# The History of Domestic Water Use at Colgate University

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## Executive Summary

This report assesses the domestic use of water at Colgate University since its founding in 1819. As a higher education institution, Colgate has the opportunity to train the world's new leaders to have a responsible mindset towards water and even provide a laboratory to practice sustainable water management. In order to progress for the future, this report fulfills a necessary step in keeping our institution accountable to how we interacted with water in the past. To do so, a current understanding of sustainability was applied to the actions of the university throughout its history.

To carry out this research, a mixture of archival research and interviews were performed. Collections in the Colgate Special Collections and University Archives, as well as digitally archived newspapers, were consulted. The four interviews were conducted with representatives of both Colgate (members of the Facilities department and the Director of Sustainability) and the village of Hamilton (the mayor and the village administrator). These interviews were approached with the three aspects of sustainability in mind: environment, society, and economy. Questions were pointed towards understanding environmental impacts of water provision and use on Colgate's campus, the social relationship between Colgate as the user and the Village of Hamilton as the provisioner of water, and the economic incentives and results of Colgate's water use.

Our results show that Colgate's decision-making about domestic water use over the years has not been motivated by environmental considerations due to the abundant water supply to which the village of Hamilton has access. In addition, Colgate has not had the mindset or sufficient metering in place to measure the amount of domestic water used or money spent on water for most of its history, leading to an inability to determine the economic sustainability of Colgate's water use. However, for much of Colgate's history, the university's amicable relationship with the town over water has led to a general state of social sustainability.

There are four main ways Colgate can pursue sustainable use of water for the immediate future. First, there should be a prioritization of the relationship between the university and the village in order to make sure that Colgate's decisions will be socially sustainable. Second, while the concept of water conservation has broken onto the scene in the last decade, increased prioritization of water conservation will be needed to ensure water security in the midst of an uncertain future with climate change. Thirdly, increased student engagement, specifically, will be crucial in water conservation efforts as they have the best ability to influence campus and the rest of the world., Lastly, the university is advised to invest in the widespread installation of water efficient technologies such as dual-flush toilets that, like the implementation of low-flow shower heads, can have a considerable yearly savings in water use.

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## Introduction

Since Colgate University's formation in 1819, there have been many changes in the way that members of the campus community live. Some of the most drastic differences between the university today and the university in the past are the ways in which people utilize water in a domestic setting. Along with innovations in technology that have dramatically altered the way that water is distributed to people and how much water people use in a typical day, the conceptualization of sustainability has also become a much more formal and pressing concern surrounding all manners in which freshwater is utilized. This creates questions about the ways in which water and water resources were both used and managed for longevity before the inception of the term sustainability. As Colgate University approaches its bicentennial in 2019 with a carbon neutrality goal attached to that date, it is important to measure how far the university has come in relation to sustainable water use. In this project, we have addressed the following research question: How has domestic water use at Colgate University changed over time and to what extent have the priorities for water use aligned with current definitions of sustainability?

In this report, we address the history of domestic water use at Colgate University. To do this, we pay specific attention to major changes in the way that campus community members have been able to use water in the residential halls and academic buildings over time. We also look for mention and measurements of water quantities, of water quality, and amounts spent on water throughout the history of the university. In doing so, we assess how decisions regarding water sourcing, use, and provision align with our definition of sustainability and a set of criteria under which we measure sustainability.

To collect data to answer our research question we utilized a multi-faceted approach. Since this is a historical analysis of water use at Colgate University, our main source of data is the university special collections and archives. Along with the research in the physical archives we also briefly surveyed the digitized records of student newspapers. To supplement the archival data, we conducted interviews with key stakeholders. The stakeholders we interviewed included representatives from Colgate University's Facilities Department and Office of Sustainability as well as representatives from the Village of Hamilton – the provider for all domestic water used at Colgate.

This report is intended to inform all members of the Colgate University community past, present, and future about domestic water use at the university and how it has been and can continue to be made more sustainable. We also intend for this report to be read by members of the Village of Hamilton who are not also members of the Colgate community as water use at the university is highly interconnected with water use for the entire village. Outside of the individuals who are immediately affected by Colgate's water use, we envision a potential audience in other universities or communities who are looking to inform similar research within their community.

From here, we discuss the literature review that provides the background information for contextualizing water use and sustainability in the university setting. We then go on to discuss the methods we employed to answer our research question, present our results, and provide a discussion of what these results mean for the scope of our research question. Finally, we discuss our recommendations for more sustainable water use at Colgate University in the future.

## Literature Review

Water is one of the ultimate public goods, a substance crucial for life that must ultimately be shared by all. Yet, in today's world, it is also seen as a private good and economic commodity. Water is not just necessary for life, it carries cultural values, social implications, and recreational uses (Gleick, 1998). This considered, there is a diversity of competing interests that make water a complicated resource to manage.

Globally, water is crucial for both considerations of well-being and wealth. On one hand, water is critical for good health and fighting disease. On the other, it is central to production and preservation of goods and services. According to the United Nations Water for Life program website, more than 1.7 billion people are currently living in areas where water sources from river basins are depleting. If this continues, two-thirds of the world's population will be living in water-stressed countries by 2025. As of 2015, after a concerted effort made by the UN to tackle water problems for a whole decade, still around 748 million people did not see an improvement in source of water and 2.5 billion people did not see an improvement in sanitation ("International Decade for Action 'Water for Life' 2005-2015," n.d.).

While global warming and its impact on the water supply has dominated the conversation around climate change, much less attention has been given to how human behavior influences the terrestrial water cycle (Vorosmarty, Green, Salisbury & Lammers, 2000). Water use comes in a variety of forms. In its most simple sense, water is used to meet basic needs, but it is also used for aesthetic, luxury and entertainment. According to Peter Gleick (1996), the basic water requirements (BWRs) can be defined "in terms of quantity and quality of four basic human needs: drinking water for survival, water for human hygiene, water for sanitation services, and modest household needs for preparing food (p. 83). The difficulty in determining what goes beyond BWRs comes in the fact that different parts of society use water for different purposes such as drinking, growing food, producing and using energy, removing and diluting wastes, using energy, etc. To define what the quantities for each country, let alone each location within a country, is difficult when the diversity of interests are considered. When there are hundreds of millions of people who like the water required to meet their basic needs, it proves tricky for societies like the United States to determine what is a responsible amount of water use.

While water can be discussed at many scales, the university setting proves to be a vital one. In fact, although water consumption is very high in higher education institutions, few universities have determined the optimization of their water systems (Gao, Zhang, Zou & Zhang, 2014). As sustainability develops nationally, water is an ever more important component of environmental management for higher education institutions (Rauen, Lezana, & da Silva, 2015). Furthermore, water planning on college campuses has been limited to professionals trained in engineering, agriculture, and hydrological sciences; yet, rural interests, religious and minority ethnic groups, environmental groups, and academics have far less say (Gleick, 1998). Water is generally a local resource so studying its use in a local context is very important (Rauch & Newman, 2009).

