WATER RISKS & OPPORTUNITIES IN NORTH CAROLINA’S TEXTILE INDUSTRY:
A MANAGEMENT GUIDE

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Masters Project submitted in partial fulfillment of the requirements for the Master of Environmental Management degree in the Nicholas School of the Environment of Duke University 2013
ABSTRACT:

Textiles have been a critical driving force in North Carolina’s economy, identity, and history. Textiles have always depended heavily on North Carolina’s water resources, evident when one realizes that much of North Carolina’s water infrastructure was built around thriving textile operations. However, North Carolina faces increasingly tangible challenges as we look to the future. Climate change and related droughts, along with a growing population and associated demand impose pressures on our precious water supply and the infrastructure that treats it and delivers it. Textile firms in North Carolina face risks that stem from these challenges. Water scarcity, interruptions in supply, or degradation in quality can pose catastrophic impacts for an industry where water is the lifeblood of its operations. I incorporate findings from literature, interviews, and plant visits to develop an understanding of water related issues the industry faces. These sources suggest that the textile industry in North Carolina is characterized by overwhelming heterogeneity and a preliminary finding emerged that a more engaged approach will be required. I conclude by proposing a process-based, strategic engagement approach founded on principles and an operational framework for addressing water issues: collaborative engagement, the real opportunity.
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INTRODUCTION

Textiles have been a critical driving force in North Carolina’s economy, identity, and history. Textiles have always depended heavily on North Carolina’s water resources, evident when one realizes that much of North Carolina’s water infrastructure was built around thriving textile operations. Today, in the midst of a globalized economy, textile operations can represent the single greatest consumers of water in certain municipalities, demanding millions of gallons of clean water every day. An adequate and dependable supply of quality water is necessary for the future of textile mills and the communities they call home.

However, North Carolina faces increasingly tangible challenges as we look to the future. Climate change and related droughts along with a growing population and associated demand impose pressures on our precious water supply and the infrastructure that treats it and delivers it. Textile firms in North Carolina face risks that stem from these challenges. Water scarcity, interruptions in supply, or degradation in quality can pose catastrophic impacts for an industry where water is the lifeblood of its operations.

My master’s project (MP) examines how the textile industry should respond to increasing concerns about water shortages. I incorporate findings from literature, interviews, and plant visits to develop an understanding of water related issues the industry faces. These sources suggest that the textile industry in North Carolina is characterized by overwhelming heterogeneity. There is also significant heterogeneity among watersheds in which these textile plants are located. This heterogeneity demands a holistic approach in crafting a guide for North Carolina’s textile industry to address water issues. Taking a holistic approach led to developing a process based direction for firms to take that is focused on engaging collaboratively in local water issues, where water is best managed.

This engagement is by no means foreign to the industry. It is a language many firms used to speak fluently. Challenges associated with textile related wastewater toxicity in the 1980’s brought a successful, collaborative, dialogue based approach to problem solving. Engagement in local water issues resulted in a reduction of textile-associated toxicity proving it as a viable approach. Unfortunately, this is a forgotten language. The industry stands fragmented and unengaged but in the same breath holds incredible potential. The language must be revived. This master's project presents a strategy for North Carolina textile firms to relearn this lost language of engagement and begin a new conversation focused on this century’s, and future, water challenges that hold particular relevance to North Carolina’s textile industry. It serves as the backbone of a document the North Carolina Sustainability Center seeks to develop aimed at addressing water related risks and opportunities for North Carolina’s textile firms.
The remainder of this MP is organized as follows. I first present a brief overview of the textile industry in North Carolina, provide current information from a global perspective of water resources, explain the basics of North Carolina’s water resources, and provide an overview of the role water plays in the textile industry. I then present the methods used to assess water challenges and opportunities for the textile industry in North Carolina. These methods lead to a preliminary finding that a more engaged approach will be required. I then look at how engagement on water issues has happened historically, and what lessons can be learned from this history. Finally, I propose a process-based, strategic direction for mitigating risk: collaborative engagement, the real opportunity.

THE TEXTILE COMPLEX | BRIEF OVERVIEW

Historically, North Carolina was a leader in textiles. The state continues to rank number one in textile production nationwide (Frederick et al. 2007). However, globalization has restructured the industry and induced significant change. In the late 1980’s and 1990’s, companies began to move offshore for cheaper labor and more lenient environmental regulations (S. Moore, Interview 2013). The passage of the North American Free trade Agreement (NAFTA) in 1995, and globalization trends spurred the movement of textile firms to regions of the world other than the United States and North Carolina (S. B. Moore and Ausley 2004). The end of the World Trade Organization’s Agreement on Textiles and Clothing in 2005 enabled firms to officially look across the globe for potential production sites (Frederick et al. 2007). 500,000 textile jobs and 414 textile plants were eliminated from the United States during the late 1990’s (S. B. Moore and Ausley 2004). From November 2001 to November 2012 North Carolina experienced a 6.9% decline in job growth rate for textile mills and a 4.5% decline in the growth rate for apparel concerns (“North Carolina - Update January 2013” 2013).

Although the industry is changing, North Carolina continues as a leader in the textile and apparel complex of the United States (Frederick et al. 2007). As of 2007, North Carolina accounted for more than a quarter the US textile and apparel employment and serves as the global headquarters for a number of firms (Frederick et al. 2007). In 2010 there were 63,164 employees in textile and apparel manufacturing, and 1,945 textiles related businesses in the state (Griner 2012). 91% of these firms are privately held (Frederick et al. 2007). Figure 1 provides a map of textile firms. As is evident from the map, textiles are highly concentrated in the Piedmont and western North Carolina, with many fewer facilities in the Coastal Plain.
**Figure 1: Textile Facilities**

This map shows textile facilities across the state. Notice the particular clusters of firms in the Piedmont, the Charlotte area, and western North Carolina. This information graphic can be accessed at:

Frederick et al. (2007) recommends that the textile industry should be looked at as the complete value chain. This value chain should encompass more than textile mills but other value adding aspects as well. This total value chain is known as the North Carolina Textile Complex and is depicted in Figure 2.

**Figure 2: Textile Complex Value Chain**

Stacey Fredrick, a referenced author in this MP, developed this value chain model. This project focuses on wet processing, which is found in the Textile Manufacturing segment of the model, represented in the color brown below. This information graphic can be accessed at:

http://www.nctextileconnect.com/value_chain.cfm
A PRIMER ON WATER RESOURCES

THE GLOBAL PICTURE

Oki and Kanae (2006) report that water resources will not diminish on shorter than geological time scales and that increases in renewable fresh water will most likely out pace world wide demand for water. Climate change is expected to produce quicker hydrological cycles leading to increases in water availability (Oki and Kanae 2006). With this in mind, the authors pose an important question “Given this background, how could water scarcity become a widespread reality within a few decades?”. The answer relies on the fact that only about 2.5% of Earth’s water is fresh, and of that 2.5% only a small fraction is accessible (Oki and Kanae 2006). The answer should also consider the increased likelihood of extreme events, population growth and the high variability of water resource availability across time and space (Oki and Kanae 2006). The world is not running out of water, but climate, droughts, and seasonal variation contribute to extreme events (WBCSD 2009). The result of these extreme events is water not always being where industry, people or the environment needs it. This is key, especially for textiles that depend on an uninterrupted supply of water. Although climate change’s impact on the hydrologic cycle are not clearly understood, likely impacts include: a more volatile hydrological cycle, modification of seasonal variation of available fresh water, degradation of water quality, and more intense and intermittent precipitation that increase the risks of floods and droughts (Oki and Kanae 2006). One clear take away is that climate change adds uncertainty to the challenges of managing water resources (“Water Resources Management | World Bank – Water”).

