water companies in Ontario, excluding municipal water and wastewater utilities). The Asset Map link is a dynamic, online resource that also provides detailed information about global issues and market intelligence while also promoting the region's companies, educational and research institutions, utilities, and other assets. The Asset Map portal also includes information about funding and tax incentives, and articles on trends and research.

WaterTAP offers a year-long entrepreneur program with a team that provides business mentorship, and marketing tools to help establish new companies' presence, and to drive

sales. Participants also have access to programs emphasizing leadership and business development.

Via email newsletters, press releases and articles, WaterTAP keeps a steady stream of news emanating from Ontario's water sector. The site's Resources links also aggregate other marketing and educational materials ranging from podcasts to books. Additionally, it serves as a portal to ten external entities whose sites connect to potential water jobs.

WaterTAP was founded and is funded by the government of Ontario, and serves a valuable role in connecting the many water-related assets of that region. It is a model for the role of government in economic development by providing resources for connecting, communicating, convening and promoting their cluster, and for entrepreneurs and businesses seeking to grow or locate in the region. As a government-founded and funded NGO, WaterTAP has predictable support, a more stable arrangement than usual for government, but still a situation subject to political winds if the program is to extend beyond the five years of its funding.

During their panel at the 2014 Water Challenge entrepreneurial competition in New Orleans, Barry Liner and Dean Amhaus both emphasized that a key ingredient for a successful water cluster is a customer base. WaterTAP provides strong support to Ontario businesses for marketing and connecting to a broad customer base of potential clients and industries, and also conducts research to provide accurate market intelligence and asset awareness.

WaterTAP is a catalyst and portal for collecting and disseminating research and market data. It also serves as a convener across sectors and via an annual water conference that attracts international participation. One measure of innovation is the issuance of patents.

According to a May 2014 news item on the WaterTAP site, when measured over a thirty-year period, Ontario is the top region in the world for the development of patents connected to water.

WaterTAP is a young cluster. It moved purposefully to assess Ontario's assets, aggregate its water sectors, provide valuable support via market research and communication between stakeholders, and to connect startup companies to resources that accelerate development and build relationships with regional companies, research and supporters. As a legislatively established entity with a specific funding plan, it was able to ramp-up quickly to create a strong presence in the marketplace.

The Milwaukee Water Council and Global Water Center

In 2007 a group of business and education leaders in Milwaukee Wisconsin formed the Milwaukee 7 to focus on the economic development needs of the seven county region. In 2009, this group recognized that one of their significant strengths is the mix of industries and resources connected to water. The Milwaukee Water Council (MWC) was conceived to find new ways to reinvigorate the regional economy around water. The group's first step was to secure a federal Economic Development Administration grant to fund a global market study conducted by the University of Wisconsin-Milwaukee. Released in 2010, *Water Markets of the United States and the World: A Strategic Analysis for the Milwaukee Water Council* (White et al. 2010) is a voluminous (427 pages) and thorough study of global water-related markets that also provides strategic recommendations for the MWC. Additionally, a study of the issuance of patents in the U.S. in 2008 provided a baseline that motivated the Milwaukee 7 to focus on patent development as a core strategy (Grossman 2009).

Located on the Great Lakes, the world's largest surface freshwater system (National Oceanic and Atmospheric Administration n.d.), Milwaukee's industrial history is framed by an abundance of companies connected to the brewing of beer and related water infrastructure. The city is home to the nation's first major industrial cluster of breweries, including Miller, Pabst and Schlitz, a history civic leaders tout as key to Milwaukee's current status as a water center.

The CEOs of two of the biggest publicly traded companies with headquarters in Milwaukee, Paul Jones of A.O. Smith, the world's largest manufacturer of hot water systems, and Rich Meeusen of Badger Meter, led the effort to create both the Milwaukee 7 and the Water Council. In the EPA report *Building a Successful Water Technology Cluster* (Fieldsteel 2013), the role of these CEOs as "first-level influencers" (p.18) is credited as fundamental to the formation and support needed to build the cluster.

First-level influencers (and second-level) are leaders and visionaries described as key to the success of technology clusters (and other similar initiatives) as noted in the writings of Smilor et al in a seminal work titled "Creating the Technolopolis: High-Technology Development in Austin, Texas" in 1988 in *The Journal of Business Venturing* (Gibson and Butler 2013). This leadership is vital to launching and sustaining successful technology clusters, and to aligning the complex network of public, private, academic and NGO resources that constitutes successful initiatives (Gibson and Butler 2013).

Structurally, MWC is a membership organization with more than 150 corporate, governmental, academic, philanthropic, and advocacy members. The MWC states its roles as:

> *Convening the region's existing water companies, and research clusters, developing education programs to train our talent, and building partnerships that cut across all sectors and geographic boundaries.* (Water Council 2014)

MWC's mission is "to align the regional fresh water research community and water-related industries to establish the Milwaukee region as the World Water Hub for water research, economic development, and education" (Water Council 2014). To accomplish this mission, the organization has committees focused on: Talent/Education, Corporate-University Linkages, Global Communications, and Water Stewardship.

MWC's work includes recruiting companies via an annual business competition called "The BREW" (Business Research Entrepreneurship in Wisconsin) with prizes that include investment capital and co-location support in the newly developed Global Water Center, a restored seven story building that serves as a business accelerator featuring prominent local water businesses and research institution tenants who also serve as mentors for the winning "Global Freshwater Seed Accelerator" companies.

MWC also partnered with a dozen local, state and national companies and institutions to develop an adjacent fifteen acre waterfront property into the Global Water Technology Park, "a mixed-use urban office, educational, research and technology zone focused on the international water industry" (Global Water Technology Park 2014).

At the 2014 Water Challenge, MWC director Dean Amhaus touted Milwaukee's private sector support as key to the formation of the organization and its continued expansion and governance. Like most clusters, MWC is a collaborative of public, private and nonprofit

sectors from industry, academia, government and advocacy organizations. MWC's membership fees are tiered to elicit support levels based on type of organization, size and economic activities. For example, academic membership has two levels based on the size of the school. Corporate membership is broken into four levels based on revenues ranging from under three million dollars to twenty million dollars or higher. MWC membership fees range from a low of five hundred dollars to a high of five thousand five hundred dollars. Their website lists more than one hundred fifty members, and their 2012 federal tax forms show that the organization raised more than eight hundred thousand dollars, of which more than two hundred thousand dollars was directly from membership.

The Milwaukee Water Council case follows a fundamental process of cluster development: visionary leadership recognizes the economic development potential of a set of strengths between industry, academia, natural resources and government; interested parties are convened, and an assessment is conducted that may include plans and strategies; support is enhanced via funds from public and private sectors; an entity is either identified to take-on cluster responsibility or an independent entity is formed.

In summary, both WaterTAP and the MWC are economic development-oriented organizations designed to establish networks of business, academia, government and NGOs in an overall effort to build upon strengths and assets, leverage and share resources, and to help their respective regions compete in global markets. Though there are differences in how each cluster was established and funded, there are more similarities than differences, and both clusters share five themes: strong and resourceful website; assertive branding; economic development mission focused on water; internal (statewide) water asset assessment; external (global) marketplace assessment and positioning. By comparison, in

Louisiana these themes exist, but, as I reveal later in this paper, not all within one organization.

