LOCAL SURFACE WATER QUALITY STUDY: COLD SPRING AND THE MILL RIVER OF NEW HAVEN, CT

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Abstract

In East Rock Park, New Haven, adjacent to the Mill River, are two groundwater springs. This project aimed to understand the drinking potential of one these springs through enzyme substrate analysis of the pathogen indicator bacterium, *Escherichia coli*. Samples from Cold Spring (N 41° 19’ 35”,W 72° 54’ 34” near the southern end of the Orange street bridge) were taken two to three times a week during base flow conditions. Some additional samples were taken during or directly following storm events to understand the effects of stormflow on fecal coliform concentrations. The second source is known as Colonial Spring, and is located near Farnam Dr in East Rock Park at 41° 19’ 34” W 72° 54’ 24”. This study also investigated the history of these groundwater springs, and produced an overview of stakeholder groups connected to the Mill River.

Introduction

History

Drinking water in New Haven was historically sourced from rivers and shallow, hand dug wells. But as the city developed, businesses expanded, and the need for fire protection increased, there became a push for a more adequate and reliable water supply. In 1849, a group of citizens received a charter from the Connecticut legislature to form the New Haven Water Company (NHWC). The role of NHWC was to supply the city with clean water for domestic and public consumption. Eli Whitney II was brought onto the project and proposed a dam be built on the Mill River. Water from this reservoir, named Lake Whitney, began distribution to New Haven residents on January 1, 1862 (Storied history, 2021).

Figure 1: Aerial shot of the Mill River exiting Lake Whitney. Star indicates Cold Spring (FUSS & ONEILL, 2019)

East Rock Park is 425-acres of parkland on the New Haven-Hamden border. Its distinguishing feature is East Rock itself, a 350-foot-tall traprock ridge formed by magma intrusions around 200 million years ago and modified by glaciers (East Rock, 2021). The Mill River carves along the base of East Rock, with the towering rock on the north and east side, and lower, flat land on the west and south. This can be seen in greater detail in Figure A in the Appendix.

Lake Whitney and the Mill River that feeds it, are classified as AA surface waters, meaning used for drinking water supply. As water leaves Lake Whitney and flows through East Rock Park, the surface water drops to class B. Then leaving East Rock under Willow Street, it becomes class SB because it is tidal in this reach. This can be further explored using this interactive map.

Involved Groups

Many individual community members and groups are interested and involved in both the Mill River and East Rock Park. Some of these groups and their website are listed below.

- Friends of East Rock Park, https://friendsofeastrockpark.org/
- Mill River Water Association, https://millriverofsouthcentralct.org/
- Regional Water Authority, https://www.rwater.com/
- Save the Sound, https://www.savethesound.org/
- Youth @ Work program, https://www.newhavenct.gov/gov/depts/youth_services/prog/work.htm

Water Standards

Coliforms are bacteria found widely in the environment including soils, waters, and animal life. Fecal coliforms are a subset of total coliforms and come from the digestive tracks of mammals, including humans. Fecal contamination of water used for recreation, fishing, or drinking can pose a threat to public health. Coliform bacteria are often used as "indicator" organisms for the presence of pathogens in water (*NYS DOH*, n.d.). *Escherichia coli* (*E. coli*) and enterococci are subgroups of the fecal coliform group, and are commonly used as indicators of recent fecal contamination (Staley et al., 2013). A delineation of how these groups relate is provided in Figure X of the appendix.

Total coliform bacteria are used to determine risk for existing and proposed public drinking water supplies. At drinking water intake structures, the allowed single sample maximum is 500 (MPN/100 mL) total coliforms (*CT TMDL*, 2012). The maximum contaminant level goal (MCLG) is the level of contaminant below which there is no known or expected risk to health. The MCLG for *E. coli* in drinking water is zero. The maximum contaminant level (MCL) is the

highest level of contaminant allowed and is the level with which the system must comply. The MCL for *E. coli* in drinking water in Connecticut is based on the results of the routine sample and its associated repeat samples. According to the Revised Total Coliform Rule (2015), the system is out of compliance with the MCL if:

1. "The system has an E. coli-positive repeat sample following a total coliform-positive routine sample.
2. The system has a total coliform-positive repeat sample following an *E. coli*-positive routine sample.
3. The system fails to take all required repeat samples following an *E. coli*-positive routine sample.
4. *E. coli* analysis is not completed when any repeat sample tests positive for total coliforms."