The impacts of climate change do pose problems, but interestingly, Vörösmarty et al. (2000) concluded that population growth, and increased demand worldwide will influence water scarcity and availability more heavily than climate change alone. Not only is population growth problematic, but where the growth is happening, the urban setting, is also important. Developed nations have high urbanization rates, for example, the US is around 80% (Pickett et al. 2008). Acquiring adequate freshwater resources is a growing concern in the United States, even in areas abounding with water resources (Jenerette, Marussich, and Newell 2006). Half of the world’s population lives in cities and all projections show increased urbanization (Jenerette, Marussich, and Newell 2006). Adding to the complexity and challenges of managing water resources, is the lack of attention and research focused on municipal water supplies (Jenerette, Marussich, and Newell 2006). North Carolina faces similar challenges. These challenges, specific to North Carolina, are discussed below.
North Carolina

North Carolina is generally assumed to be “water rich” with abundant water resources (N.C. DENR et al. 2009). The state receives about 48 inches of rain per year (N.C. DENR 2001). However, water resources in North Carolina are not immune to risks. The assumption of “water rich” is dangerous. Population growth is increasing the demand for water. From the 1990’s to late 2000’s North Carolina’s population has increased at approximately 38% (N.C. DENR et al. 2009). Growth in water supply is far behind (N.C. DENR et al. 2009). In 2001, The State Water Supply Plan reported that North Carolina was already starting to see water shortages and increased competition in areas where natural availability is not as high. The same 2001 plan reported that the headwaters of the Piedmont river basins and aquifers of the Coastal Plain are already experiencing supply problems. The Southeastern United States will likely have to deal with more intense precipitation events and more severe droughts (US EPA 2013). Projections of climate change impacts for North Carolina include a very high risk of sea level rise, and the very high likelihood of experiencing increased droughts (“Climate Change Initiative” 2013). Figure 3 below represents areas expected to undergo increasing drought conditions.

**Figure 3: Drought Trends**

This map shows observed drought trends. Increasing drought trends are shown in the color brown. This information graphic can be accessed at: [http://www.epa.gov/climatechange/impacts-adaptation/water.html](http://www.epa.gov/climatechange/impacts-adaptation/water.html)
These events can put pressure on water supply systems and treatment facilities. Climate change will likely require our water supply infrastructure and wastewater treatment systems to effectively manage challenges associated with swings in availability due to drought, and challenges related to heavy precipitation (Auguste 2013).

North Carolina’s climate is cyclical and is characterized by periods of abundant rain and extreme droughts. Since the 1700’s, the state has experienced 11 four year droughts ([Ortega 2008] cited in N.C. DENR et al. 2009). The most recent, notable drought the state experienced was in 2007. During 2007 and 2008, all counties in North Carolina experienced drought conditions (EPA Water Sense 2010). Many streams across the Southeastern United States were estimated to be 25% or less of their average flow, while groundwater levels suffered as well (Pickle, Rogers, and McCue 2008). The vast majority, 97%, of water sources for North Carolina are surface sources including rivers, lakes, and streams (US Geological Survey cited in N.C. DENR et al. 2009). With degradation in water quality and more seasonal variation in available fresh water, North Carolina could face problems considering its dependence on surface waters. Even if we take climate change out of the discussion, North Carolina’s vulnerability to extreme events is reason enough for businesses and communities to pay careful attention and plan accordingly (“Climate Change in North Carolina | State Climate Office of North Carolina” 2013). It is important to note that these global and regional trends do not always apply on a finer scale. Water is a local issue and is best managed as such (N.C. DENR 2001).

**WATER & NORTH CAROLINA TEXTILES**

Every business depends on water. Future business success, especially in the textile industry, is impacted by the availability, cost, and quality of water (WBCSD 2006).

Water is a critical input for textile production. The most intensive water use is in wet processing: dyeing and finishing. Figure 4 below shows images of these processes at textile firms in North Carolina. This MP focuses on the wet processing, a part of the Textile Manufacturing segment of the value chain depicted in Figure 2 above. Figure 5 below shows a map of wet processing facilities across North Carolina. As is evident from the map, wet processing facility locations follow the same pattern of concentration as the entire Textile Complex observed in Figure 1 above. The vast majority of fabrics go through at least one of these processes (S. B. Moore and Ausley 2004). Moore and Ausley (2004) report that even though there has been 100 years of process improvements wet processing still requires large volumes of clean water. The majority of textile facilities source water from
municipal supply, although a rare few textile facilities do pull water from underground wells depending on geographical location (Walker, Interview 2013).

Water consumption for fabric finishing can range from one half of a gallon per pound produced to 112 gallons per pound produced in finishing felted fabric (US EPA 1996). Dyeing cotton can use up to 100 liters per kilogram of cotton dyed (“Textile World - Sustainable Dyeing And Finishing” 2013). Water use in the industry varies widely depending on the process, the plant, equipment, and management philosophy (US EPA 1996). The specifics of water use get cloudy when looking closely at textile firms in North Carolina. Often there are big misses in the measurement of water consumption (Textile Expert 1, Interview 2013). Exact data is scarce, while figures and metrics differ across firms and facilities. Water is measured into textile facilities through the supply meter. Occasionally, water is measured out of the facility, but includes domestic waste, in addition to process water. Finally, water is unlikely to be measured at the actual equipment, where we lose, what might otherwise be, a clear picture of consumption. As mentioned above, 91% of the firms in North Carolina’s Textile Complex are privately held (Frederick et al. 2007), which presents problems for acquiring data. Cost is a major barrier here. The experts I interviewed noted that firms do not make money through measuring water this closely (Information on interviews conducted can be found in the Methods section of this project). Firms need incentives to act. In general the industry is reactive in nature, not proactive. This is the limiting factor in measuring water inputs and outputs more closely at the equipment and process level.

**Figure 4: Wet Processing Images**
*Images of wet processing in mills across North Carolina.*
Figure 5: Textile Wet Processing Facilities

This map shows locations of wet processing concerns in North Carolina. The concentration of firms follows the same pattern as shown in Figure 1 above. Concentrations are in the Piedmont, Charlotte area, and western North Carolina. This information graphic can be accessed at:

Wastewater leaving these wet processing facilities is complex and production dependent (Water Manager A, Interview 2013). There is considerable heterogeneity. It can change from plant to plant and day to day. Total suspended solids (TSS) are typically low in wet process wastewater. However, biological oxygen demand (BOD) and chemical oxygen demand are of concern (US EPA 1996). Priority areas of pollution prevention in textile wet processing include BOD, COD, temperature, pH, metals, and water volume used (US EPA 1996). Overall, treatment of textile wastewater is mature and well developed. However, some pollutants (color, electrolytes, low metals, and aquatic toxicity) are difficult to treat with existing treatment methodologies (US EPA 1996). For these, prevention, not treatment, is key.

Water as a resource, and as an input in manufacturing processes is the lifeblood of operations. From a business standpoint, it will become an even more important issue of focus in the future considering challenges brought about by water shortages, climate change, and population growth.
THE BROAD BUSINESS TRENDS

Resource limitations will demand a new thought process as resource based limitations impact productivity and overshadow traditional limitations, such as labor (Accenture 2013). “The state of our planet in a 4°C warmer world will have disruptive impacts on water resources” (Kyte 2013) that many businesses depend on. From a global perspective, water shortages are likely, and there are business opportunities and risks associated with those shortages (Westervelt 2013). These risks are physical, reputational, and regulatory. Deloitte (2012) reported that globally, water demand is expected to outstrip supply by 40% in the year 2030 taking a business as usual approach. In the same report it was noted that the drought in the US in 2012 was the largest declaration of a natural-disaster by the US Department of Agriculture and resulted in wide spread repercussions. These are warnings that a more careful consideration of water is inevitable.