Research Question

In designing a qualitative study of the phenomenon of water technology innovation clusters, I ask a simple question: where does Louisiana stand in comparison to the development of other water clusters? To answer this question I research existing and nascent water clusters in a descriptive qualitative study and analysis.

This paper is a descriptive *qualitative study* (Creswell 2013) that explores water technology innovation clusters, and presents an overview of water sector assets in Louisiana. It features an analysis of two existing water clusters, in which I examine "themes across cases to discern themes that are common and different" (Creswell 2013, p. 294), and an analysis of Louisiana's potential to develop similar water clusters. This is a *multisite, instrumental* study of clusters in many geographic locations that focuses on aspects of water clusters, rather than on the cases themselves (Creswell 2013). It is a heuristic journey into complex and relatively new phenomena for which literature is scant.

As a qualitative study, I utilize *multiple sources of information* (Creswell 2013), including articles, reports, interviews, websites and audiovisual materials. Data gathered constitute a *judgment sample* based on my "practical knowledge of the research area, the available literature, and evidence from the study itself" (Marshall 1996, p. 523). It is a *holistic account* in which I identify "many factors involved in a situation" and describe "a larger picture that emerges" (Creswell 2013, p. 47).

The design utilizes *content analysis,* in which "many different kinds of texts and artifacts can be studied, including… documents, newspapers, magazines, photographs, books…and so forth" (Hesse-Biber and Leavy 2011, p. 228), including personal experiences, communications, observation, participation and relationships. I compare two cases in relation to Louisiana via an analysis in which I examine thematic elements and arrive at *assertions,* in "an interpretation of the meaning" (Creswell 2013, p. 101), found later in this document in my Analysis and Findings.

In approaching the topic as a qualitative study, I made "a decision about what is to be studied, not a methodological decision," (Hesse-Biber and Leavy 2011, p. 255) based on my fundamental belief that Louisiana has the capacity to strengthen, expand and sustain its economy based on water-related assets within the state's social, industrial and environmental resources. This premise is the foundation of my assertions, and is supported by evidence and activities.

Theoretical Framework

My approach to this research is from the theoretical perspective of *pragmatism* in which my ontological beliefs are based on "what is useful, is practical and 'works'" (Creswell 2013, p. 37) in relation to the socioeconomic and environmental aspects, impacts, and perceived potential of water clusters. Pragmatism's epistemological framework embraces objective and subjective research tools, and both qualitative and quantitative data; its broad approach includes the discussion of values of the researcher and the participants (Creswell 2013) which allows the researcher to share perspectives and vision in a participatory role with the subjects and issues. "Pragmatism is a philosophy of action" (Joas 1993, p. 18), and I seek to both study and prompt action via this research.

Role of the researcher

This research is grounded in: more than five years of my own work promoting integrated water management via my role as a founder and current co-chair of the Horizon Initiative Water Committee (2009 to present), an open-membership, multidisciplinary group of volunteers who meet monthly to discuss water management issues; five years of planning and participating in the Building Resilience Workshop (2009-14), an annual conference addressing a range of water-related issues threatening communities in coastal environments; and four years (2010-14) as a co-founder and coordinator of the annual Water Challenge entrepreneurial competition which "seeks to discover and nurture entrepreneurs whose business ideas address significant water issues"(Picou and Mendoza 2011) in southeast Louisiana.

In conducting the research, much of which is based on personal interactions with diverse water leaders, programs and projects over the past decade, I address my own and others' assumptions regarding Louisiana's perceived strengths and weaknesses relating to water.

These roles, including my pursuit of a post-graduate degree, were enabled by my job as an extension agent (March 2008 to October 2012) with the LSU AgCenter Cooperative Extension Service where I focused on sustainable housing, best practices for building in hot, humid climates, energy efficiency, and economic development promoting the emerging green economy.

Data

I collected and reviewed one hundred fourteen sources of data from government, private, and academic sources, including sixty reports, articles, and correspondences about Louisiana's water and economy. I also collected information on ninety organizations and institutions connected to water in Louisiana, including funders, advocacy groups, business and trade associations, government agencies, and academic and research institutions.

Other data for Louisiana includes research gathered over two years from forty interviews conducted with individuals working in a wide array of public and private sector professions connected to water in Louisiana, including professionals working in economic development, academia, resilience, coastal restoration, water law, engineering, architecture, philanthropy, planning, and cluster development. Interviews were conducted either in person or by telephone, and answers were captured via notes.

I attended and/or participated in several relevant professional conferences including: WEFTEC 2013, 2014; State of the Coast 2014 (where I served as a panelist on the subject of water clusters); and Building Resilience Workshops l through V where I served as an advisor and moderator. In addition to interviewing Dean Amhaus, director of the Milwaukee Water Council, and Dr. Barry Liner of the Water Environment Federation, I also moderated a panel discussion with them at the 2014 Water Challenge.

To gain an international perspective I collected data from websites of some of the clusters identified by the European Cluster Initiative Survey. I reviewed these clusters for commonalities and themes to determine similarities and differences in relation to North American clusters.

Methods

In using a content analysis approach, I reviewed all data using a framework of keywords and themes to examine how clusters are formed, including review of mission statements and programming, and then separating information into commonalities and differences.

With the cases, and in my research of the clusters participating in the EPA WTIC, I conducted a review of fifteen clusters located in the United State and Canada. Case data were gathered from multiple sources, including reports, interviews, meetings, conferences, panel discussions, websites, personal correspondence, newsletters, news articles, financial records, and personal interactions.

I reviewed a wide range of data from the cases and from organizations in Louisiana, including annual reports, board and organizational structure, mission statements, financial reports, programs and objectives for key components such as directories and/or maps of regional assets in business, government and academia; business development tools and references; entrepreneurial programming and resources; and studies and market analyses. I analyzed the interviews for codes focused on economic development, entrepreneurialism, perceptions of leadership, and holistic perspectives of water management. Data was validated and corroborated by crosscheck analysis that confirmed common codes and highlighted divergent aspects.

Understanding the genesis of clusters necessitated research into how ideas were formed and communicated, who led the first steps, and what those first steps were. I developed codes to help me determine aspects of clusters and to discover similarities and differences between the cases and Louisiana.

A priori codes included: cluster-oriented economic development; asset maps and resource directories; plans and reports; branding and marketing; systems to access venture capital and investment; entrepreneurial programming and support; focus on water businesses and industries; convening and conferences; collaboration between business, government and academic institutions; innovation programs and support; water technology research and patent development systems; public policy research and initiatives; and global or international market aspirations.

Analysis

To develop codes, clusters were analyzed for commonalities, such as systems for: network building and communications; research and technology commercialization; entrepreneur recruitment and business accelerator programs. All cluster data were reviewed for processes and history that led to formation of the cluster, differences in funding and administrative structure, key water sector emphases, unique aspects, and common traits.

In addition to the two featured cases, all of the EPA WTIC participants were analyzed for key aspects such as whether they were initially established and operated under public, private, or academic organizational structures, primary sources of funding, economic development and entrepreneurial programming, and areas of specialization.