E. coli are used as Connecticut's primary indicator bacteria for assessing recreational uses in the State's fresh waterbodies (*CT TMDL*, 2012). For water to be swimmable, it needs to have fewer than 235 colonies of *E. coli*/100 ml. For non-designated swimming recreation with high water contact (such as tubing or water skiing), the water must not exceed a single sample maximum of 410 *E. coli* colonies/100 ml. Lastly, for all other recreation uses (such as kayaking), there should be a maximum of 576 *E. coli* colonies/100 ml in a single sample (*CT TMDL*, 2012). These distinctions can be investigated further in *Figure C* in the Appendix.

Enterococci bacteria are used to assess recreation uses in salt waterbodies. In saline recreational waters of classes SA and SB, designated swimming areas must comply with fewer than 104 *Enterococci* (MPN/100ml), and all other recreational areas must have fewer than 500 *Enterococci* (MPN/100ml) (*CT TMDL*, 2012).

Fecal Coliform Sources

Contamination of water from human or animal waste can be attributed primarily to several key sources. This includes improperly treated septic and sewage discharges, leaching of animal manure, and waste from domestic animals, pets, and wildlife (*CT TMDL*, 2012). These sources can be transported into rivers, lakes, or groundwater from precipitation and storm water runoff.

Storm events are known to increase fecal coliform presence in water bodies. It has been commonly found that fecal indicator bacteria concentrations vary significantly temporally, and these variations are correlated with antecedent rainfall events. A study in Florida found that rainfall that occurred 1 day ($R = 0{\cdot}46$), 3 days ($R = 0{\cdot}43$) and 7 days ($R = 0{\cdot}53$) prior to sampling impacted the fecal coliforms (Staley et al., 2013). A study in Oregon found that almost 70% (53/77) of the bacterial exceedances recorded had occurred within five days of a significant

rainfall (7 mm in 24 h) event (Neumann et al., 2006). Therefore, stormwater runoff is a major player in bacteria contamination management.

Mill River Watershed Management

Driven by water quality concerns in the Mill River, organizations including Save the Sound, the Connecticut Department of Energy and Environmental Protection (CTDEEP), the watershed municipalities, and other key stakeholders came together to create the Mill River Watershed Management Plan. A Project Steering Committee for the Mill River was formed in March 2018 and this committee along with other stakeholders identified issues of concern and watershed planning priorities. There was interest in controlling pollution from stormwater runoff, water quality, and bacteria levels (FUSS & O'NEILL INC, 2018). The second of the five primary goals of the management plan is directly water quality related. It states,

1. "Improve the water quality of the impaired segments of the Mill River and its tributaries by reducing loadings of bacteria and other pollutants.
2. Consistently meet water quality standards for recreation and aquatic habitat.
3. Protect and enhance high quality and unimpaired waterbodies" (FUSS & O'NEILL INC, 2018).

One of the sub-objectives towards meeting this goal, is the continued monitoring of water quality. This water quality study attempts to contribute a subset of data towards this greater goal.

Although the data we collected are not included in this report, the results were that Cold Spring was found to be of drinking water quality in terms of the absence of bacteria.
Similarly, the nearby river was found to be swimmable except immediately following rain events, which tend to wash bacteria in from the watershed.