Reducing Risks and Driving Business Value, published by the Carbon Disclosure Project, written by Accenture, is a report that aims to drive action on climate change and supply chains. Over 2000 companies responded to their information request. 70% of member manufacturing firms perceived increased supply chain vulnerabilities due to physical activities such as water shortages (Kyte 2013). Interestingly, more than half of the member firms involved in the study ranked water related risks high or medium. However, only a quarter of the participating firms are engaged in work to identify and mitigate these water related risks. Moreover, more than 50% of the participating firms’ suppliers are unaware or are not engaging in mitigation strategies.

Another report by the Carbon Disclosure Project, authored by Deloitte (2012), was focused on water and business (See Deloitte [2012] for details on the study and more information). The most important findings from the report follow. Risk management of water related challenges and the awareness of these challenges is lacking in the broader business world. They reported that 36% of responding companies across the nation are unable to state risks in the supply chain related to water. The report concludes that the “full extent of vulnerability to supply chain risk is not well understood” (Deloitte 2012).

NORTH CAROLINA

How does North Carolina fit in with the narrative above? What water issues do textile firms in North Carolina face? Specific impacts, risks, opportunities, and management philosophies combine to produce unique challenges for North Carolina’s textile firms. To uncover this information I went straight to the industry and conducted interviews. The following combines information from
published literature and on the ground research with firms, experts, and water management officials to illuminate the picture for North Carolina and its textile firms. The aim of this MP was to go beyond simply uncovering the issues. With this in mind, the following description of methods and findings precede the discussion of a proposed strategic, process-based, actionable way forward.

**METHODS**

The methods used in this report are snowball interviews and literature reviews. I wanted to gain an “on the ground” understanding of what firms and the industry are doing with regards to water risks and opportunities from a business perspective in North Carolina. The snowball process was extremely informative and delivered information not found in literature.

The snowball interview approach filled the gap between the more broad based literature and specific industry knowledge on local issues related to North Carolina. The snowball approach consisted of “seeds” to begin the snowball process with each interviewee leading to another potential respondent. The seeds were based on geography, different aspects of the textile value chain (dyeing, finishing, weaving...) water treatment and supply, and experts from academia and industry. As the snowball process proceeded the different seeds began to overlap as I was referred to another firm, expert, or treatment works, and supply facility. The interviews began with officials at textile firms and it became apparent that understanding the water supply and treatment side of the picture, and issues external to the firms, was vital. It also was apparent that information from experts in the industry with knowledge of North Carolina’s Textile Complex would be just as critical.

I developed four interview instruments for the foundation of the interviews. I developed two Firm Level instruments crafted for respondents at textile firms. One had a focus on management and strategy. The other focused on manufacturing process specific issues. The two instruments were necessary depending on the role the respondents played in the firms. I developed one Industry Level instrument crafted for industry experts. Finally, I developed a Water Manager instrument crafted for officials and experts at supply and treatment work facilities. The instruments can be found in Appendix A, B, C, and D, respectively.

Through mutual respect and agreement, the firms, officials, water managers, and respondents requesting it are kept anonymous in this MP by all efforts possible. Where allowed, I recorded the audio content of the interviews. I either took detailed notes or transcribed the interviews in whole or in part to analyze the data collected, generate the findings below, and gather the insights incorporated throughout this project. The focus of the interviews was on firm processes, water use, water treatment, business risks etc. Because no questions were asked about the
respondents personal preferences, demographics, or opinions it was determined that humans were not the subject of the research, and hence the research did not require IRB approval.

I interviewed 15 officials at 8 textile firms across North Carolina that are, in some capacity, involved in wet processing. The firms are referred to as Firm A, Firm B, C, D, E, F, G, and H in the following discussions. The interviews were either by phone or in person. The roles of the interviewees ranged from Sustainability Manager, Sustainability Engineer, Production Manager, Strategic Professionals, Upper Level Management, Dye House Manager, Process Employees, and President. The interviews resulted in five plant visits. The plant visits gave me an opportunity to understand and see first hand the manufacturing processes, firm culture, and challenges the firms face. The findings from the firm based interviews are discussed below, in the Findings from Interviews section.

I interviewed four water managers on both the treatment and supply side of water infrastructure in the Piedmont and western region of the state. Water managers are referred to as Water Manager A, B, C, and D. In instances where specific information gleaned from an interview with a water manager is incorporated in a discussion in this MP, the interview is listed in an in-text citation as "Interview, 20XX" and not listed in the References section. These interviews provided a valuable understanding of issues from an external viewpoint relative to the firms.

I interviewed five experts from industry. Three of the five expert respondents were willing to be identified in the work. The respondents willing to be identified are Bill Gerrow, Roger Walker, and Dr. Sam Moore. Bill Gerrow is President of Performance Textiles, Inc. in Greensboro. Roger Walker is VP of Manufacturing at Performance Textiles, Inc. Dr. Sam Moore is Manager of the Hohenstein Institute America and Instructor at North Carolina State University. Two other experts were not willing to be identified. The knowledge gleaned from the industry expert interviews is presented throughout this MP and noted with in-text citations as "Interview, 20XX". The anonymous expert respondents are referred to as Textile Expert 1 & 2. These interviews are not listed in the References section of this MP. The industry experts interviewed had combined experience of over 120 years in the industry.

A discussion of findings from the interviews conducted with firm officials and water managers follows. Then, these findings are woven into a following discussion of their implications.
FINDINGS FROM INTERVIEWS

FIRMS

All firms interviewed had wet processes in their production on some level. When discussing business risks associated with water, all firms reported physical risks as being the most threatening. Physical risk are described further in following sections of this MP, but include droughts, water scarcity and interruptions in water supply. These risks are intuitive and can be catastrophic for a textile mill. Although Firms A, B, D, and E reported having overarching environmental strategies, no firm had specific strategies in place to address physical risks. Firm B mentioned “It was easy in the past you could just send it to another part of the state not experiencing a shortage”. However, as mentioned throughout this MP, those links are fragmented and the textile community is not as strong. One firm drilled wells in the past, however those wells have run dry. There seems to be a lack of attention throughout the industry concerning physical risks. Comments included “we’re blessed with cheap water” from Firm C, and “North Carolina is water rich” from Firm D. Both convey possible reasons for this lack of attention.

Only one firm, Firm E, reported that water is measured throughout the supply chain due to customer demand. However, these figures are difficult to develop. Perhaps this is due to the misses in measurement described in Water & North Carolina Textiles above. All firms were aware of their water usage from the supply side of the equation and water service bill. However, these figures do not represent true usage in the process (again, see Water & North Carolina Textiles above). Firm E also reported that selling price is key and can quickly outweigh customer-buying decisions based on water usage.

Firm H is the only textile mill interviewed that receives water from sources other than a municipality or public supply, as the vast majority of the industry does. They secure water from a river, treat the water to near potable quality, treat their wastewater and directly discharge the water back to the river. Firms A, B, C, D, E, F, G are all indirect discharges, their wastewater goes to a publicly owned treatment work (POTW). All firms reported that regulation specific to water does not pose a significant impact on their business, however Firm H, a direct discharger, faces more regulatory issues than the indirect discharges.