Analysis of the Louisiana's water-related assets, including overviews of market sectors and more in-depth research of key entities that compare to the cases, produced codes that I divided into strengths and weaknesses. Using a white board, codes were grouped to determine similarities and differences between the cases and then in comparison to Louisiana. Using this technique, the five common themes (or cluster traits) noted earlier

were identified: strong and resourceful website; assertive branding; economic development mission focused on water; internal (statewide) water asset assessment; external (global) marketplace assessment and positioning.

In analyzing water-related economic activities in Louisiana I reviewed eighty-nine organizations, institutions, and businesses, including funders, and determined that two, the Water Institute of the Gulf, and Greater New Orleans Inc. (GNO Inc.), exhibit enough similarities to the cases to warrant further analysis and description, found later in this paper.

Discussion

What this research reveals is that Louisiana has many of the pieces of the puzzle to build a strong and unique water cluster, but there appears to be no puzzle master or even a clear picture of what a finished puzzle looks like. In the following passages, I describe possible versions of a completed puzzle.

Louisiana's Gross Domestic Product (GDP) in 2012 was measured as $243 billion, ranking the state 23rd in the U.S. and an amount equivalent to the entire economy of Israel (Perry 2014). In maritime industries, the state is ranked number one overall and number three in shipbuilding (Young 2014, gCaptain 2014, WorkBoat 2014). Its roles in water-based industries are vast and numerous, and underlie every business and quality of life measure. Four of the state's universities have institutes dedicated to water and coastal research (Battelle 2013), and an assessment done for the Regional Planning Commission in 2013 sets forth clear strategies to more effectively connect industry and universities in New Orleans, and could contribute to cluster development (Klein 2013).

Much of my water-related work involves multidisciplinary efforts to share and instill integrated water management principles across all possible sectors, and I am not alone in proposing that Louisiana has the talent and the resources to build a stronger, more resilient economy by acting upon the many aspects of its water sector. Such awareness is common among this—and other (Bufe 2012)—states' major economic development and planning entities, as evidenced by water management's inclusion as a key industry in the literature produced by Louisiana Economic Development, GNO Inc., the New Orleans Business Alliance, the Greater New Orleans Regional Planning Commission, the Bayou Vermilion District, and a growing number of business support organizations (Louisiana Workforce Commission 2011, GNO Inc. 2013, New Orleans Business Alliance 2013).

The development of water clusters in other regions follows a general pattern of assessment then plans. In Louisiana, the plans seem to come first. Louisiana has several multi-billion dollar water plans representing thorough and original research on coastal restoration and planning, urban water management, and flood mitigation and protection. And though broad assessments of the state's overall economic strengths and regional cluster potential were conducted (Battelle 2013, Rho, Rochat, and Lynch 2012), no holistic economic assessment of Louisiana's diverse water sectors is available.

This initial exploratory study shows that while Louisiana has many of the elements of a water cluster, research did not identify a formally declared water cluster in the state. Although Louisiana has institutions that compare favorably with WaterTAP and Milwaukee in many ways, a major difference is that those two programs are dedicated, full time economic development-oriented water clusters in name and mission.

No organization or role is responsible for comprehensively managing water knowledge across all possible sectors or for developing a statewide economic development strategy specifically for water in Louisiana. This study shows that despite compelling needs, issues, incentives and talent, no entity, organization or person is responsible for knowing, connecting to and communicating about all of Louisiana's many water sectors, resources, and issues. Nonetheless, the state has strong plans, programs and organizations that could coalesce into a water cluster.

Legal responsibilities for water in Louisiana are fragmented across many agencies and entities, creating overlap, gaps, and duplication of effort, and contributing to funding and management challenges. This is corroborated by the work of the Louisiana Water Resources Commission, that of Mark Davis and the Tulane Institute on Water Resources Law & Policy, and formalized by the Louisiana State Law Institute in 2014 in its Report to the Legislature regarding Senate Concurrent Resolution No. 53 of the 2012 Regular Session (Davis 2014, Louisiana Department of Natural Resources 2012).

My research also indicates that most water clusters are in early stages of development, and there is a lack of literature on the phenomenon. I reviewed fifteen clusters in North America and several clusters in Europe and Asia. The majority of formally declared water clusters were established within the past five years. Only two of the clusters I researched were founded more than five years ago.

One of the early steps in forming a cluster is an assessment of regional assets and capabilities. This assessment process includes (but is not limited to) analyses of academic, research, business, natural resource, government, NGOs, and market strengths. Assessments can also include wider market analyses, and strategies for next steps (White

et al. 2010, Bufe 2012, Milwaukee 7 2014, Austin 2013, Davis 2011). Louisiana's *Coastal Master Plan,* and the *GNO Urban Water Plan* compare favorably to research done by other clusters, but broad assessments focused specifically on water cluster development have not been conducted in Louisiana.

Abundant natural resources, various combinations of concentrated industrial and research facilities, global marketplace opportunities, and urgent challenges or threats can all be drivers of clusters. And Louisiana is not alone in facing significant threats from rising seas, coastal land loss, or water scarcity. Such compelling issues are often cited by leaders as motivating factors for the formation of coalitions and clusters (Bufe 2012, WaterTAP 2014, Milwaukee Water Council 2013, GNO Inc. 2014a).

Water clusters are dynamic initiatives developed by private and public leaders (first-level influencers) who determine that natural resources, regional strengths and expertise in business, academia and government can be coordinated to more effectively leverage institutional, industrial, and natural assets to compete in global markets and address urgent challenges. This determination, made by action-oriented leadership, is the first step to actually forming a cluster. Methods to effectively achieve this coalescing vary only slightly from cluster to cluster. Literature shows that first-level influencers (or leaders with influence, typically from business, but political leaders cannot be ruled-out) are key to building viable clusters (Gibson and Butler 2013, Fieldsteel 2013). This initial study shows that Louisiana has potential leaders, but they are not yet purposefully acting to coalesce support to establish the state's water cluster.

Strengths in Louisiana's Water Sectors

Water is big business in Louisiana. The state's abundance of water resources and industries connected to water constitute much of Louisiana's gross domestic product. Parsing water data to arrive at accurate numbers is difficult. A complicating factor in this research is that many of these sectors overlap or are co-dependent and synergistic.

Based on spending levels, available data on economic impact, and on knowledge of plans and programs, the following list of key industries and water sectors in Louisiana emerged:

- Coastal and environmental management and restoration including flood management and surge protection systems, disaster management, and mitigation
- Sewer and water infrastructure including municipally managed urban drainage systems
- Industrial use including energy, manufacturing and flow technologies
- Agriculture and food including fisheries
- Maritime and navigation
- Law and policy
- Cultural and ecological tourism

This list is based on available data and observations of the interactions between certain sectors. For example, projects engineered to manage floods logically impact fisheries and the environment (hence mandates for environmental impact studies), but many flood and surge protection systems also impact navigation and urban drainage, and in some cases might impact industrial use. And Louisiana's identity, its rich cultural fabric, is woven by complex relationships with water; from the state's iconic seafood and cooking styles, to its swamp- and duck-themed pop culture television shows, water is the common element. Even Louisiana's globally significant musical contributions were first delivered to the world by its rich maritime legacy.

Coastal and environmental management and flood protection represent Louisiana's most pressing challenge and potentially biggest opportunity. Tens of billions of dollars in past and future spending, along with thoroughly researched plans, make this sector the top candidate for cluster development. Municipal sewer, water and drainage infrastructure in Louisiana is also a major sector representing billions of dollars of current and planned spending (Miller 2013, WBRZ 2013). Though the large-scale engineering of mostly gray infrastructure utilized by municipal and industrial water users would seem a difficult sector in which to plant seeds of innovation, emerging factors contribute to a more visionary approach in the state.