In a study conducted at a small liberal arts school in upstate New York, there was noticed a shift in how people use water on campus: communal sharing to privatization and commodification, from water fountains to water bottles (Kaplan, 2011). Throughout history, water has been understood as a public resource that should be accessible to all humans.

However, with the rise of consumerism in the past century, water has become increasingly viewed as a product on the consumer market. It has led to people, including students, to desire ownership over their water. The result has been a widespread use of personal water bottles and a decreased use of communal water fountains. This individualistic consumption of water, unfortunately, has led to an increase in environmentally harmful products like plastic water bottles. Yet, there have been moves to combat the negative impacts that come with the commodification of water. Recent national college campus competitions focused on conserving water have changed student behavior and how people think about water (Petersen, Frantz, Shammin, Yanisch, Tincknell, & Myers, 2015). While social initiatives started by students are one important aspect of changing the way we interact with natural resources such as water, there is also a need for leadership amongst universities to create a new national culture amongst higher education. Over the past two decades, a select few colleges and universities have undertaken leadership responsibility by starting and then expanding environmental research programs, integrating conversations about sustainability into curricula, adopting sustainable operations and management strategies, and constructing facilities to be green (McNamara, 2010). As early as 2003, the National Council for Science and the Environment stated that educational institutions are "uniquely positioned to help solve the challenges of environmental, social and economic sustainability through innovations in teaching" (2003, p. 5). The university may just be the ideal place in which to practice sustainability and equip young adults with the knowledge and experience to bring sustainable thinking out into the world.

Colgate University is situated in Hamilton, New York which is known to be in a water-rich part of the country. According to statistics which compare relative population and water stress, Hamilton is in one of the least stressed places due to its small population and secure access to water (Vorosmarty et al., 2000). It is not far from Lake Ontario of the Great Lakes, one of the biggest freshwater sources in the world. It is also close to a smaller network of lakes called the finger lakes in upstate New York. That said, Colgate has a responsibility like any other institution to be mindful of how it uses its water. As an institution of higher education in the United States of America, Colgate needs to be aware of national standards that are set. For example, Colgate University has made a commitment, when renovating or building new buildings to do so with LEED certification. LEED (Leadership in Energy and Environmental Design) is a national standard that Colgate has adopted in order to be at the forefront of the sustainability movement and as a means to measure success. LEED encourages and rewards institutions for decreased water use as well as for alternative water sources such as rainwater collection and wastewater recovery (Starr & Nicolow, 2007). It is within understanding Colgate's position within all of these contexts (global, national, as a higher education institution, and being located in central New York) that the university must make decisions going forward. It is especially important in the face of a changing global climate, whose variability could lead to unpredictable vulnerabilities in the future (Vorosmarty et al., 2000).

## Methods

To carry out our research on water at Colgate, we followed a multi-step approach. First, we narrowed down a research question to pursue. Then, we decided which definition of sustainability to use for our project. Next, we created a set of criteria to which we would measure how water use has or hasn't been sustainable. We then gathered data through archival research methods and through interviews with key stakeholders to answer our question.

*Research Question Scope*

The first step in our project was deciding what the scope of our project would be and which question we would seek to answer. As our research question we chose: How has domestic water use at Colgate University changed over time and to what extent have the priorities for water use aligned with current definitions of sustainability? Since water influences so many different things and comes into play in many areas of a university, it was necessary for us to define a narrow scope within which we would work to answer our research question. We chose to focus our project solely on domestic water use because it is through domestic use that students and other campus community members most directly interact with water in a campus setting. We also chose to limit the scope of our project in this way because how people use water on a day-to-day basis has changed drastically over the last 200 years. Within our analysis of water use over time we have a sub-question of how the technologies used for domestic water use have changed over time and how these decisions to change technology may have been aligned with modern sustainability. We use the phrasing "aligned with current definitions of sustainability" because we realize that sustainability as we conceptualize it is a relatively new idea in relation to the history of Colgate University and any specific references to sustainability or evidence of intentionally sustainable choices will be limited to recent times.

*Operationalizing Sustainability and Defining Criteria*

The definition of sustainability that we are using for this project is informed by Theis & Tomkin's (2012) re-envisioning of the three pillars model as a Venn diagram. In this model, the environmental, economic, and social components are represented as three equally-sized circles that intersect each other, and only where all three circles overlap can be defined as true sustainability. We chose this model over a more traditional three pillars model because it emphasizes the interconnections between the pillars as the requirement for sustainability. Our definition of sustainable water use, for the purposes of this project, is the provisioning of domestic water for Colgate University in an intra- and intergenerationally equitable manner from an environmental, economic, and social perspective.

After outlining which definition of sustainability we would use for our project, we decided which criteria to use in order to evaluate whether and to what extent water use has been sustainable over time at Colgate. We divided the criteria into three distinct sections, one for the environmental, economic, and social aspects of sustainability. Within each section, we have sub-questions that we used to evaluate sustainability.

For the environmental component of sustainability, we have focused on whether Colgate has used water in an ecologically responsible manner. Has Colgate ever drawn so much water that it has put a strain on the aquifer? This can be measured by the quantity of water that Colgate

used, and by whether there has been evidence of water source depletion at any point in the university's history. Our second environmental sub-question is whether Colgate has ever been responsible for polluting the water source when drawing it from the village supply. This is measured by the presence of contaminants in the water supply at points of testing. The third sub-question is whether Colgate has maintained water quality throughout domestic use including stages of filtration processes and the actual use of the water. This is measured by Colgate's adherence to state water quality standards. These criteria are informed by and adapted from Gleick (1998) and Theis & Tomkin (2012) who stress the importance of quantitative measurement of water use and pollution in the long-term water planning and management that leads to sustainability.

For the economic component of sustainability, we considered how economic considerations have been included or prioritized in the decisions the university has made regarding water use and water distribution technologies. This is measured and quantified by three questions: How much domestic water is being used per capita? How much money is being spent on domestic water per capita? How does the money spent on water compare to the amount of money spent on other things? The last question is important to include because the value of the dollar has not been remained stagnant over time and we seek to find what proportion of Colgate's spending went to water at different periods.

For the social component of sustainability, we have focused on the relationship between Colgate University and the Village of Hamilton. Theis & Tomkin (2012) point to the importance of relationships between institutions and people as a fundamental aspect of social sustainability. Taking this into consideration we chose the relationship between the university and the village because the village represents both the university's water provider and all the members of the surrounding community. Within this context for social sustainability, we have two sub-questions: How has Colgate involved the Village of Hamilton in its decision-making process regarding changes to domestic water use? And has the university used water in a manner that is equitable to the village? To measure whether water use is equitable we aimed to compare how the percentage of water use by Colgate compares to the amount of space and people that the university represents within the community. These sub-questions speak to the importance of the relationship between Colgate and Hamilton and are trying to get at whether the university recognizes its place as a member of a community, includes the voices of relevant stakeholders, and respects the needs of that community outside of itself.