Firms B, D, and E reported that key drivers for measuring water quantity and quality are product consistency whether it’s dyeing operations, finishing operations; efficient loom operation; internal sustainability drive from management; and less common: customer demand. Cost of water, at the time of this report, is not a driver and was not seen as a risk, as it is with other utility expenses,
such as energy. Energy costs do come into play with water indirectly, as heating water for dyeing or making steam is expensive. Solar panels and holding tanks are costs drivers from this perspective.

Reputational risks, described in the following Implications section of this MP, were not reported as posing a significant risk. Generally, textile mills are multiple links upstream from the end consumer, so visibility, by the consumer, is less significant.

**Water Supply and Treatment Entities**

The issues facing treatment works and suppliers of water are spatially dependent. Facilities are not the same in terms of what amount of contaminants they can handle without infringing on stream standards or capacity. All water managers reported that textile wastewater is not as problematic as it used to be when the industry was larger; in fact, the loss of industry can have negative engineering impacts (explained below in Implications). As my findings with the firm interviews suggest, Water Manager C reported that the majority of textile firms in North Carolina are indirect dischargers: “It is too expensive to treat your own waste”.

Water Managers explained that the main contaminants and challenges with textile wastewater in North Carolina are: metals (chromium, zinc, copper), conductivity, chloride, pH, color, and flow rate. Many large consumers of water have flow equalization tanks. Water Manager C reported that few firms have effluent flow meters, while Water Manager D reported that it is often the case that firms do not have the capital for installation, maintenance and monitoring of effluent flow meters. These meters, as mentioned above in Water and North Carolina Textiles, measure a combination of process wastewater and domestic wastewater. Water Manager D reported that in the vast majority of situations the plumbing in textile mills was not engineered to separate the two streams. Water Manager C reported that the cost associated with treatment and water supply is increasing. Water Manager C also reported mandatory conservation measures focus on maintaining water for hospitals and residential use first. Industry is an afterthought in extreme situations. Water Managers C and D reported that surcharges could incite firms to look more carefully at conservation, chemicals used, and processes. All Water Managers reported reduced flow and reduced revenue as a result of textile firms exiting North Carolina.

**Critical Takeaway**

The overall critical takeaway from the interviews is a sense of heterogeneity in the industry and in water management. Each firm has a different culture, produces different products, has
differing competing projects, has a different cost of capital, uses different chemicals, has different equipment, receives water from different sources, sends their wastewater to different places, etc. Water management issues are also heterogeneous across the state: stream standards differ, treatment works and the supply side are managed differently, the capacity of treatment works differs, the demand of water differs, prices and rate structures differ, sources of water differ, management cultures differ, capital differs, etc. This sense of heterogeneity plays a critical role in this MP and poses a unique challenge for crafting a recommendation for addressing water issues.

The following section examines the implications of the findings from interviews and incorporates information from literature to develop a background and form the foundation of a recommendation for moving forward.

IMPLICATIONS

NORTH CAROLINA TEXTILES & WATER INFRASTRUCTURE

The Textile Complex impacts the water supply and treatment infrastructure as well as the environment. The water infrastructure in many parts of the state was built up to accommodate and anticipate a thriving textile industry. As the industry globalized the burden of textile wet processing wastewaters on POTW were reduced. Interestingly, environmental research on textile wastewaters declined drastically (S. B. Moore and Ausley 2004). Through the 1980’s, 90’s, and finally in the 2000’s as firms exited, some of the supply and treatment facilities were facing new challenges from impacts based on reduced flow and reduced revenue. One respondent estimated that in the height of textiles in North Carolina 50% of the wastewater flow treatment facilities received was from textile operations. They went on to estimate that that figure is likely reduced by 90% to 95%. This loss of flow can augment how the infrastructure, from a supply and treatment standpoint, operates (Textile Expert 2, Interview 2013; Water Manager A and B, Interview 2013). As textile firms exited it was not uncommon to lose 2 million gallons a day. “It has been a time of great change,” noted one respondent. Municipal supply and treatment works relied on textile firms for flows and for revenue. Often textile firms were heavily involved in their planning. That is not the case in the present.

These challenges can seem counterintuitive in a sense, and are difficult to uncover. One might think that since the textile industry effluent is reduced from an environmental standpoint we are better off. This might not always be the case when viewing the full value chain as a virtuous cycle. Depending on the location, reduced flow can negatively impact the treatment works from an engineering perspective and the supply infrastructure from a quality perspective. If water supply fails to be turned over it can cause problems from a quality and safety viewpoint. This same reduced flow can cause engineering challenges in treatment plants. It is harder to operate an under-loaded
plant (Water Manager B, Interview 2013). Water Manager A mentioned, “This is a food product that we’re supplying to people and quality can be compromised from reduced flow.” The same respondent explained: “The supply systems protect people from the environment and the treatment works protect the environment from people, both of these have been impacted by the exiting of textile and apparel firms.”

It is necessary to realize that each drinking water plant and treatment plant is different as noted in the interview findings above. Engineering aspects are different, capacities are different, headworks analysis is different, even the microorganisms in the facilities adapt to the local water quality issues. Again heterogeneity is a critical facet of this project. Below is a discussion of the implications for North Carolina’s textile firms.

**North Carolina Textile Firms**

**Risks**

The following is not an exhaustive explanation of risks that North Carolina textile firms face concerning water. Although the most threatening risk identified, and the focus of this MP, is physical risk, the following discussion is presented for completeness. Every firm faces different risks and the nuances of those risks are unique to each firm and location. The risks associated with water and textile firms in North Carolina resemble those noted above in the section: The Broad Business Trends. These include physical, reputational and regulatory risks.

Reputational risks are an interesting and dynamic issue for North Carolina’s textile firms. The target seems to be on the back of firms manufacturing over seas (S. Moore, Interview 2013). As mentioned in the interview findings, the further firms get from the end consumer the less risk they see from a reputational standpoint. Two issues must be addressed with that thought process. On a local level, a stained river in a community is not acceptable business practice. In the broader context, customers may see demand and risks based on the end consumer. Often, data must be reported on water consumption, but price remains the primary criteria and driver for obtaining business. One responding firm noted that selling price overrides decisions in the relationships between supplier and customer.

Although businesses around the globe face regulatory risks, North Carolina’s story is unique. One firm specifically reported that regulatory risks do not impact them on a significant basis. Regulatory risks are not on the radar of most firms. One reason is that as environmental regulations were being passed in the 1970’s the textile industry had a very powerful lobbying effort that kept
them clear of many national and state level environmental regulations that would have been targeted at the textile industry (Water Manager D, Interview 2013). Perhaps another is that, in the vast majority of situations, firms do not treat their own wastewater. As explained above, “The cost to do so is too high,” noted Water Manager C. However, there are two regulatory issues that should be on the radar of textile firms in North Carolina: Drought management and response, and proposed reductions concerning metals limitations.

Mandatory drought management plans are of issue. These plans allocate water to hospitals and residential uses first (Water Manager C, Interview 2013). Localities are required by the state to develop these plans. There are also cases where supply cutoff provisions are written into permits. Many textile firms operate under these permits, as Significant Industrial Users (SIU).