In 2013, GNO Inc. and the Governor's Office of Community Development released the Greater New Orleans Urban Water Plan (UWP), a new approach to water management based on more than two years of research by an international team led by New Orleans architect David Waggonner. The UWP shifts the paradigm of drainage away from traditional pumps and pipes:

> *Addressing today's water and soil management challenges requires a new paradigm in which stormwater and groundwater are managed as valuable resources rather than as nuisances. The Urban Water Plan outlines a 50-year program of systems retrofits and urban design opportunities for achieving a safer and more sustainable balance between ground and water. The retrofits emphasize slowing and storing stormwater rather than pumping, circulating surface water and recharging groundwater, creating vital public spaces around water, and incorporating natural elements and processes into the operation of an integrated living water system.* (Waggonner et al. 2013)

The UWP focuses on the relationships between water, soil and urban development. The voluminous sets of plans, guides, concepts, and analyses are built on new research into subsidence, soil composition and water absorption, and the roles of shallow groundwater in urban settings. The main components are divided into three sections, Vision, Urban

Design, and Implementation, with detailed drawings and financial projections on cost and benefit, including policy recommendations and procedures to accelerate adoption.

The UWP's cost-benefit analysis states that if the six billion dollars in plans are implemented, they will produce twenty two billion dollars in benefits. If nothing is done, the region faces more than ten billion dollars in consequences (Waggonner et al. 2013).

Much like the multi-billion dollar green infrastructure plans in Philadelphia (Philadephia Water Dept. 2014), the UWP seeks to install green projects that soften hard infrastructure and provide for more interactive water features that transform the relationship between people and environment from adversarial to cooperative, best expressed as "living with water." The UWP is a bold and transformational plan. Regional political leaders publicly embrace it, but are not yet taking strong steps to fulfill it. The UWP is a strength, but only if it is implemented.

Wetlands assimilation projects that use municipal wastewater to replenish degraded wetlands are also leading to new ideas and projects with the potential to become global models of best practices for sewer and water infrastructure in coastal communities (Louisiana Department of Environmental Quality 2014, Jackson and Thornton 2011, Mack et al. n.d.). Additionally, municipal drainage systems are increasingly embracing low impact design and green infrastructure principles via proposed new zoning codes (New Orleans City Planning Commission 2014), pilot projects, design competitions, and educational outreach (Benepe 2013).

In an attempt to better manage the cost of stormwater, and to help meet water quality standards to reduce pollution, drainage "utilities" are being considered by city and parish governments. These new funding mechanisms share the costs of drainage with property

owners via fees based on traditional impervious surfaces and easily calculated volume of runoff, and use incentives to encourage owners to implement new technologies and designs that work more harmoniously with natural systems (Waggonner et al. 2013, Thomas 2012). These drainage fees discourage impermeable surfaces, and reward innovation and green solutions, giving rise to new services and jobs. As validated in the GNO Urban Water Plan, the region will benefit from better water management approaches that reduce runoff by capturing, holding and even using rainwater via integrated systems that allow the water to recharge aquifers, reduce subsidence, and lower energy costs for expensive pumping systems.

Increasing pumping capacity produces less benefit than large-scale implementation of green infrastructure (Waggonner et al. 2013). Additionally, when all city operations are compared, the Sewerage and Water Board of New Orleans pumping system is the top energy user and produces the largest carbon footprint (Moore and Stone 2009).

Industrially, the Mississippi River in Louisiana is home to the largest concentration of petro-chemical refining and manufacturing in the world, many of which rely on both surface and groundwater for processing, and all of which take advantage of maritime resources and thousands of miles of pipelines crisscrossing the soft land (Elliot Blair 2006, Datamonitor PLC 2011).

Most of Louisiana's industrial sector is comprised of large-scale petrochemical operations and refineries, including more than one hundred thousand miles of pipelines within the state's boundaries. Combined, the chemical and petroleum industries are estimated to contribute more than $135 billion to the state's economy (Scott 2012, 2011). These industries are growing due to new finds of natural gas—and subsequent lower gas

prices—driving the expansion of refining and gas-based chemical and fertilizer manufacturing. More than $50 billion in new construction is planned in the corridor along the Mississippi River between Baton Rouge and New Orleans and in the Lake Charles area on the Calcasieu and Sabine waterways (Font 2013).

Electricity production, and energy extraction based on hydraulic fracturing ("fracking") both use enormous amounts of water. In Louisiana, electricity production accounts for half of all water consumption (American Society of Civil Engineers 2012). Statewide statistics on fracking are not available, but the technique is known to use from two to ten millions of gallons per well (Jenkins 2013)[5]. Industries located on major water bodies such as the Mississippi River also use large quantities of both surface and ground water, and are dealing with increasing scarcity of the latter, causing conflicts with municipal uses in the Baton Rouge area, in particular (Skains 2014).

An initiative led by the U.S. Business Council for Sustainable Development is working with Entergy, Coca-Cola and other industrial users in an effort to create a type of cluster focused on more efficient use of water by large industries (U.S. Business Council for Sustainable Development 2012). This program has potential to be an important piece of the puzzle in developing an industrial water cluster that could include innovations in flow technologies, a component of the Colorado Water Innovation Cluster (Colorado Water Innovation Cluster 2014).

Food is also a big business in Louisiana, and the state's rich alluvial soils and globally significant delta estuaries are made possible by abundant fresh water resources above and

[5] At that rate, with the approximately 2,500 fracked wells drilled in the state since 2008, total water use would range from 500 million to 2.5 billion gallons, extracted mostly in Northwest Louisiana (Sourcewatch 2013)

below the ground. In 2013, agriculture and related natural resources contributed more than eleven billion dollars to the state's economy (Richardson 2014). In fisheries, Louisiana is second only to Alaska in pounds landed, and tenth in value with nearly two billion dollars in economic impact (National Oceanic and Atmospheric Administration 2012). These sectors each benefit from dedicated state government and higher education research and resources, and are logical cluster components.

Louisiana's role in maritime industries is large and longstanding. Recent studies place the state's port system as the country's leader in tonnage and overall economic impact. Additionally, the state is third in shipbuilding (Young 2014, gCaptain 2014, WorkBoat 2014). Because of its role at the terminus of the Mississippi River watershed, and its significant contributions to energy exploration and processing, the state has a deep mix of maritime and navigation strengths, including a naval architecture program at the University of New Orleans, that constitute a substantial part of Louisiana's Gross Domestic Product.

Water's complexity is compounded by a relative lack of legal frameworks, a situation contributing to a growing number of legal cases, disputes, and demands for rights; a global reality that contributed to the creation of the Tulane Institute for Water Resources Law and Policy, and is driving the State of Louisiana to revamp the Groundwater Resources Commission into the Water Resources Commission (Davis 2011).