*Archival Research*

The first step we took to answer our research question and subsequent sustainability criteria sub-questions was to conduct primary research in the Colgate University archives. We looked in both the university's physical archives and the digitized student newspaper archives. We were looking for documents from throughout Colgate's history that reference how water was being used at certain time periods, what amount of water was being used and what amount of money was being spent on water, and information about the decision making processes behind big changes in water use. Since the Village of Hamilton is the university's water provider we also looked for documents from that side of the relationship that referenced how much water was being pumped out during a given time period, how water was being distributed to village residents, and how the water was treated prior to distribution.

The biggest limitation that we faced in conducting our archival research was the general

lack of data regarding water use and systems at Colgate over time. Textual references, photographs and publications relating to water use were rare and not centralized in any systematic way.

One collection in the Colgate University archives that proved particularly helpful for our project was the Building & Grounds collection which contains records for each of the campus structures. Within these series we looked at boxes that were potentially relevant to water use and water technologies. We found that for some buildings, the university retains copies of the architectural plans which contain references to the water technologies that were installed in the building.

Along with the Buildings & Grounds collection we looked at documents from many other collections. We looked at the records of Board of Trustees meeting minutes to see when the university made big changes regarding water use and what informed those decisions. We looked at the Master Plans to see how the university has factored water use and sustainability into its long-term planning initiatives. We used the Hamilton Water & Light collection for information about water quantities pumped out to the university. The last collection we looked at was the Hamilton history collection which provided information about the history of the village's water system and how the village has provided water for its residents, including Colgate.

*Stakeholder Interviews*

Along with archival research, we also interviewed key stakeholders with questions about current water use and any information they could provide about the history of water use at Colgate. Each interviewee filled out a Certificate of Informed Consent form (See Appendix A) and stated whether or not they would give consent to their names and direct quotes to be used in this report. We audio recorded all but the first interview. Each interview took between 20 to 45 minutes to complete. Our first interview was conducted with a group of representatives from the university's Facilities Department who came from both the planning and management side of facilities. While some members of this group requested not to be explicitly named or quoted in the communication of our research due to the sensitive nature of their positions, we were able to gain invaluable insight into water use at Colgate from our conversation with them. We chose to interview this group of individuals because Facilities is the department under which water and the technologies for distributing water are currently managed.

We then interviewed John Pumilio, Colgate University's Director of Sustainability. We chose to interview Mr. Pumilio because he is the person on campus most informed about and responsible for all sustainability initiatives on campus. We focused our questions for him on the state of water on campus over the past 7 years he has been at Colgate. We were particularly interested in obtaining his thoughts about recent efforts for water conservation and the sustainability of the water system on campus.

Our final two interviews were conducted with stakeholders who represented the Village of Hamilton. We chose to interview Bob McVaugh because he is both a Colgate professor and the Mayor of Hamilton and is therefore informed about the relationship between the university and the town from both sides. We also received a suggestion from other students in Community-Based Study of Environmental Issues that Mr. McVaugh would be a good person to interview for our project because of his knowledge of the history of Hamilton and Colgate University. We asked Mr. McVaugh questions focused on historical sources and uses of water, the current quality of water at Colgate, and the historical and current relationship between the village of

Hamilton and Colgate. We also interviewed Sean Graham, Village Administrator, because he is responsible for managing the village water supply and is, therefore, the most informed person about the current state of the village's water. We concentrated our questions for Mr. Graham on the sourcing and provisioning of water to the village and Colgate along with decision-making priorities of the village as they relate to current and future water projects.

In addition to the stakeholder interviews, we toured Colgate University's heating plant in order to gain a better understanding of how water is involved in providing heat to the residence halls and academic building. On this tour, the manager of the heating plant entertained our questions regarding the water boilers, steam pipes, and water's overall significance to the heating system.

## Results

*1819-1890s*

According to the earliest found account of domestic water use at Colgate, at least by the 1850s "Bathing facilities consisted of a bath house to which spring water was piped down the hill. In winter some Spartan youths took morning showers in the ice- cold water, roaring with pain at the shock, and then wrapped in overcoats, they dashed to their warm rooms to recover" (Williams, 1969, p. 161). Prior to this account, we were not able to uncover any records of domestic water use at Colgate. Historical records of the earliest years in Colgate University's history imply that water was available in springs in between Alumni Hall and West Hall and behind what is now Andrews Hall and Stillman Hall. There was also a water basin, specifically a trough, in the Southeast corner of East Hall. In addition, there are mentions of a fountain located on Cardiac Hill, a route from Willow Path to the Chapel prior to the construction of Persson Hall, which was subject to vandalism in the 1880s (Bob McVaugh, personal communication, April 12, 2017).

Sometime before the 1880's, the first indoor bath facility was created, with funding from the Colgate family themselves. It was located in the northwest corner of East Hall. Prior to this, if students wanted to get baths, they had to go downtown (Bob McVaugh, personal communication, April 12, 2017). Around the same time, the first drinking fountain on campus came into existence. From an article in the Colgate Maroon from 1924 mentioned a water fountain financed by the Class of 1872 when they were Freshmen in 1868. It was placed on the west end of West Hall and stayed until it became rundown and was transferred to a different location. In 1924, the fountain was refurbished, while maintaining the same outside appearance, and moved to the west end of Andrews Hall. This water fountain was mentioned for "its usefulness as an everyday convenience" and its rich history. A man named Colonel Ballantine did an investigation and found that "the drinking fountain was an exceedingly novel idea and if not actually the first it was among the first drinking fountains in this country" (Interesting History of Drinking Water. 1924, p. 5).

*Mid 1890s-1965*

It was not until the end of the 19th century that more modern water systems technology were installed at Colgate. As Williams (1969) writes, "In 1893 a sewer system connecting all the buildings was constructed though it was not until 1895 and 1896 that electricity and water from

the village began to be available in one building at a time" (p. 222). The Hamilton Water and Light department was incorporated in 1895 and marked the official beginning of the village providing domestic water to the university, as stated in a letter Howard Williams wrote to James Hughes on February 1, 1968. This is corroborated by our finding of a Rates and Regulations booklet published by the Hamilton Water & Light Department in 1895 (Colgate University, 1895). At this time, village residents were charged for water based on both amount used and the types of water use technologies present in their homes or number of livestock owned (Figure 1) (Colgate University, 1895). In addition to this, there were different rates charged based on the type of residence or business (Figure 1) (Colgate University, 1895). Within 20 years, the Village exhibited changes to the ways in which they billed residents for domestic water. In the 1913 Water Rates and Regulations, the Board of Water and Light Commissioners began charging all water users the same rate and required all water users to be charged at least $1.50 per quarter or $6.00 per year (Figure 2) (Colgate University, 1913). The 1913 Water Rates and Regulations also included recommendations for residents about water use. The Water and Light Commission suggested that water users "read their meters frequently, and with especial care in extreme weather" to determine whether there are spikes in water use associated with a leak and that "much water that is now wasted could be saved by keeping a pail under the faucet to catch the surplus water when drawn for drinking or other purposes and this water used for cooking and washing" (Colgate University, 1913, p. 15, 18).