The vast majority of textile firms involved in wet processing in North Carolina are SIU’s and indirect dischargers (Water Manager D, Interview 2013). Significant industrial users are identified as industrial users that discharge 25,000 gallons per day or are allocated a certain percentage of a POTW’s headworks allocation. The local water management entity issues a SIU permit to the indirect discharges in the textile industry in North Carolina. North Carolina, as required by the Clean Water Act, reviews its surface water quality standards every three years, known as the Triennial Review. In 2010 North Carolina’s Division of Water Quality proposed new Water Quality Standards for metals. These metals are important in textile wet processing. The new standards are much lower than current standards (“N.C. DENR - Pretreatment” 2013). The proposed changes to the standards reflect dissolved metals concentrations and the additions of acute and chronic standards (“N.C. DENR - Surface Water Triennial Review” 2013). In the interviews conducted, respondents at publicly owned treatment works and industry experts mentioned that these standards could have significant impacts on the Textile Complex and treatment works (Water Manager C and D, Interview 2013; Textile Expert 1, Interview 2013). In an assessment on the economic impact of the new lower limits proposed for metals, the North Carolina Pretreatment Consortium noted that many Significant Industrial User Permits (SIU) permits will have to be adjusted to avoid over allocation of allowable headworks at treatment facilities. Firms may face the reality of meeting lower permit levels, new or additional pretreatment requirements, or even no allocation available for a certain metal parameter (North Carolina Pretreatment Consortium, Inc. 2007). Zinc is one of these metals and, interestingly, much of the plumbing in textile facilities is galvanized steel, which can leach zinc into water (Water Manager D, Interview 2013).

Finally, physical risks are key, as evident from the interview findings. This includes shortages, droughts, quality issues, and related cutoff provisions written into contracts and permits for water supply. Physical risks for textile firms are heavily dependent on the municipalities and infrastructure that supply their process water and the facilities that treat their wastewater. Many
respondents noted they have no back up supply or strategy in place associated with these risks. Droughts, increased demand, population growth, flooding and other issues discussed in this work all put pressure on our water infrastructure. These pressures can manifest themselves as risks in different ways, in different localities, and for different firms. During severe droughts water restrictions would be devastating for a textile firms and can shut down a dyeing or finishing operation. Water Manager D noted that they can ask their domestic household users to reduce water consumption by 25% through conservation but asking industry, and especially textile firms to do so is nearly impossible on a short time scale, as would be required with the onset of drought. Textile Expert 1, mentioned that other physical risks include a water main breakage and a disruption or contaminants such as sediment entering their supply line.

**Barriers To Realizing Risks**

An interesting observation, noted above in the Findings section of this MP and in the section above discussing the broad business trends, is the lack of attention concerning water based business risks and opportunities. My research efforts seemed to bring an attention to water related issues for the textile firms I interviewed when they worked to develop answers for the questions I posed. The following discussion presents possible reasons for the lack of attention including cost of water, and knowledge of the sources of water beyond the tap.

Price is a critical barrier. Water service pricing hinders innovation (WBCSD 2006). My interview findings show the same in North Carolina, although rate structures have shifted in the last decade. They have transitioned from rates that create disincentives for conservation to rates that incentivize conservation. The strength of this incentive is questionable, as most see water as “cheap”. Likely the rates are too cheap to take major action or spur significant innovation. Businesses need incentive to innovate and adopt new technologies. That incentive associated with water is elusive for many of North Carolina’s textile firms. Technology exists for conservation, water reuse and green chemicals but companies need incentive to change and implement such technology. Adoption has been slow. The biggest hindrance is cost, and as noted throughout this work, water is not, as of yet, a significant cost driver (Gerrow and Walker, Interview 2013; Textile Expert 1, Interview 2013). One expert mentioned: “The fundamental problem under these issues is that water is artificially undervalued.” One firm mentioned, “We are blessed with cheap water.”

Knowledge is another key barrier to identifying and mitigating risks related to water. Often knowledge stops at the tap. Firms should understand their watershed, sources of water and the challenges the water supply and treatment infrastructure face (Textile Expert 1, Interview 2013;
Water Manager A and B, Interview 2013). The misconception, mentioned above, that our water supplies from a quantity and quality standpoint are safe due to being “water rich” is a dangerous barrier to understanding risks. It represents a blind to realization and developing knowledge. This misconception and its impact on business depends on local and regional aspects: from past and current water demand, age of infrastructure, river basin dynamics, hydrologic cycle, permits, rate structure, etc.

**LOOKING TO RISKS FOR OPPORTUNITIES**

Opportunities associated with water are likely to be based on the risks described above. The majority of the respondents at firms noted that a more careful consideration of water leads to more consistency in their products and that this is a key opportunity. In dyeing this is especially true. For example, certain customers demand exact shades and consistency in the textile products they buy. One firm has made capital investments in new dyeing machinery that enables them to dye higher volumes of products at one time, increasing consistency.

From the industry’s perspective, North Carolina is a state with infrastructure that understands textiles. More increased environmental scrutiny and increasing labor rates overseas may prove to some firms that doing business in a regulated environment can be cheaper (S. Moore, Interview 2013). This is a possible bright point for the textile industry as a whole. One respondent mentioned that, because of these reasons, it is probable we will see a return of textiles to North Carolina. However, they will most likely never reach the level we have seen in the past.

Reputational risk can be turned into an opportunity. Depending on customers and consumers, firm can benefit from the marketing message of cleaner, less water intensive processes. As consumers gain knowledge about the environment, then potentially develop concern about the environment; more ecologically friendly consumption patterns begin to emerge (Brosdahl and Carpenter 2010). When looking specifically at the apparel and textile industries the “concern” aspect is paramount. Knowledge alone is not as powerful of a driver as one might assume (Brosdahl and Carpenter 2010).

With these implications in mind and facing the challenges associated with heterogeneity, what is the best recommendation to make to North Carolina’s textile industry in addressing water issues? The following sections present the real opportunity. That opportunity is to strategically and proactively engage in water management issues. Fortunately, this notion is not foreign to the industry, and we can look to a precedent from the past. The following discusses engagement and the precedent, followed by a proposed engagement strategy.
ENGAGEMENT | THE REAL OPPORTUNITY

We all must recognize that the water landscape is evolving: the costs of supply and treatment are increasing; new restrictions and legislation could pose new risks; while climate change and population growth will likely have impacts on water supplies as well. Firms cannot take the business as usual approach. “North Carolina is water rich” cannot be the safety net. Other researchers, (Childs 2008), have noted this same misconception. After all, water is the lifeblood of the industry.

In 2006 the World Business Council for Sustainable Development published a report that developed 3 water scenarios out to 2025 (WBCSD 2006). Although these scenarios were “stories” it helped businesses see themselves in the water challenges of the future. North Carolina’s Textile Complex must do the same in light of the discussion above. It is important for firms to visualize where they fit in with the challenges of the future water landscape. They can achieve this through engagement. In the water scenarios that were developed by the WBCSD (2006), businesses in a workshop concluded that technology alone is not the solution. Stakeholder participation and partnerships are critical and can lead to more effective innovation (WBCSD 2006). It is critical for firms to be engaged in the communities in which they operate. This engagement and knowledge can lead to focused innovation on conservation, pollution prevention, risk mitigation and an understanding of what efforts might prove necessary from a individual firm’s business perspective.