Tourism is one of the world's largest industries (Lindsay 2003). And it is a major industry in Louisiana. Twenty seven million visitors spent a total of more than ten billion dollars in the state in 2013, an increase over 2012 (Louisiana Department of Culture 2014). Though specific numbers regarding ecological-related tourism (ecotourism) are not readily

available for the state, ecotourism is a rapidly growing global phenomenon (Bricker 2014). Water's role in Louisiana tourism is difficult to measure, but its ubiquity in the state's tourism promotions is obvious. A sample of Louisiana tourism advertising shows seafood, swamps, rivers, and outdoor recreation prominently featured, often with a sense of humor. One recent advertisement (funded by money from the first round of BP oil spill penalties), promotes fishing by proclaiming "good things come to those who wade" (Louisiana Tourism Coastal Coalition n.d.).

Each of these sectors represents a powerful driver of the state's economy and lifestyles. Each impacts the other. All impact the environment. This paper proposes that better coordination of water management across and between these sectors is not only possible, but is necessary to sustaining the state's wellbeing. In summary, Louisiana has the plans and organizational structures in place to have a strong cluster, and if all of the state's strengths were coalesced, that cluster would represent a unique and powerful blend of assets when compared to other clusters.

Weaknesses in Louisiana's Water Sectors

The complexities and "conundrum" represented by water are succinctly expressed in this passage from the introduction of the 2012 report "Managing Louisiana's Groundwater," issued by the Louisiana Groundwater Commission (recently re-named the Louisiana Water Resources Commission):

> *Water is a conundrum, being the only natural substance that can be found in all three physical states (solid, liquid and gas) at normally occurring temperatures. It is equally enigmatic as it pertains to regulatory classification in that water is simultaneously a precious life-giving necessity, a commodity with universal utility in industry, and a nuisance to be disposed of, diverted, and controlled. As such, a hodgepodge of laws, rules, regulations, and regulatory authorities have evolved to address the complicated*

> *management of this resource. Currently in Louisiana, there are at least four federal agencies, eight state agencies, two ground water conservation districts and more than 700 local entities such as watershed districts, surface water conservation districts, reservoir districts, drainage basins, waterway commissions, lake commissions, water and sewerage districts, waterworks and recreation districts with management or regulatory authority over the resource.* (Louisiana Department of Natural Resources 2012)

Let's look closely at the above statement and its breakdown of the complexity of dealing with the legal framework of water in Louisiana. There are:

- Four federal agencies
- Eight state agencies
- Two ground water conservation districts
- 700 local entities

Balancing needs and interests, indeed, merely communicating effectively across such a broad range of public agencies is daunting; some might say impossible. The core premise of this thesis is that if Louisiana chooses to tackle these complexities via cluster models, the state will set the stage for more efficient resource management and thus build mechanisms that lead to greater prosperity and sustainability.

These disconnected agencies and institutions represent what the US Water Alliance in its 2010 report *Managing One Water* calls a "piecemeal approach" that "may have seemed logical at a time when the problems appeared unrelated" (US Water Alliance 2010, p. 5). As the cluster phenomenon illustrates, and the US Water Alliance emphasizes, there is "one water," and all its problems and challenges are related.

Clusters exist to coalesce organizations and regions into a more cohesive force, to share resources, bridge communications gaps and create a more powerful collective. A commonly used phrase by clusters—and a finding of the 2013 Nature Conservancy-Water Institute of the Gulf *Innovation Roundtable* meetings—is the need to "reduce silos" (Taylor 2014).

Louisiana's water "silos" are complicated by many longstanding regional differences that in the past proved difficult to solve. With water, there are potential conflicts for support and funding between the needs of northern and southern parishes, and between the needs of industries and municipalities. And powerful interests in Baton Rouge and New Orleans sometimes pull against each other, as each city competes to be a center of water expertise.

Old, regional differences are gradually shifting as the existential threats of coastal land loss and storm surge unite once-separate communities, and the sprawl of cities and industries blur old political boundaries as workers commute across parishes (Ortiz and Plyer 2013). As a result of recent studies of these phenomena, GNO Inc. is now promoting the "super region" of Southeast Louisiana that includes the most populous part of the state, including Baton Rouge and New Orleans (Glover 2010). Additionally, much of the research advocating for more holistic water and watershed management helps remove political barriers. This kind of new, watershed-oriented thinking helps assuage old grudges and sets in motion a better dynamic of connectedness favorable to cluster development.

Louisiana's recognition of the costs of inaction in addressing the threats of coastal land loss, rising sea levels, water security, climate change, and storms has steadily increased in the decades since the passage of the federal Coastal Wetlands Planning, Protection and Restoration Act of 1990. Though this legislation put many forces into action, as noted in the 2012 *Managing Louisiana's Groundwater* report, laws addressing the complex nature of water lack clarity in dealing with supply and source issues; most importantly, regulating ground and surface water use with regards to ownership and public rights.

In Louisiana, a lack of regulation of ground water sources in the late 1990s spawned a rush by investors to build natural gas-fired electric power plants, leading to some of the

first serious attempts to pass laws regulating water sources (Brannon 2000). More than a dozen such plants were constructed, evidently unhindered by the new regulations. Each of these gas-fired generators withdraws millions of gallons of fresh water per day, with no mandates for reuse. This sector is rich with opportunities for innovation, cost-savings, and resource efficiencies.

Abundant, clean water is vital to producing Louisiana's world-famous food and to the state's cultural riches, and water security is not a widely discussed or addressed issue. Major pollution incidents such as the BP oil spill create lingering impacts that may never be accurately measured in dollars. The state struggles with the balance between its powerful industrial interests and its natural resources. A substantial percentage of coastal land loss is attributable to oil and gas exploration and transportation (Marshall 2013). Thousands of miles of aging pipelines and thousands of abandoned wells exist in the state's waters, representing looming threats for which Louisiana is not fully prepared. Innovation in prevention and remediation technologies that address these looming threats is a logical sector upon which new businesses and jobs could be found; but not since the BP oil spill has that need drawn wide attention or support.

In 2014, both the governor and legislature aggressively dealt with some of these issues by passing legislation preventing lawsuits by public bodies seeking to spread responsibility for land loss to companies and industries (Marshall 2013). This paper cannot realistically calculate the possible consequences of this complex legal battle, but to fail to include these realities would be a disservice to any seeking to evaluate weaknesses and threats found in Louisiana's water sectors.

Water law and policy are national and international issues as important and compelling as any we face. Disputes among landowners, the general public, states and nations competing for already stressed water supplies are anticipated to create instability and conflict as the world's demographics and resources reach critical milestones (Office of the Director of National Intelligence 2012). If Louisiana effectively addresses its legal and policy framework, this weakness will become strength, validating the theme that challenges can be opportunities.

A growing number of organizations in academia, business, government and NGOs seek to address water issues and opportunities in Louisiana. A combination of causal factors contribute to this growth, ranging from increased institutional and organizational response to threats such as storms, coastal land loss, and environmental degradation; to the need to improve resource efficiencies; to parish and municipal responses (including ports) to enforcement of water regulations and laws by EPA and other government agencies. This growth is not widely monitored, connected or collected, and further represents a fragmentation exacerbated by competition for funding both within state budget processes and for grants and philanthropic support.