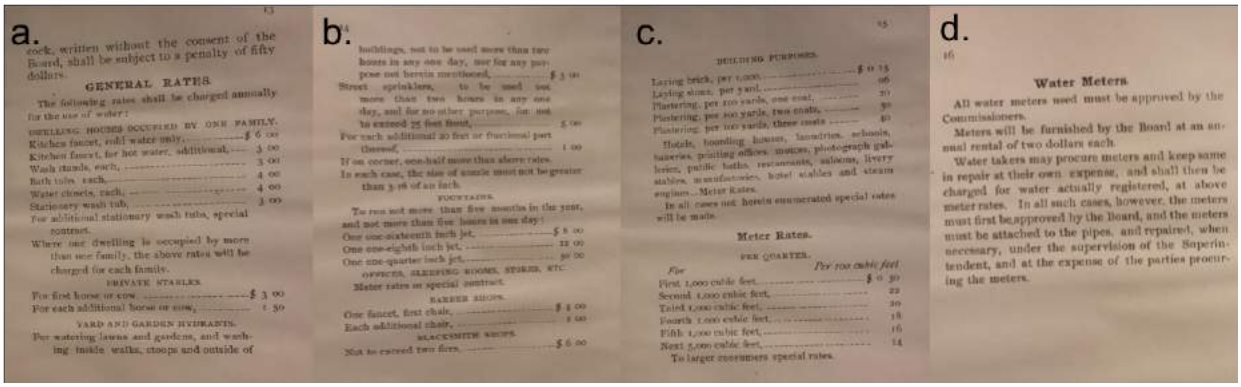


**Figure 1:** Excerpts from the 1895 Hamilton Water and Light Commission Rules and Rates. (a.) Depicts the General Rates charged to single-family residences based on the types of water technologies present in the home. (b.) Depicts the charges for varying additional water uses and for businesses. (c.) Depicts water meter rates. (d.) Depicts charges for water metering (Colgate University, 1895).

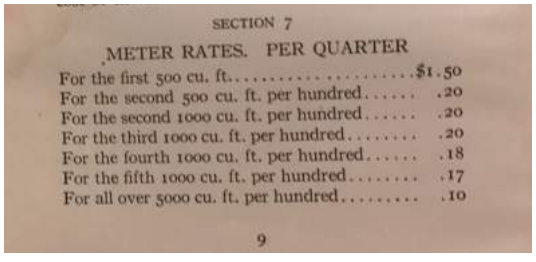


**Figure 2:** Excerpt from the 1913 Board of Water and Light Commissioners Rates and Regulations depicting the meter rates per one hundred cubic feet, to be charged once a quarter

(Colgate University, 1913).

The provisioning of water to residents whether by the Hamilton Water & Light Department of 1895 or by Hamilton Water Works now, has always fallen under the Hamilton Utilities Commission. The commission is a governing body that handles all the utilities provided by the village. It consists of an appointed board that holds the majority of the responsibility but the Mayor sits on the board at some points. Current Mayor Bob McVaugh estimates that 50% of his job as Mayor is focused on utilities (Bob McVaugh, personal communication, April 12, 2017).

Prior to the modern-day water sources for the Village of Hamilton, it cannot be said exactly how Colgate got its water. Interviewee Sean Graham theorized that where Taylor Lake is, they would have had hand-dug wells. Over the years, the village found cisterns across from Whitnall Field, where the old administration building was located. Where the water came from, he doesn't know. It may have just been groundwater running in there but this could not be validated by any means. Sean Graham also said that every once in a while a car in the village will cave into the ground because it was parked on top of an old cistern that was hidden by grass grown over it. In addition, Mr. Graham explained that through the process of digging up and rebuilding roads, there has been some evidence of an older water main system attached to an unknown former water source:

> When we rebuild roads, every once in a while we'll find a wooden water main, and they actually used to have hollowed, they hollowed logs out and brought water down from the eastern portion of the village, which is up above the golf course. Now where it came from, I just don't know. But there was another source at one time besides Woodman Pond and the wells we own now (Sean Graham, personal communication, April 14, 2017).

In the archives, we found a letter written by Professor Whitnall to the Geologic Survey on May 18, 1936, asking if the fluorescein (used with a salt called uranin to trace underground water) had any health effects if consumed. The geologic survey replied that they have had no reason to think that fluorescein was a health hazard. They said that if the salt were poisonous, "there is little probability that anyone would drink enough of the colored water to produce any harmful effect." This was then sent to the Public Health Service (in the Treasury Department in Washington) which is the federal source of authoritative information on matters relating to health. The Public Health Service corroborated this and said that at the time, dyes and other agents besides common salts weren't used much (Folder 187- Box 5 in the Harold Orville Whitnall collection). This represents a potential instance in which the actions of representatives of Colgate University could have polluted the water source for the village but took the necessary precautions before acting on that potential.

In 1907 Colgate built a Central Heating Plant which changed the way that the university provided heat to its residence halls and academic buildings. The Central Heating Plant functions by burning something (initially coal) to boil water which is then pressurized and pushed through steam pipes going into every building (Figure 3) (Representative from Facilities, personal communication, April 21, 2017). Once in the buildings, fans blow hot air off the steam pipes and into specific rooms (John Pumilio, personal communication, April 21, 2017). The Central Heating Plant represents a major use of domestic water on campus and the university uses the same methods for heating buildings today, though they now burn wood and natural gas

(Representative from Facilities, personal communication, April 21, 2017). Today the Central Heating Plant is 90% efficient at capturing and reusing water that has been turned into steam to heat the buildings and then recondensed (Representative from Facilities, personal communication, April, 21, 2017). Despite this efficiency, the plant still uses between 3,000 gallons of water a day in the Summer and 10,000 gallons a day in the Winter (Representative from Facilities, personal communication, April, 21, 2017).