The engagement strategy proposed in the remaining sections of this project is a practical approach based on the heterogeneity throughout the industry and the vernacular nature of the issues. It provides firms with a key, overarching opportunity that is to become an informed stakeholder equipped with the language to participate in a revived community and a new, locally based conversation about water and textiles. It is a strategy that has the potential to address all the risks identified and capitalize on a number of opportunities. Not only do firms stand the chance of mitigating physical risks, firms can mitigate reputational risks by taking action on the issues imposing the risk and communicating their social and environmental commitment. Firms can even address regulatory risks by becoming involved in the permitting process and the development of limitations on pollutants (metals limitations are an example noted in this MP). Further, Moore (2010) found that richer stakeholder groups provide more opportunity for value creation. Each scenario or “story” will be unique for each firm and based on their own vernacular.
At first glance addressing the risks and opportunities that textile firms face may seem to be a linear process that can be viewed in a silo model of Firm | Process | Effluent: Conservation is vitally important to protecting the resource as a whole and reduction of contaminants is paramount to being a responsible steward. A proposal in light of linear thinking might note a conservation technique in the vein of counter-current washing or water recycling. It might also identify areas of innovation that should be investigated for pollution control. However, without an understanding of a firm’s unique situation, their vernacular (including but not limited to: geography, hydrology, treatment capacity and headworks, raw materials, dyes, chemicals, processes, equipment, machinery, customers, suppliers, management philosophy, current strategies, cost structure, hurdle rates, competing risks, competing projects, SIU permits, water rate structures, etc.), a specific technology or solution is difficult to recommend. I am charged with looking at the industry as a whole, not one firm. In the context of this work, a solution soundly recommended for one particular firm may not fit another firm at all. That same solution may have negative impacts on engineering aspects of water infrastructure, impact product quality or send ripples through the culture of a firm.

The best solutions for each firm must be determined locally and applied to their unique situation. How can one deliver a recommendation when it depends so heavily on local, individual aspects? For the researcher, it requires stepping back and thinking holistically in a systems mindset to arrive at means that can be applied locally in order for firms to develop tailored solutions that fit into a larger picture.

“Systems thinking” is a shift in mindset from looking at the parts to looking at the whole (S. B. Moore and Ausley 2004). The solution here is not making recommendations aimed and specific solutions to a firm that knows the intricacies of its processes, culture and strategic direction more than an outsider. Each variable involved makes this impossible, and at the least, a misguided approach to addressing water issues. “A successful design is not one, which is imposed on or provided to the organization from a source external to the system.... the success of a design is directly related to the level of stakeholder participation in the development of the design” (Pourdehnad, Wexler, and Wilson 2011). In many cases textile firms are the largest consumers of water in the cities and towns that they operate in. They have an important role to play is securing what all stakeholders need and want: a resilient and dependable supply of quality water. This approach, implementing dialogue and systems thinking is characterized by an outcome such as what the industry should be striving for, a favorable future for all stakeholders (S. B. Moore and Ausley 2004). The way forward is to engage in a new, revived dialogue, informed. A new conversation must be started and an old conversation revived, but how? The key is establishing stakeholder participation and engagement...
that enables firms with an appropriate process-based, strategic direction. For some firms this will be new, for others it will require the revival of a skillset from the past. What might this look like on the ground, in the real world? Fortunately, there is a precedent that can be examined.

**THE PRECEDENT: A CRITICAL LINK & COLLABORATIVE PROBLEM SOLVING**

Many towns in North Carolina were founded because of textile operations. Even some towns were named after mills and mills were named after towns. The rich history of textiles in North Carolina is visible throughout the state. In Greensboro, Revolution Mills is a revived textile mill turned office space and the impact of the Cone family is seen everywhere from hospitals to universities. Multiple generations of families worked in the same mill in the same community (S. B. Moore and Ausley 2004). Moore and Ausley (2004) reported the importance of community bonds developed between the stakeholders in these towns and the state. The stakeholders were joined together by jobs, water infrastructure, and even as a property tax base (S. B. Moore and Ausley 2004). The authors also mention that the stakeholders were intertwined: what was good for the town was good for the firm. This represents a critical link.

One critical environmental challenge was addressed and solved based on a similar link and collaborative problem solving. The following is a summary of the detailed case analysis presented by Manring and Moore (2006). In 1982 the United States Environmental Protection Agency (USEPA) and the North Carolina Division of Water Quality (NCDWQ) implemented new water quality testing methods. Through the 1980’s and 1990’s a large portion of publicly owned treatment works’ wastewater was found to be “acutely toxic” and even a greater percentage was not suitable for aquatic reproduction based on the new tests (Manring and Moore 2006). Estimates of costs for improvements of treatment works were in the millions of dollars and budget constraints made this infeasible. Another solution had to be found. The solution was based on a new dialogue and action between stakeholder groups based on a common purpose: to alleviate the toxicity issues.

A successful network was developed where diverse stakeholders were involved as resources in problem solving (Manring and Moore 2006). The stakeholders involved were local communities, textile firms, the NCDWQ, the USEPA, engineering firms and POTW managers. The network of stakeholders effectively resolved environmental non-compliance concerns at minimal cost to the stakeholders involved by optimizing pollutants out of the textile processes (Manring and Moore 2006; S. Moore 2013). This network was a strategic partnership between stakeholders who came together to address the environmental problem of aquatic toxicity (Manring and Moore 2006). The network was larger and more effective than the individual stakeholders working to solve the
problem independently (Manring and Moore 2006). It was an ad hoc alliance between stakeholders that was nonhierarchical while power structures were democratic (Manring and Moore 2006). Manring and Moore (2006) also note that the network of stakeholders was “leaderful” not leaderless. With multiple leaders, they concluded that the network as a whole was resilient. Overall, textile process efficiencies were developed, toxicants were identified and the result was improved water quality. It all depended on a network of stakeholders that were mutually committed to a commonality of purpose.

The precedent proved that engagement was possible and viable. Where does this engagement stand now? Unfortunately, as the textile industry in North Carolina faced globalization this community and network of stakeholders became unconnected. This historical connectedness was broken and the links in the value chain are not as strong, in some cases nonexistent (Gerrow, Interview 2013).

**The Current State of Engagement**

It is important to realize where the industry is now and note the current engagement by textile firms. Whether this lack is from the reduction in trade organizations, reduced voice in lobbying, and the degradation of relationships between firms in the value chain, disengagement seems to be the consensus.

In the height of North Carolina textiles, firm leaders sat on town boards, assisted in water related decision-making, had a large industry voice, a large lobbying presence, while even the water infrastructure in North Carolina was built to handle a thriving textile industry. Those notions are no more. Further, the majority of interaction with regulators and water authorities takes place on the wastewater treatment side of the water equation because of the SIU permits mentioned. For many firms interaction with the supply side likely does not extend beyond paying the water bill and turning on the tap (Water Manager D, Interview 2013). When the industry was booming firms had the means of investing in what “might have happened” (Water Manager D, Interview 2013) whether it was through engagement or capital expenditure. Now, this capital is not available. Water Manager D noted that stakeholder involvement in water issues is a cost effective means to spend resources, both money and time. One industry expert noted that firms are now reactive in nature, not proactive (Gerrow, Interview 2013). If the industry is serious about mitigating the risks they expressed and capitalizing on opportunities, this whole paradigm must shift.

With the understanding that the above precedent took time to unfold, one quickly realizes that it is critical for firms to make a strategic decision now. In the face of a changing water landscape,
firms must take a proactive step. In times of crises, it is likely that engagement efforts and building the appropriate relationships are often difficult if not impossible to establish in the time frame that would be required. Preventing crises by acting strategically and proactively is key. What should this action look like now? This MP concludes with a discussion on how to move forward with engagement, based on principles and a framework for applying them. This engagement is the real and overriding opportunity.

**THE ENGAGEMENT STRATEGY**

The following process-based, strategic engagement approach is critical to success and resembles the precedent set in alleviating toxicity problems in the 1980’s. In 2010 the United Nations Global Compact, Pacific Institute published a guide, *The CEO Water Mandate*, for business engagement in water policy (see Morrison et al. 2010). It includes “Core Principles for Responsible Engagement” and how a firm might align those principles in practice through an “Operational Framework.” The report takes a global tilt, but the message is relevant. With this in mind, the following discussion strives to distill the information and relate it to North Carolina textile firms where possible.