Though water is increasingly recognized as a key driver of the state's economy, the rise of new organizations such as the Water Institute of the Gulf and the stability of vital NGOs such as the Coalition to Restore Coastal Louisiana—the first independent NGO in the state to effectively lead coastal restoration efforts—are hampered by a lack of dependable sources of funding, a common problem also referenced in the *Managing One Water* report (US Water Alliance 2010, p. 5). Since 2008, the state's budget has been in a free-fall from which it is yet to escape. More than seven hundred million dollars have been cut from

public higher education, eviscerating departments and programs with connections to water science and research[6] (Mathis 2012, McGaughy 2013, Vincent 2011). Such disinvestment is a serious threat to the future of Louisiana, and undermines systems needed to build a strong water cluster.

Lack of leadership is also a significant weakness. The GNO Urban Water Plan represents some of the most thorough and specific research ever conducted in Louisiana. Yet regional leaders have not acted purposefully to implement it. In July 2014, Dale Morris of the Royal Dutch Embassy traveled to New Orleans to find out why the region is moving so slowly to implement the UWP, a project done with Dutch partners and investment. He delivered a serious message regarding the pace of adoption of the UWP, noting that the longer the region takes to implement the plan, the more likely it will lose its current claim of leadership, and will ultimately fall behind other regions working more aggressively to address integrated water management (Waggonner 2014).

Defining Louisiana's Water Cluster(s)

Louisiana is a water state. Water built the land, and due to a combination of human activities and sea level rise, Louisiana's coastal lands are disappearing at the rate of between twenty five to thirty five square miles annually (Climate.gov 2013). Most of the (relatively young) land in Louisiana was deposited by the Mississippi River by a process of accretion over thousands of years as its terminus meandered across the state like an out-of-control fire-hose. When humans arrived, they found organically rich soils interwoven with myriad waterways in what is often described as one of the most fecund delta estuary

[6] My job at the LSU AgCenter as an extension agent promoting best practices in the built environment, a position that empowered me to help found the Horizon Initiative Water Committee, was one of hundreds of positions cut.

systems on the planet. Further enabled by a semi-tropical climate and abundant rainfall, South Louisiana is biologically rich, but also vulnerable. The combination of river, rainfall, sea level rise and hurricanes contributes to a high-risk for the likelihood of negative impacts on human developments (U.S. Global Change Research Program 2014, Batker et al. 2010), but perception of that risk is offset by the abundance of positive factors, and by the (increasingly expensive) levees and ever-expanding flood protection systems, giving rise to current patterns of settlement and of agricultural, industrial and urban infrastructure.

Water is a key business asset driving nearly every industry (IBM 2009). Louisiana's roles in transportation, petrochemicals, agriculture, forestry, seafood, manufacturing and recreation are all fundamentally due to the combination of water, soil, geology and climate, with water being a connecting factor across all economic activities. Whether it is the state's location as the terminus of water-based transportation that carries a vast amount of the nation's agricultural exports and 20% of all water-borne shipping (gCaptain 2014, WorkBoat 2014, Young 2014), its robust groundwater resources and rainfall that nourish abundant agricultural resources, or North America's largest freshwater swamp that contributes to estuaries and coastal fisheries that supply more than a quarter of all commercial seafood landed in the lower 48 states (Batker et al. 2010), water is the single most significant commonality in the environment, and by subset, the economy of Louisiana.

However strong Louisiana's reputation is in many sectors connected to water, nothing compares to, or stirs the imagination more than the state's tragic history of hurricanes. When parsing the economy of the state's water-related industries—and their vulnerability—hundreds of billions of dollars in damages, repairs, restoration and fortification represent only the most recent impacts of a small number of storms (2013a,

2013b, Coastal Protection and Restoration Authority 2014, Blake and Gibney 2011, Forgette et al. 2009, Knabb, Brown, and Rhome 2006, Knabb, Rhome, and Brown 2005, Swenson). The upside, in the wake of these events and the billions of dollars that continue to be spent in response, is that the storm-related experiences of individuals, companies, organizations and institutions created a pool of knowledge upon which old and new ventures grew in academia, government and the private sector, capitalizing on myriad aspects of recovery, disaster management and mitigation. These relatively new developments constitute a significant component of Louisiana's nascent water cluster.

With regards to water, Louisiana is at a grand convergence of interests, resources, needs and action. The volume and diversity of scientific research of the environment—despite significant de-funding of public higher education (McGaughy 2013)—combined with the continuing growth of existing industries across nearly all sectors presents opportunities to strengthen the socio-economic fabric of Louisiana and provide a stronger tax base from which to launch water and ecosystem initiatives. However, that base is not yet evident due to the rise of anti-tax groups whose influence on the Louisiana Legislature and governor resulted in an ongoing, exponential budget drop caused by the elimination of taxes, and a refusal to pass any tax-related revenue measures for the past seven years (Moller 2012, Mathis 2012).

Louisiana's coastal and environmental management and restoration resources are coalescing into the state's logical *de facto* water cluster. Many developments and plans make this clear, including these key factors:

- Coastal Protection and Restoration Authority and the Louisiana Coastal Master Plan (CMP)

- Dedicated state and federal funding for coastal restoration projects
- Funds from the RESTORE Act and dedicated spending of fines from the BP oil spill
- The Water Institute of the Gulf (an officially designated Center of Excellence per the RESTORE Act) and plans for the Water Campus in Baton Rouge
- Academic institutes and programs focused on coastal issues, disaster management, resilience, naval architecture, engineering, and law
- Expansion of the state Water Resources Commission role in managing the legal framework of water
- Economic development organizational focus on emerging environmental and water management
- The rise of business and design competitions and challenges such as the Water Challenge, the Tulane Grand Challenge, and Changing Course
- Strong urban planning and smart growth resources in academia, NGOs and government working with thoroughly researched plans and studies such as the Center for Planning Excellence's *Coastal Planning Toolkit*
- Ongoing and growing philanthropic investment and NGO commitments to programs such as the GNO Inc. philanthropy-funded and business-led Coalition for Coastal Resilience and Economy, the America's WETLAND Foundation's family of programs, the NGO-led Mississippi River Delta initiative, and other watershed-oriented initiatives
- Ongoing U.S. Army Corps of Engineers projects, including more than $14 billion in levees, surge protection, pumps and drainage infrastructure since 2005

The Coastal and Environmental Management and Restoration (or simply coastal restoration[7]) sector is logically Louisiana's most recognized and active water cluster.

[7] On a personal note, I find the phrase "coastal restoration" to be a gross simplification that misrepresents the near-impossibility that humans will reverse climate change and land loss within the span of a few generations. However, it is the most commonly used phrase to describe all of the mechanisms involved in addressing coastal land loss and for the sake of simplicity I will use the term, but I prefer the more accurate "adaptation."

Coastal Restoration: Should It Be Louisiana's Brand?

The state's Coastal Protection and Restoration Authority is arguably the most significant and active water sector agency. The CPRA is responsible for formulating and implementing the Coastal Master Plan (CMP), and its budgets and spending are catalytic forces impacting the public and private sectors. The CMP is a $50 billion, fifty-year plan forecast to spend nearly a billion dollars a year for the next half decade (Coastal Protection and Restoration Authority 2013). Both the general public and elected officials strongly endorse efforts to combat coastal land loss (Johnson and Murphy 2014). This dynamic of need, response and support contributes to the overall momentum of the coastal restoration sector, and to the rise of new academic and private research organizations and businesses to address and fulfill both the CMP and the growing awareness that coastal land loss issues represent global opportunities to capitalize on Louisiana's investments in this sector.