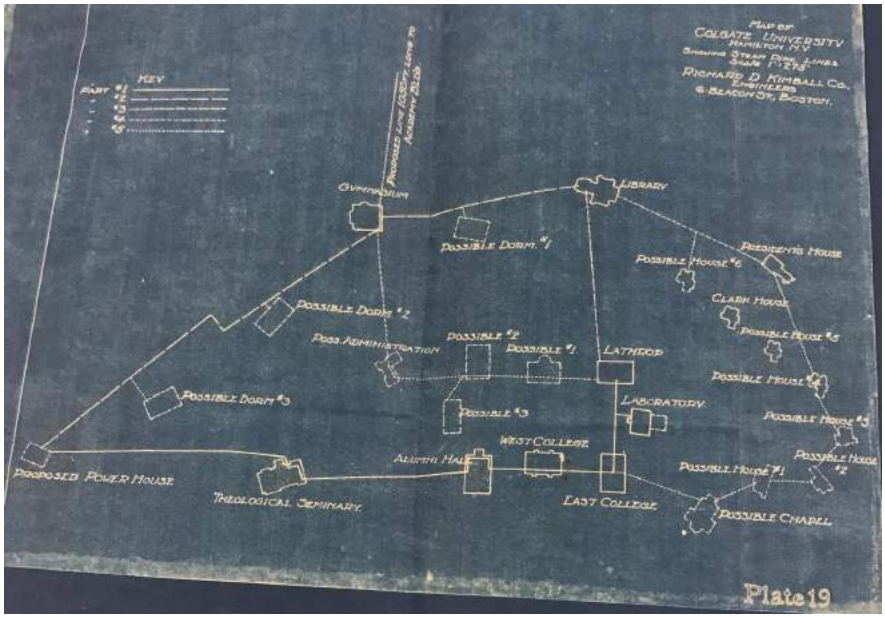


**Figure 3:** Map of steam pipelines on Colgate University campus associated with the building of the Central Heating Plant in 1907 (Colgate University, n.d.)

*1965-Present*

In the 1965 Colgate University Comprehensive Master Plan there was discussion of the situation of water at Colgate and in the village. They stated that "the water supply system is generally adequate at present" and that "improvements have been and continue to be made to the system on a regular basis" (Colgate University, 1965, p. 47). They express concern over the water table in this document calling it "an important factor to consider in all new construction" not as a warning against depletion but rather because of "limitations due to prolonged or seasonal wetness" (Colgate University, 1965, p. 47). They end with recommendations for the future:

> Future plans for improvement include construction of reinforcing mains and the elimination of dead-ended lines in the distribution system, establishment of a permanent dam and intake structures at the water source, provision of additional pumping capacity and filtration at the treatment plant, and the eventual construction of expanded reservoir capacity. In addition, an ongoing program of modernization, repair, replacement, and extension will be carried out as at present.

The Village of Hamilton used to get water from Woodman Pond, a surface water facility located in the northwest corner of the village (Figure 4). Not much could be found out about the details of how water was gathered from Woodman Pond. However, Sean Graham explains that "we don't use that anymore. It would take an enormous amount of money to filter and disinfect

the surface water so it's much easier to use groundwater. It's much less expensive to treat" (Sean Graham, personal communication, April 14, 2017). Bob McVaugh elaborated on the switch to groundwater from Woodman Pond, stating "Prior to that you really tasted the migration of the geese. If you're drawing water from a migratory lake or pond, there are seasonal differences. And no one wants to go back to that" (Bob McVaugh, personal communication, April 12, 2017).

Today, Colgate gets its water from two artesian wells, which means the wells are tapping into an aquifer, over by the [Hamilton Central School] high school (Figure 4). Colgate is on the water system that gets its water from the Municipal Utility Commission (Bob McVaugh, personal communication, April 12, 2017). The date for the installation of the wells is not known exactly but the thought is sometime in the mid-1980s. The water runs from the wells through a ten-inch water main (pipe) that goes to the heating plant. It then runs up to the tank at the top of the ski hill. There is another tank on the west side of the village. The water pressure from these two tanks keeps the water pressure from around 95-100 psi. Colgate has it's own water tank up on the campus for the "high zone." Colgate owns its own pipes and the village owns their pipes. As soon as you step onto Colgate's campus, the water infrastructure is Colgate's jurisdiction. Buildings and Grounds take care of all these. In Mr. Graham's opinion, "they do a very good job" managing their water infrastructure (Sean Graham, personal communication, April 14, 2017).

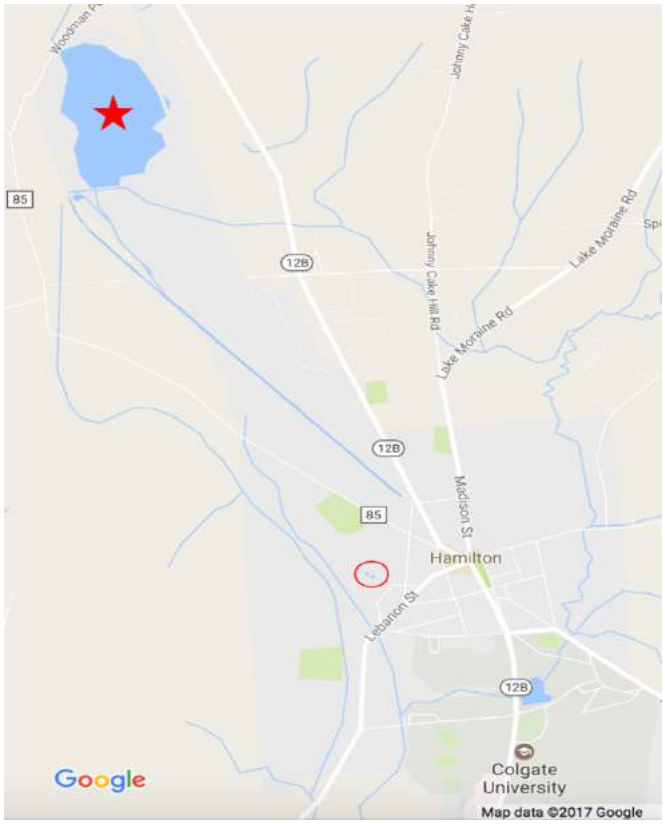


**Figure 4:** Map of the Village of Hamilton including the locations of key locations for water provisioning. The red star indicates the location of Woodman Pond, the water source for the Village of Hamilton until the 1980s. The red circle indicates the location of the two wells that the Village of Hamilton currently uses for water.

Pertaining to the costs of water, rates are determined by the number of "units" used. A "unit" refers to 100 cubic feet or 748 gallons of water. For 748 gallons, an amount equivalent to about 3000 bottles of water, ratepayers pay a rate of $3.02, which is a drastically less expensive than buying the bottles at the store. There are monthly records going back to the past 50-60 years but records from before this period were probably destroyed. The prices for customers of water from the village are the same. The university is the biggest customer in all of the utilities. If they just stopped taking water, they would decrease the amount of water needed to be supplied by over half. As Mr. Graham relays, "Colgate is a significant user, it's great for the village...We enjoy working with them." (Sean Graham, personal communication, April 14, 2017). That being said, if the university were to stop using village water or use drastically less water the rates for the rest of the residents of the village would have to be raised to cover the unchanging costs of facility maintenance and water treatment (Sean Graham, personal communication, April 14, 2017; John Pumilio, personal communication, April 11, 2017).