**PRINCIPLES**

“**ADVANCE SUSTAINABLE WATER MANAGEMENT (SWM)**”: Firms must be genuinely driven to better the economic, social and ecological situation in the community they operate in (Morrison et al. 2010). Fundamentally, this is SWM. Firms might see SWM as securing a reliable supply, economist might view SWM as pricing water to sustain the water infrastructure in a locality, while some may see SWM as maintaining flows in the environment required to sustain ecosystems, and finally some may see SWM as providing clean and reliable water to all people (Morrison et al. 2010). Local engagement provides firms the opportunities to address all of these issues while mitigating their own business risks (Morrison et al. 2010).

“**RESPECT PUBLIC AND PRIVATE ROLES**”: Firms must ensure that their engagement activities do not undermine, but bolster, the efforts of those charged with the management of water resources (Morrison et al. 2010). Firms have a responsibility in being committed to operate in a regulated,
enforced environment (Morrison et al. 2010). Engagement provides businesses with the chance to work with water managers and governments to promote policies that align with Principle 1 above through multi-stakeholder dialogue (Morrison et al. 2010). In interviews with water managers, I found that this principle is critical and might be welcomed by water managers across the state.

“**Strive for Inclusiveness and Partnerships**” : Engagement should be focused on inclusivity and building genuine partnerships (Morrison et al. 2010). This focus is intended to ensure commonality of purpose (Morrison et al. 2010). Inclusivity and building real partnerships can mitigate reputational risks by “galvanizing” the legitimacy of the firm’s engagement. Involving many different stakeholders gives the opportunity to implement expertise across a number of disciplines. The precedent above was based on this same principle, bringing in experts, POTW personnel, regulators and the community to solve a problem shared by all.

“**Be Pragmatic and Consider Integrated Engagement**” : Engagement must proceed with the understanding that water issues are interconnected. River basins are interconnected. Water infrastructure is interconnected. The issues around the economic, social, and environmental context in communities are also interconnected (Morrison et al. 2010). As mentioned above firms must focus on being proactive, contrary to the current, generally reactive nature of textile firms. Further, engagement must not attempt to enact “parallel efforts”, but rather work inclusively to develop new initiatives where none are in place or add momentum to existing initiatives (Morrison et al. 2010).

“**Be Accountable and Transparent**” : Firms must engage in a way that is fully transparent, accountable, and engenders trust amongst all stakeholders (Morrison et al. 2010). One interview respondent for this MP mentioned that residents in a community were outraged when they uncovered that the rate structures in place promoted firms using more water through declining prices while the opposite was true for the residential users. Since then, rate structures have been changed, but transparency earlier on would have mitigated this outrage. The key is to limit perceptions of ill-intent or regulatory capture (Morrison et al. 2010).
OPERATIONAL FRAMEWORK

The principles discussed above form the foundation for an operational framework. This operational framework, presented in *The CEO Water Mandate*, includes: assessing the context, exploring engagement opportunities and pursuing engagement strategies. The two most relevant sections are "Assess the Context" and "Explore Engagement Opportunities and Prepare for Action". Applicable information is adapted to this MP’s scope below.

"Assess the Context": This aspect of the framework requires developing internal company buy-in, understanding, and focus to support meaningful engagement external to the firm (Morrison et al. 2010). The physical risks of scarcity or supply interruptions that threaten textile operations are external to textile firms. The key is for firms to develop an understanding of its local water resources, stakeholders and political context (Morrison et al. 2010). *The CEO Water Mandate* recommends that engagement must be grounded in a nuanced understanding of the political and resource management context in the community that it operates in. It must also be grounded in an understanding of the other stakeholder’s concerns. Fundamentally, the list of stakeholders includes anyone who depends on a reliable source of quality water. Developing these understandings can provide insight to what strategic directions are appropriate. In an effort to understand the local water issues and what role the firm can play, textile firms might bring people in from the municipality to present current issues and future concerns on water (Water Manager D, Interview 2013). It will become critical for firms to understand and become reconnected with their watersheds, moving beyond the tap.

**Critical Questions Likely Include:**

**Water Resources:**

- Where does our water come from beyond the tap?
  - One water manager interview respondent mentioned that this understanding is lacking across industries and residential users.
- What risks does our watershed face?
- What is the likelihood of a physical risk becoming a reality in our community?
- Does our community have enough water for the future?
- Is the infrastructure in place to handle future demand?
- Are we interconnected with other cities or water suppliers, are plans in place, what role can we play?
**Political and Water Management Context:**

- Who is responsible for supplying water and treating wastewater?
  - This answer will differ based on location throughout North Carolina. Sometimes this is under the same roof, sometimes not.
- What is the level of interest of water managers in our community for collaboration and cooperation?
- What needs do water managers have? Is it capacity building, political support etc.?

**Stakeholders:**

- Who are the stakeholders?
- What are the perspectives and interests of other stakeholders?
- How can we work to develop a shared understanding of the issues?
  - Could it be through community water forums, interactions with POTWs, roundtables or consultation with NGOs?
- How can we engage with the local community on water issues?
- What training or knowledge do our employees need to understand the importance of water to our business and to the community?

**“Explore Engagement Opportunities and Prepare for Action”:** Once a firm understands the nuances of its local situation and context it can begin to move forward with action. This includes aligning engagement with the appropriate scale (Morrison et al. 2010). North Carolina textile firms should focus on local engagement and the relevant stakeholders identified above. As mentioned in the section of this MP that described North Carolina’s water resources, water is a local issue and is most appropriately managed locally (N.C. DENR 2001). We have to address the global water landscape on a local scale. Municipalities must grapple with local and watershed level constraints to develop adequate water resources (Jenerette, Marussich, and Newell 2006). Firms have an important supportive role. Further, firms should establish and articulate their engagement goals to develop clarity of purpose and avoid perceptions of ill intent (Morrison et al. 2010). “Creating trust can help secure the license to operate” (WBCSD 2006, pg 43). Creating this trust is most efficiently achieved by developing a new network, system mindset and stakeholder relationships. The range of engagement opportunities depends on the local nuances each firm finds. Possible engagement opportunities might include the following.
DIRECT ENGAGEMENT WITH THE LOCAL COMMUNITY

Firms might advocate the importance of conservation, or the need to understand local water resources. They might also communicate the importance of engagement based on their own experiences.

ENGAGEMENT WITH WATER MANAGERS

Further, even simply having the contact information between officials at the treatment works, water supply, and textile firms should be viewed as critical. From the wastewater treatment perspective, it is critical to have a solid relationship with industry to manage the wastewater treatment plant effectively (Water Manager D, Interview 2013). If an anomaly occurs in processing, such as a textile plant shut down, without being communicated to the operational staff at a wastewater treatment facility, it can be a major disaster for the treatment plant and environment. The reverse is true as well. A main breakage imparting sediments or contaminants in the water supply, or an interruption in supply can have catastrophic impacts on a textile firm.

POLITICAL SUPPORT

Firms might provide political support along with innovation for conservation projects, interconnection projects, and supply development.

SEEK STRATEGIC PARTNERSHIPS WITH NGO’S OR OTHER STAKEHOLDERS

Firms might find immense value in developing strategic partnerships to collaboratively solve problems and share expertise.