The Water Institute of the Gulf (TWIG), originally funded in 2012 with money from the BP oil spill, is an

> *Independent research institute dedicated to advancing the understanding of coastal, deltaic, river and water resource systems, both within the Gulf Coast and around the world. Our mission supports the practical application of innovative science and engineering, providing solutions that benefit society.* (The Water Institute of the Gulf n.d.)

The Water Institute of the Gulf is a catalytic organization strengthening Louisiana's coastal restoration resources and "functions as a hub for innovation" (The Water Institute of the Gulf n.d.). The state's Coastal Protection and Restoration Authority, the most stably funded such organization in Louisiana, partners with TWIG for research and programming and in the construction of The Water Campus, a fifteen acre site in Baton Rouge that will house several agencies, companies and research facilities dedicated to coastal and

environmental restoration (The Water Institute of the Gulf 2013b). This development in many ways mirrors Milwaukee's Global Water Technology Park which pledges to serve as "the physical hub and brain of an international water cluster" (Global Water Technology Park 2014). A significant difference between the two is that the Water Institute of the Gulf's mission (and other statements) does not contain language indicating a desire or plan to assume responsibility for coordinating economic development, one of the two key aspects of the EPA's cluster definition (EPA 2011a). Though the Global Water Technology Park in Milwaukee and the Water Campus in Baton Rouge have many similarities, the absence of bold economic development declarations by the Water Institute of the Gulf reflects that organization's strong research and academic roots and differentiates the two endeavors.

The Coastal Protection and Restoration Authority, which funds an increasing amount of the work of the Water Institute of the Gulf, is similarly focused on its mission to restore the coast and protect citizenry who are increasingly in harm's way. Both entities are actively supporting innovation via a program to identify businesses capable of effectively performing coastal restoration work. The Coastal Innovation Partnership Program is not a competition to discover start-ups (like the Water Challenge), but does connect coastal restoration entrepreneurs and businesses by evaluating their "innovative concepts, technologies and techniques" (The Water Institute of the Gulf 2013a) to determine whether they are qualified to work with the Coastal Master Plan and the CPRA. This kind of programming fits well into how clusters operate.

The Water Institute of the Gulf is aware of the need to coordinate economic development activities focused on innovation and entrepreneurship. Recently announced findings from a collaborative Innovation Roundtable staged in late 2013 by the Water

Institute of the Gulf, the Nature Conservancy, Tulane, LSU, GNO Inc., America's WETLAND Foundation, and Coast Builders Coalition suggest that the state "form an umbrella entity to support innovators and promote innovation within and outside of Louisiana" (Taylor 2014). The final report on this roundtable has not been released, but is expected to contribute to ongoing dialog.

The Water Institute of the Gulf exhibits many of the key aspects of a water cluster. It is an applied research institute that connects a wide range of scientific, academic and business expertise in a model that seeks to do business internationally. It is self-identified as a hub, and actively seeks and reviews innovative projects and products aimed at participating in the state's coastal restoration plans. The Water Institute of the Gulf and the Water Campus plans mirror many of the themes identified in the cases. And though it hosts a Liaison Group of diverse NGOs including economic development agencies, the Water Institute of the Gulf has yet to formally state that it is focused on economic development; but it is well-positioned to do so, and lead a Louisiana water cluster.

Louisiana's largest economic development organizations are actively promoting coastal and ecosystem restoration and management as a key industry, and developed basic assessments of the state's business resources. Louisiana Economic Development (LED) the official economic development agency of the state, has a web page dedicated to Water Management that states, "forty one percent of all U.S. firm headquarters with capabilities related to Gulf Coast restoration and water resource management are located in the state" (LED 2014). But this page is brief and features a single link, to a *Forbes* article that touts the state's overall business environment.

Coastal restoration is the proverbial "eight hundred pound gorilla," but many of its most important actors are laser-focused on protecting Louisiana, not as concentrated on fundraising, economic development, or marketing the state's growing expertise to the world. However, as this thesis was nearing its deadline in July 2014, GNO Inc. announced a new initiative to address part of this problem by assembling a select, multidisciplinary group of "high level" executives to serve as a Coalition for Coastal Resilience and Economy (CCRE) (GNO Inc. 2014a). Designed to be "a unified, neutral business voice for coastal restoration," the CCRE will:

- Reiterate the build the business case for coastal restoration in Louisiana (marketing)
- Maximize RESTORE and other federal funds that are allocated to Louisiana
- Ensure that RESTORE and other federal funds are spent on their intended purposes (LA Coastal Master Plan)
- Leverage RESTORE and other federal funds to direct other revenue streams (e.g. WRDA, revenue sharing, etc.)
- Create opportunities to engage local businesses and workforce in implementation (Barnes 2014)

By gathering many top-level influencers from business in support of coastal restoration, the CCRE manifests one of the most important steps in building a cluster. And by engaging business leaders to directly participate in what has primarily been the realm of scientists, engineers, academia and government, the CCRE establishes a powerful and effective multidisciplinary dynamic to build cluster potential.

Initial funding to support the CCRE is via the Walton Family Foundation (Advocate staff 2014), a possible weakness when compared to the Milwaukee membership support model, but GNO Inc. is adept at raising funds and managing complex projects. The CCRE is a newly launched program and the organization's long-term vision and financial support plans are not yet publicly known.

GNO Inc. administered and is also supporting the Greater New Orleans Urban Water Plan (UWP), a significant and transformative body of work that is attracting the attention of municipalities in other states, and creating the potential of broader economic development impacts as the planning team exports its knowledge and skills. The UWP is an integrated water management plan that works in harmony with the Coastal Master Plan, a fact that strengthens GNO Inc. as a cluster leader and increases the organization's responsibilities to coalesce these plans into a greater water management role.

GNO Inc. continues to attract financial support to expand their work with the UWP. The agency received additional funding from the Office of Community Development and added support from the Surdna Foundation. The Surdna funds are to create "the first Greater New Orleans Urban Water Index detailing stormwater and integrated water management initiatives" (GNO Inc. 2014b). This is an assessment of plans, demonstration projects, public works projects, public or private site development, outreach or education, monitoring, and policy. Announced in June 2014, this assessment is another important step in cluster development.

With regards to asset and market assessments and development, GNO Inc. played a key role as a connector for companies and organizations in Louisiana that responded to Hurricane Sandy in 2012. The agency thus served a cluster role in tallying the economic impact of this work and connecting local expertise in disaster response to the immediate needs of an external market, in this case the Eastern Seaboard impacted by the storm. Additionally, they strengthened the region's reputation as a center of disaster management and response expertise (a water-related sector in Louisiana) when GNO Inc. Executive Vice President and Chief Operating Officer Robin Barnes served five months in Washington as

an advisor to the federal Department of Housing and Urban Development in its response to Hurricane Sandy.

In comparing the cases to the actions and programming of GNO Inc., many of the key fundamentals needed to lead a broader cluster effort are moving into place, and GNO Inc. is positioned to lead a Louisiana water cluster if it chooses to do so.

In an ideal situation, GNO Inc., the Water Institute of the Gulf, the Coastal Protection and Restoration Authority, Louisiana Economic Development, and the Water Resources Commission would work with government, business, university, and NGO partners to create an umbrella organization to facilitate a Louisiana water cluster, but someone, preferably a "first-level influencer" must take the lead in building such a coalition.