The village currently has a new project for improving water provision underway. They would like to perform a rate analysis and consider putting in a third well far away from the existing two wells because "if there was ever a groundwater contamination near those two wells that are only about 100 feet apart, it would probably affect both of them. Because if you lose water, you're about done. You can go without electricity because you have generators...but if you can't provide potable drinking water for your residents, the students, faculty and staff and everyone who is tied to our system, you're done. There aren't enough tankers locally to supply enough water on the hill. So we are working to help curb that problem" (Sean Graham, personal communication, April 14, 2017).

*Water testing*

Village administrator Sean Graham had a lot to say about testing the water quality that is sourced to the village and to Colgate University:

> We are required to report to the Madison County Health department on a monthly basis on usage, on fluoride, on disinfection (which is chlorine)...residuals at the end of the system, making sure it's disinfected and there's not just stagnant water out at the ends. They test for things like turbidity" (Sean Graham, personal communication, April 14, 2017).

We found a manual for a water chlorination system in the archives that was dated 1921, providing evidence for the amount of time for which the village has been disinfecting the water. When the village was still getting water from Woodman Pond, they implemented a slow-sand filtration system but residents were still unhappy with the quality, which ultimately prompted the shift to groundwater (Sean Graham, personal communication, April 14, 2017). In addition to chemical tests and treatments regarding the drinking quality of the water, the water in Hamilton is also very hard or contains a lot of mineral content. Rather than the village softening the water before it is piped to people's homes and businesses, that aspect of treatment is left up to the homeowners to handle (Sean Graham, personal communication, April 14, 2017). The hardness of the water poses a problem for Colgate's Central Heating Plant, drastically reducing the lifespan of the various equipment the water comes into contact with, causing some parts to need replacement every year (Representative from Facilities, personal communication, April 21, 2017).

*Looking to the Future*

When John Pumilio was hired by Colgate University in 2009, the rates for water were more expensive and Colgate was using more water than we currently are (John Pumilio, personal communication, April 11, 2017). When discussing what water use looked like in this time period John said:

> There wasn't a campus-wide or university-wide water conservation program. No one was really paying attention to how much we used on campus or even how much we spent on campus with what. Because, you know, each building gets its own bill. So while the buildings would get billed, we didn't have a good sense overall of how much we were paying for that...The whole thing of you manage what you measure, we began to measure and report that. (John Pumilio personal communication, April 11, 2017).

In this discussion, he was getting at the fact that because the university was paying for water for each building individually and did not get a single bill for the entire water usage, there was no measure of how the university was doing in relation to water usage. He also points to taking the next step and measuring total water usage as a precursor to managing the amount of water we were using.

In terms of projections for the village water department, there is an efficiency project in the works: considering installing an AMI (automated meter infrastructure). Each house would replace their current meters with AMI which would notify the residents and the town about a spike in water usage above any of their averages. This notification system is important for catching potential leaks before it is too late and the homeowners have a bill that could be as high as $30,000 from water leaks (Sean Graham, personal communication, April 14, 2017).

## Discussion

As the results section showed, there are multiple changes in water sources, water systems, and water use throughout Colgate's history (Figure 5). In this analysis section, we will attempt to bring the most important results of our research to the surface and point to how they have symbolized thinking that has lined up with sustainability thinking or other important considerations for the future.

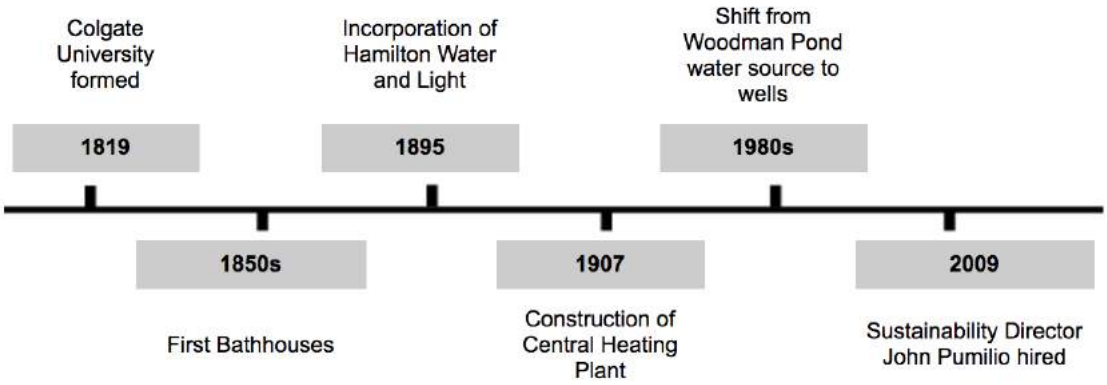


**Figure 5:** Timeline of the major events that have changed the way that water is used and prioritized at Colgate University since its formation.

*Environmental Sustainability*

Our criteria for determining whether domestic water use at Colgate has been environmentally sustainable are whether Colgate has ever overdrawn water from the aquifer, or whether the aquifer has been strained for any reason. The other piece of our environmental criteria is whether Colgate has ever been responsible for polluting the water supply. In terms of environmental sustainability, we have no reason to believe that Colgate has ever strained the water supply. As village administrator Sean Graham communicated to us, in tests where a significant amount of water was pumped out of our aquifer to see replenishment rates, the water level returned to normal quickly. In terms of having contingency plans, Sean Graham noted the lack of a good backup water source right now and mentioned a new project being pursued by the town to build a third well that will be used as backup and will minimize damage to the aquifer if there is an environmental stress like drought or contamination.

In terms of whether or not Colgate has polluted the water source, there was no indication of such a circumstance. While there were mentions of older filtration and water quality tests done earlier on in the 20th century such as the slow-sand filter system, it is unclear whether these water quality tests were successful and if Colgate as a university contaminated the water in a way that ruined these systems. From Sean Graham's thorough explanation of the water quality tests that the village performs now and Colgate's cooperation with this in their use and wastewater, it appears that the water quality of the aquifer has been paramount in both entities for the past couple decades.

The thing that did concern us was the fact that meters in all the buildings on Colgate's campus have still to be implemented. They are installing more and more but water metering is still not campus wide. And it appears that throughout most of Colgate's history (up until the 21 century) there was no metering by building. While this is an economic concern, it also has environmental implications as Colgate is not sure how much water they are spending exactly in which area. Sean Graham also mentioned that with the meter monitoring systems they have now, there is the possibility of a water leak at a residence or building to go unnoticed if the monthly meter check had been completed before the leak started. This raised concerns for unintentional water use for both the university and the town. As John Pumilio said in our interview with him "you manage what you measure" in order to better manage our water resources we need to measure our usage better (John Pumilio, personal communication, April 11, 2017). Universities are hubs high water usage and provide home to students from a variety of backgrounds (Gao et al., 2014). Better management strategies at universities will have a disproportionate impact on local water resources relative to the amount of land that they take up. These management strategies will also have a ripple effect on areas outside of the campus as students return to their homes or move to other places to get jobs.