As one can see the opportunities are diverse. Each firm will face unique challenges and unique situations. The takeaway is to develop a nuanced understanding of the issues the firm faces and move forward with a tailored strategy based on this understanding. It requires a shift to acting proactively and provides opportunities that an internal focus cannot. The end goal is mitigating risks and the direction elaborated above provides a strong opportunity to do so.
FINAL REMARKS

My research through literature reviews, interviews, and plant visits suggest the Textile Complex, more specifically the wet processing segment, in North Carolina is characterized by extensive heterogeneity. The watersheds and water infrastructure the industry depends on shares this characterization. Although there are significant water related challenges faced by the industry, my research indicated physical risks as being the most threatening. These physical risks of water scarcity, interruptions in supply, or problems associated with water quality can be catastrophic for a textile operation. Further, many firms in North Carolina’s Textile Complex still operate under the assumption that North Carolina is “water rich”. This assumption will likely prove perilous in light of the future challenges North Carolina faces with respect to climate change and population growth that can both incite physical risks.

Based on an understanding of the heterogeneity and of the risks, the challenges faced cannot be appropriately addressed by the industry as a whole with a uniform technological approach. As is seen in the project, it must be looked at from a holistic mindset. With this in mind, my findings suggest a more engaged approach.

Engagement in local water issues is not a foreign notion for the industry when its history is examined. An engaged industry worked to collaboratively and successfully solve toxicity challenges in the 1980’s through a dialogue based approach, proving engagement in local water issues as a feasible course of action. Unfortunately, this dialogue, successful engagement, and the stakeholder groups no longer exist. This project should serve as a call to action to reunite and recreate these engagement processes, or even begin anew. At the same time, it delivers a process-based, strategic engagement approach for firms to enact.

Firms must focus this approach on principles for responsible engagement that focus squarely on a genuine, pragmatic, and transparent effort. With these principles as the foundation, firms can concentrate on developing a nuanced understanding of their situation, explore engagement opportunities, and act on those opportunities strategically.

Perhaps such an approach, as the one proposed in this project, can ensure the viability of North Carolina’s textile firms, helping them maintain their status as critical driving forces for North Carolina’s identity, history, and economy. Trends, concerning environmental scrutiny abroad and increasing prices in other regions of the world, indicate that textiles may return to North Carolina, finding it worthwhile to operate in a well-regulated environment. These notions combined, point to what might be a prosperous, and sustainable future for North Carolina’s Textile Complex.
APPENDICES

APPENDIX A: STRATEGIC INSTRUMENT

WATER RISKS AND OPPORTUNITIES IN NORTH CAROLINA'S TEXTILE INDUSTRY: A MANAGEMENT GUIDE

NORTH CAROLINA SUSTAINABILITY CENTER

INTERVIEW INSTRUMENT: STRATEGIC FIRM LEVEL

1) What is your firm's overall strategy on water use?
   a. What are the goals of your water management program?

2) At what management level is water use and conservation managed?

3) What are the reasons for control?

4) What are the barriers and/or drivers to measuring water inputs and outputs?

5) Do you monitor throughout the supply chain or just at the production facility?

6) Where does water present the biggest impacts, challenges or opportunities in your operation?
   a. How does that change with processes, or with consumer demand?

7) Do you work with other industry partners to reduce consumption or manage effluent?

8) Who do you work with in the community on effluent and supply?
   a. How do you interact with each?

9) What are your water sources? Back up sources? Output sources?

10) What treatment does the effluent get, where?

11) What are the barriers and/or drivers for innovation concerning water as a resource?
    a. Is there a competitive advantage?
    b. Who is responsible for sources, treatment, waste, and conservation?

12) What risks does your firm face concerning water?

13) Have droughts or water shortages put pressure on the business?
    a. What are those pressures?
    b. Are droughts or water shortages a future concern from a strategic standpoint, 5, 10, 20, 30 years out?
    c. What plans are in place to mitigate the risk?

14) How does regulation, concerning water, impact the business?
    a. What regulations?

15) Do you have anything interesting you would like to share about the firm that we didn't cover?

16) Can you refer me to someone else in the industry that might be willing to speak?
APPENDIX B: PROCESS INSTRUMENT

WATER RISKS AND OPPORTUNITIES IN NORTH CAROLINA'S TEXTILE INDUSTRY: A MANAGEMENT GUIDE

NORTH CAROLINA SUSTAINABILITY CENTER

INTERVIEW INSTRUMENT: FIRM PROCESS LEVEL

1) How do you measure water and what are the reasons for control?

2) What are the various significant consumption points in your process?
   a. What standards or metrics are used for measurement?
   b. How accurate is the measurement?
   c. What is the cost at each point?
   d. What are the barriers and/or drivers to measuring water inputs and outputs?

3) How much water is lost in the process? How much goes in? How much goes out as effluent?

4) How could you reduce consumption?
   a. What would the cost be? The reward?

5) Where does water present the biggest impacts, challenges or opportunities in your operation?

6) What impact does regulation have?

7) Do you have anything interesting you would like to share about the firm that we didn’t cover?

8) Can you refer me to someone else in the industry that might be willing to speak?
APPENDIX C: INDUSTRY INSTRUMENT

WATER RISKS AND OPPORTUNITIES IN NORTH CAROLINA’S TEXTILE INDUSTRY: A MANAGEMENT GUIDE

NORTH CAROLINA SUSTAINABILITY CENTER

INTERVIEW INSTRUMENT: INDUSTRY LEVEL

1. What are major sources of water use in the textile industry in NC?
   a. Are there particular sub-industries that are heavy water users?
   b. Are there particular geographic areas where water issues are more acute?

2. How are firms measuring water inputs and water outputs?
   a. What standards/metrics are being used?
   b. What are the barriers and/or drivers to measuring water inputs and outputs?
   c. Do firms focus on measurement just at the production facility or across the supply chain?

3. What water risks do North Carolina’s textile firms face?

4. What water related opportunities do North Carolina textile firms face?

5. Where does water present the biggest impact, challenges or opportunities in the supply chain?

6. How do global trends impact water strategies for North Carolina’s textile industry?

7. Are there any new trends in water risk management within the industry in NC, particularly in response to recent droughts?

8. What are best practices in the industry for addressing water risks and opportunities?
   a. What are the barriers and/or drivers for innovation concerning water use?
   b. How can innovation be turned into a competitive advantage?
   c. What are the limiting factors in measuring water risks?

9. How does regulation or environmental law concerning water impact the textile industry in North Carolina?

10. Do you have anything interesting you would like to share about the industry that we didn’t cover?

11. Can you refer me to someone else in the industry that might be willing to speak?
APPENDIX D: WATER MANAGERS INSTRUMENT

WATER RISKS AND OPPORTUNITIES IN NORTH CAROLINA’S TEXTILE INDUSTRY: A MANAGEMENT GUIDE

NORTH CAROLINA SUSTAINABILITY CENTER

INTERVIEW INSTRUMENT: WATER MANAGERS

1. How are firms measuring water inputs and water outputs?
   a. What standards/metrics are being used?
   b. What are the barriers and/or drivers to measuring water inputs and outputs, costs or credits?

2. How do textile firms interact with treatment works and supply entities?

3. Does geographic location play an important role?


5. How does regulation, concerning water, impact the textile industry in North Carolina?
   a. What regulations?

6. What risks and opportunities do North Carolina based textile firms face concerning water?

7. What are best practices for addressing water risks and opportunities in the textile industry?
   a. What are the limiting factors in managing water risks?

8. Have droughts or water shortages put pressure on businesses or presented risks?
   a. What are those pressures or risks?
   b. How can firms mitigate that pressure or risks?

9. What are the barriers and/or drivers for innovation concerning water use?

10. Do you have anything interesting you would like to share that we didn’t cover?

11. Can you refer me to someone else in the industry that might be willing to speak?
REFERENCES