Conclusion and Recommendations

Water built Louisiana, providing the setting for one of the world's great cultural and ecological wellsprings. Appropriately, Louisiana has the opportunity to build its future on these two assets by recognizing the power of water and people. How do we start?

The first steps are being taken. However, to fully engage and transform the state into a water innovation wellspring will require new policies, laws and actions. Chief among the issues is managing water resources. Without laws and policies that protect public interests, Louisiana's water abundance could become a thing of the past. The Water Resources Commission, the Tulane Institute on Water Resources Law and Policy and the Louisiana State Law Institute's Water Law Committee are collectively advancing efforts to reframe the legal environment to more effectively manage the state's water resources (Davis 2014).

The existence of robust plans does not preclude the need for water-themed assessments similar to those done by other clusters. Broad studies of Louisiana's economic assets by McKinsey (2009) and Battelle (2012) included water management as a sector, and LED and GNO Inc. address water in their work portfolios. Additionally, GNO Inc. is expanding programming both in support of the GNO Urban Water Plan and of coastal restoration (they also lead a powerful coalition working to solve flood insurance issues). However more information is needed to ascertain the capacities and needs of existing organizations, and to more clearly understand and define Louisiana's water assets and challenges.

The next step is to build or identify an organization to connect the state's water sectors and assets. This could be accomplished by an alliance or collaborative based on a membership model such as the Water Council in Milwaukee or the Water Economy Network in Pittsburgh.

In 2013 I co-authored the *Water Challenge Action Plan* for the Greater New Orleans Foundation and The Idea Village in which the research we conducted sought to answer several key questions regarding the status of Louisiana's water sectors (Picou and Mendoza 2013). The primary objective was to determine which organizations were positioned to assume the lead role in managing the Water Challenge entrepreneurial competition, an annual event designed to "position the New Orleans region as a global hub of innovation and entrepreneurship in water management; elevate entrepreneurial opportunity in integrated surface water management; encourage innovative solutions in the water industry; accelerate the development and growth of entrepreneurial water ventures; and to

attract, engage and retain a global network to collaborate towards long-term regional revitalization in water management." (Park, Madero, and Williamson 2010)

In the *Water Challenge Action Plan* the formation of a Louisiana Water Economy Alliance (LWEA) was proposed to serve as a central organization connecting all possible water sectors and interests. In parallel to this recommendation, in the initial findings of the Innovation Roundtable led by The Nature Conservancy and the Water Institute of the Gulf, the need to "build an umbrella organization" was called "the biggest thing to come out" of those meetings (Taylor 2014). But, as noted in EPA's water clusters program website, first-level influencers are needed to lead, and with regards to building a broad, statewide water cluster, such leadership is not apparent in Louisiana.

Funding for water innovation represents an ongoing challenge. Currently, philanthropy is taking a lead in many significant efforts in Louisiana. The Greater New Orleans Foundation funds the Water Challenge business competition, and the Baton Rouge Area Foundation is the main founding partner of the Water Institute of the Gulf, and also the real estate developer of the Water Campus. If an "umbrella organization" like LWEA is to be formed, it must be funded, and dependency on state government for startup money is not only unlikely, it is unwise. A membership model similar to Milwaukee's or Pittsburgh's is strongly recommended.

A coordinating entity would provide the framework for the development of water clusters across a wide range of interests, locales and age groups by providing guidance, communication and support for water-related initiatives. The entity would serve as a connector, a hub, a repository and a wellspring for information, news and opportunities. By structuring it as a multidisciplinary entity with a primary mission of coalescing water

knowledge and activities to maximize positive economic, environmental and social impacts, this entity would help Louisiana build a "culture of innovation" in which citizens of all ages are encouraged to seek solutions to the state's water challenges.

An important early step to build support for an umbrella organization is to celebrate water statewide via a series of events during a designated "Louisiana Water Month" and a "Louisiana Water Week." These events are proposed to inspire school science fairs, youth organizations such as Junior Achievement and scouting groups, and regional economic development entities to build competition models celebrating science and entrepreneurs. Regional programs would be designed to feed-in to a statewide final series of events such as New Orleans Entrepreneur Week or a similar major program. This system is intended to empower scientists and entrepreneurs of all ages; stimulate new policies, research and jobs; and seed innovation across the state. Regional small business development agencies, chambers of commerce, academic institutions and NGOs all have significant interests and roles in the successful implementation of such a system.

Louisiana Water Month and Louisiana Water Week provide broad banners under which even the smallest town, school, or youth group could participate in building a sustainable, resilient future for the state. This dynamic is a powerful tool for education, community engagement, career building, and innovation. It strengthens the state's economy by empowering all citizens to be part of the solutions to the urgent and vexing challenges we face. And it reconnects Louisiana to the landscapes and waters that define us to the world. But most of all, it connects us to each other as we strive to protect, preserve and thrive in this amazing and inspiring place.

Will it take a new organization to elevate and build Louisiana's water cluster potential? If not a new organization, which existing entity should lead? And who is or will be the first-level influencers to catalyze support no matter which of these options is pursued? This initial study shows that internal and external forces are growing to support Louisiana's efforts, but many challenges persist, the most significant being the need for bold leadership to recognize and fund a more cohesive, holistic, and collaborative water agenda.

Louisiana is at a crossroads. We can continue with our reactive, piecemeal approach, or we can coalesce into a more dynamic, proactive state, working together to leverage our expertise and renown across our many water sectors. We can join the vanguard or we can fall behind. It is time to make that decision.

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Appendix A

Research Data

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Appendix B

Interview data: interviewees by profession

Profession	Number of Interviewees
Academia	3
Architecture	1
Cluster Development	3
Coastal Restoration	3
Economic Development	11
Engineering	3
Entrepreneur	6
Law	3
Philanthropy	1
Planning	4
Resilience	2
TOTAL	**40**

Vita

Stephen C. Picou is a native of Eunice, Louisiana and a resident of New Orleans since 1991. He is an accomplished musician and was inducted into the Louisiana Music Hall of Fame in 2013. From 1992 to 2005 Steve served as Assistant Director of the Louisiana Music Commission, an entity within the state's economic development agency. In 2007 he was certified by the Residential Energy Services Network (RESNET) in Home Energy Rating Systems, and was a founding member of the team behind South Coast Solar, now the largest solar company in Louisiana. Steve then spent nearly 5 years as an extension agent with the LSU AgCenter where he promoted climate-appropriate building practices as the region rebuilt post-Katrina, and focused on sustainability, resilience, and growing the green economy.

Along with his partner Grasshopper Mendoza, in 2009 Steve co-founded the Horizon Initiative Water Committee; and, with the Greater New Orleans Foundation and The Idea Village, they co-founded the Water Challenge entrepreneurial competition, which they managed from 2010 to 2014. In 2012 Steve and Grasshopper formed NOLA Vibe, a strategic sustainability consultancy working in real estate, water, economic development, music, and social change.

Steve earned a Bachelor of General Studies from the University of New Orleans in 1994. He is a 1995 Fellow of the Loyola University of New Orleans Institute of Politics and a 2010 Fellow of the Loyola University of New Orleans Institute for Environmental Communications.