*Social Sustainability*

Our criteria for determining social sustainability focused on the quality of the relationship between the university and the village. Our two sub-questions within this were: How has Colgate involved the Village of Hamilton in its decision-making process regarding changes to domestic water use? And has the university used water in a manner that is equitable to the village? In asking some of the same questions about stakeholder involvement to both the Colgate facilities staff, mayor Bob McVaugh and the village administrator Sean Graham, we were looking to see

whether there were any discrepancies in they ways that they viewed their relationship. We asked probing questions that would hopefully reveal any opposed perspectives if they did indeed exist. From their responses, neither groups, those representing the university nor those representing the village mentioned anything negative about their relationship. This makes it seem like the relationship is based on respect and that each party is satisfied with it. We also asked about the extent to which the university involves the village before there is a major change in water use and both parties indicated that this involvement was present. From this, we conclude that the university is exemplifying democratic decision-making between themselves, their provider, and their neighbors regarding domestic water use. The inclusion of the Village of Hamilton in the university's decision-making processes is representative of procedural justice (Walker, 2012). We asked stakeholders from the village and from Colgate a question using the word equitable and both parties relayed the message that everything has gone smoothly regarding the use of water and both parties understand that there will be an inequality in water use between the university and other residents because it is such a large consumer but don't think that it is disproportionate or inequitable. This is representative of distributive justice which along with procedural justice is a key component of social sustainability (Walker, 2012).

*Economic Sustainability*

Our criteria for determining economic sustainability questioned how economic considerations impacted water use decisions and consisted of three sub-questions: How much domestic water is being used per capita? How much money is being spent on domestic water per capita? How does the money spent on water compare to the amount of money spent on other things? From the data we collected, particularly from the interviews with Sean Graham and the utility staff at Colgate, it appears that Colgate has made decisions throughout its history based on economic principles. While Bob McVaugh and Sean Graham both mentioned water as a natural resource, they focused on water as a utility, in other words, a product that can be bought and sold. This lines up with Peter Gleick's (1998) thought that in this world, water carries an important identity as a private good which sometimes overpowers its identity as a shared resource. However, the Village of Hamilton's position as a government that is providing water to its residents complicates the notion that they are perpetuating the commodification of water. While they are selling the water to their residents, they are attaching a price to the water because they are providing the water and the treatment of water as a service to their residents. The cost for the water could also be considered a tax that the village's residents pay. John Pumilio corroborated that water today is often managed with an economic motive. As he told us about water conservation on campus, "We're getting to more awareness. Not for environmental reasons, but because for economic reasons. We want to conserve water "to save money and be better stewards of our operating dollars" (John Pumilio, April 11, 2017).

A concern towards economic sustainability is the lack of water meters that are currently in buildings on campus. The goal for Colgate utility staff to put meters in all the buildings is a movement towards being able to keep Colgate accountable of all the water it uses and then work towards economic sustainability. For so long, the amount and price of water were not recorded which doesn't allow us to say whether or not Colgate was economically sustainable based on the criteria we set forth: how much water has been used and how much money spent on water per capita over the Colgate's history. The lack of any economic incentive to conserve water is consistent with Colgate's positioning in a water-rich area (Vorosmarty et al., 2000). Vorosmarty

et al. (2000) show that this area has populations that are much lower than the threshold to cause water stress. However, there is also a projection for increased water stress in the future as a result of climate change and population increases (Vorosmarty et al., 2000). Keeping these projections in mind will be important for providing economic justifications for water conservation in the future.

## Recommendations

In closing, we present some final recommendations to Colgate University for sustainable water use that ensures the campus is viable for another 200 years. These recommendations include continued prioritization of the relationship between the university and the village, increased prioritization of water conservation, increased student engagement in water conservation efforts, and widespread installation of water efficient technologies.

*Continued Prioritization of Colgate-Hamilton Relationship*

In our discussions with representatives from Colgate University's Facilities Department and with Sean Graham, both parties expressed positive opinions of the relationship between the university and the Village of Hamilton. These positive opinions along with the open communication between these two entities is a strong sign of social sustainability and we consider maintaining the strength of this relationship to be the key to continued security of local water resources. Maintaining this relationship will also allow for the continued flow of information between these entities which can promote more widespread adoption of sustainable water use.

*Increased Prioritization of Water Conservation*

Throughout Colgate University's history, there is little evidence of a strong desire to reduce water use or conserve water for ecological purposes. It makes sense that the water conservation would not be a priority historically, because of the positioning of Colgate in a water-rich area that does not experience shortages. However, in the future, potable water availabilities will be altered by climate change and the sooner the university takes water conservation seriously the better prepared we will be for any potential changes in water availability. This recommendation is also made with the consideration of the notion that even though we are in a water-rich area we still have an obligation to use it wisely as we are not the only consumers of our water supply. Reduced water usage will also save the university money as with increased water use the university pays more for both water and wastewater treatment.

*Increased Student Engagement in Water Conservation Efforts*

Along with the lack of prioritization of water conservation, there are very few efforts to engage students in water conservation. Aside from passive water conservation signs installed above water fountains as a result of a partnership between the Office of Sustainability and Shaw Wellness Center, there are currently no Office of Sustainability initiatives to educate students about their water consumption or any events for engaging students in efforts to reduce their water consumption. Despite the water richness of this area that may warrant a decreased prioritization, current students represent 47 states and 75 countries and education about how to conserve water will have a ripple effect out to other places where the issue may be more

pressing. One possible way to achieve this is through the implementation of a program similar to Colgate Unplugged or RecycleMania, which are existing competitions that encourage students to decrease energy usage and increasing recycling rates, respectively. A water conservation competition would provide the opportunity to both educate and engage students in water conservation efforts.

*Widespread Installation of Water Efficient Technologies*

Our final recommendation is a more widespread installation of more water efficient technologies. The installation of low-flow shower heads saves the university more than $100,000 a year despite an upfront cost of only $17,000. Not only do these showerheads save water, they also save the university money. It is because of this that we recommend Colgate implement more water efficient technologies such as dual-flush toilets with two settings, one for liquid waste and one for solid waste. These dual-flush toilets have already been installed in a select few buildings on campus. With a wider integration of these toilets, the university could save .5 gallons of water for every flush of liquid waste which would add up to a large number of gallons saved over one year.

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# Appendix A: Consent Forms

## Certificate of Informed Consent – Colgate University
## Sustainability of Water Use throughout Colgate's History - Staff Interview

**Overview and Procedure:** We are a group of students at Colgate University who are studying the domestic water use and systems at our university both in the past and in current times as a contribution to the Colgate Bicentennial Project. We would like to ask you questions concerning these topics in order to understand how they relate to present day understandings of sustainability. The interview will take about 45 minutes of your time.

**Risks:** Your participation in this project is low risk, as we merely seek accurate explanation of Colgate systems and priorities.

**Confidentiality:** While the student researchers for this project will be the only persons with access to the original data, this project includes making a video project that will be published on Colgate's YouTube page and a final report to be presented to Colgate administrators. The intention is to use images and/or quotes from this interview in either of these two components of the project. Results from this study will be made available to you should you desire

**Compensation:** There is no compensation involved in completing this interview.

**Your Rights:** As your participation is fully voluntary, you have the right to withdraw from this study at any point or decline to answer any question.

**Contact Information:** If you have any questions about this study or your rights please contact the principal investigator: Dr. April Baptiste (abaptiste@colgate.edu; 315-228-6740). You can also contact the Chair of the Institutional Review Board of Colgate University (IRB_Chair@psych.colgate.edu; 315-228-7354).

Please circle the appropriate choice for each of the following:

Yes or No: I give permission for my voice, image, name etc. to be used for your video component of your class project

Yes or No: I give permission for my quotes to be used in your project

By signing below, you are agreeing 1) to participate in this study, 2) to allow the researcher to use your responses either in full or part for reporting the results of this interview and 3) that you have read and understand all of the information provided on this form.

| | |
|---|---|
| _____ | _____ |
| Participant Name (please print) | Researcher Name (please print) |
| _____ | _____ |
| Participant Signature | Researcher Signature |
| _____ | _____ |
| Date | Date |

## Appendix B: Interview Questions

John Pumilio Interview Questions:

1) What did water use at Colgate look like when you were first hired? Do you have a sense of what the university's priorities regarding water use were during this time period?

a) How have you seen water use change in the years that you have been working here and the priorities that the university has included in water use decisions? Has Colgate prioritized saving money, saving water as a resource, etc.?

2) What do you see as the biggest challenge that the university faces with domestic water use?

3) What are some initiatives that Colgate has pursued to alter the way students use water? Which ones have been successful and what are the criteria you use to judge them as succesful?

4) What do you consider the biggest accomplishment in the movement towards sustainable water use on Colgate's campus?

5) In your opinion, how well does Colgate follow through with their priorities in water use? How does Colgate's water use compare to peer institutions?

6) How do you see the relationship between the university and its water provider?

7) Do you see any ecological impacts of water use at Colgate and, if so, what are they?

8) Where do you see a push for more sustainable water use coming from? Your office? The Sustainability Council? The administration? Students? Or is there no push for more sustainable water use?

9) What changes to water use do you hope the university makes in the future? Is there anything you wish the university would adopt in the future?

Bob McVaugh Interview Questions:

1) Where does Colgate get its water now? Where has the university historically gotten its water from?

2) How does Colgate's position as a major water consumer affect the dynamics of water resources and price for the village?

3) How would you characterize the relationship of Colgate University and the Village of Hamilton concerning water?

4) Have there been any disputes between Colgate and the Village over water sources or utilization? Are there any questions in equity in water use?

5) Which stakeholders are involved in decision-making of water on Colgate's campus? Are administrators or even citizens from Hamilton involved in the discussion? What is your role as mayor in facilitating conversations?

6) What are some of the uses of water at Colgate that we might think of as pre-modern in terms of technology? Which pre-modern uses were water resource-heavy?

7) What were some major shifts in water technologies/sources over the course of Colgate's 200-year history? Are there periods at which domestic water uses (those in the dorms and academic buildings) fundamentally changed?

8) Do you know of any concerns about water quality either on campus or in the village of Hamilton, historical or present day?

-(using knowledge from previous interviews) Are there any health effects that are worrisome from such hard water?

9) Do you know of ongoing or future projects concerning water that Colgate or the Village of Hamilton will be tackling?

10) In your opinion, as both the mayor of Hamilton and a scholar, what kind of mentality should Colgate maintain in decisions regarding water use?

11) Is there anything else that you would like to mention about water at Colgate at the university, local or regional scale?

Sean Graham Interview Questions

1) From which source does the Village of Hamilton get its water now? Where did Hamilton get water in the past?

a) What were some major shifts in water technologies/sources over the course of Hamilton's history in the past 200 years?

2) How does Colgate get its water now? Where has the university historically gotten its water from?

3) Do you keep records of the quantity and cost of water as the Village of Hamilton or do you know where to find them? If so, when did records start?

4) How does Colgate compare to other users of water in the Village of Hamilton?

5) How does Colgate's position as a major water consumer affect the dynamics of water resources and price for the village?

6) How would you characterize the relationship of Colgate University and the Village of Hamilton concerning water?

7) Have there been any disputes between Colgate and the Village over water sources or utilization? Are there any questions in equity in water use?

8) Which stakeholders are involved in decision-making of water on Colgate's campus? Are administrators or even citizens from Hamilton involved in the discussion?

9) What is the quality of water like in Hamilton? In what ways is water treated before consumption and use? Do you know of any concerns about water quality in the village of Hamilton, historical or present day?

a) Are there any health effects that are worrisome from such hard water?

10) What are some ongoing or future projects concerning water that the Village of Hamilton will be tackling?

11) Does the village of Hamilton make any efforts to conserve water? When did these initiatives, if any, begin? Is there evidence of conservation efforts in the past that are not still underway?

12) What are the priorities when making decisions about water in Hamilton in general? For example, do the major considerations involve money spent on water, using water efficiently, or culture of water use among residents?

13) In your opinion, what kind of mentality should the village of Hamilton maintain in decisions regarding water use? And what mentality would you like Colgate University to hold?

14) Is there anything else that you would like to mention about water in the Village of Hamilton, on a local or regional scale?

Buildings and Grounds Interview Questions:

1) Where exactly does Colgate's tap water come from? How long has this been the case?

2) How would you characterize the university's relationship with its water provider? Have there ever been any conflicts?

3) Do you keep records of the quantity and cost of water use at Colgate over time? If so, when did that start?

4) What are the priorities when making decisions about water use on campus in general? For example, do the major considerations involve money spent on water, using water efficiently, or culture of water use among students?

5) Over the course of Colgate's history, we assume that there have been major spikes in water use due to new ways utilize water and installation of new systems. In terms of policy, if there is a major increase in water usage, does the university contact its water source ahead of time?

6) What are some major changes in the water systems/sources over the past 200 years?

7) Within dorms and academic buildings what are the modern uses of water that are the most water intensive?

8) Are there any ways that water is used in residential halls or academic buildings that people don't know about or don't pay attention to? Examples being...

9) Does the university make any efforts to conserve water? When did these initiatives, if any, begin? Is there evidence of conservation efforts in the past that are not still underway?

10) Are there any plans on the table that will be changing water use at Colgate in the future?