Site Description

This project investigated two natural springs near the banks of the Mill River and the Mill River itself in New Haven, Connecticut. Both springs have pipes to channel the water and surrounding stone facades. The spring on the south side of the Mill River is named Cold Spring, and the spring on the north side is named Colonial Spring. Only Cold Spring was tested in this sampling campaign because Colonial Spring does not have the structure to provide running water.

a) b) c)

Figure X: Cold Spring; a) stone facade and pool area of Cold Spring, b) inflow pipe of spring water, c) outflow of spring water to Mill River from under the landing

d) e)

Figure X: Colonial Spring; d) stone facade surrounding spring, e) small pool and drainage pipe of spring water

History of Cold Spring

Cold Spring has been used for drinking water in New Haven since colonial times. It was known for having clear water and was a resource treasured by the community. Below is an excerpt from a Hot Weather Resort from 1838, an article that lists places to seek refuge during extreme heat. The full text is shown in Figure B in the Appendix.

> *"Cold Spring, on the southern bank of Mill River, about a mile from the Court House, is a pleasant place for a leisure stroll or a short ride; but there are no artificial conveniences—you must carry your own tumbler; besides, somebody is apt to be in exclusive possession of the quarters before you arrive. The shades are, however, extensive, and the best water runs free to all" (Dana Collection, Vol 96, 1838).*

Figure X: Postcard depicting the view from Cold Spring towards the Mill River, facing east. The date of the image is undetermined, but the postcard itself was sent in 1908 (Postcard Collection, 1908)

The earliest photograph that documents someone drinking from Cold Spring, is from the front page of the Saturday Chronicle dated October 6, 1906.


SATURDAY CHRONICLE

New Haven, Conn., October 6, 1906

SINGLE COPIES FIVE CENTS

COLD SPRING NEAR EAST ROCK ROAD.

Figure X: Photo of man drinking from Cold Spring on the cover of the Saturday Chronicle (Saturday Chronicle, 1906).


Cold spring, Mill River - 1910
Photography by Myron W. Filley, New Haven

Figure X2: Cold Spring in 1910 along the bank of the Mill River (Dana Collection, Vol 102A, 1910)

The image (Figure X) shows a man drinking what is presumed to be spring water from Cold Spring. The surrounding forest looks to be sparsely wooded, and Mill River runs closer to the spring compared to its present condition in 2021. There is no other descriptive text about this

image included in this Chronicle issue. Figure X2 is of the spring four years later, in 1910, and it captures a dog and a man drinking from a cup near Cold Spring.

At an undetermined date in the mid 1900s, a stone facade was built around Cold Spring which further established it as a place of significance for the East Rock community.

Figure X: Postcard of people drinking from Cold Spring using a metal cup attached to a chain (Dana Collection, Vol 102A, n.d.)

But at some point, the maintenance of the spring halted. For more than half a century, sediment and refuse slowly covered the path and the spring. It was rediscovered around the early 1970s by the East Rock Neighborhood Association and Cub Scout Pack 36 when they were doing cleanup work in the park. A newspaper article describes the rediscovery of Cold Spring and details of the spring itself.

> *"The pipe from the spring extends out of the base of a vertical niche which is recessed in a four foot wall constructed out of rusticated stones. The niche stands about three and one half feet tall and is arched at the top and has a flat stone terrace and two stone stairs at the front. On this terrace the thirsty wanderer used to kneel down and fill his canisters from the ample flow. In the past, the spring was provided with a tin cup on a chain for drinking. The hook for the chain can still be seen in the wall. Association members said the spring site is still covered with mud and is not yet safe for drinking. Whether the spring can be restored to the state of purity required for drinking has not yet been determined" (East Rock Microfilm, n.d.)*

This report also dates the building of Cold Spring before 1900 and states that it “has not been used since World War 1.” A photograph of the report can be found as Figure C in the Appendix.

Figure X: Photograph of Cold Spring (Feldman, 2021)

And today (2021), Cold Spring still sits near the bank of the Mill River with its stone arch and terrace exposed to those passing by on walks or bike rides. It is no longer commonplace to drink straight from the spring, but to do so would certainly be like drinking history. Thus, this research hopes to shed light on the possibility of reconnecting the people of East Rock with Cold Spring as a drinking water source.

History of Colonial Spring

Colonial Spring is located at the foot of East Rock, just East of Orange St (Figure A in Appendix). It has stonework surrounding the mouth of the spring, and two staircases leading up to English Drive on either side.

Figure X: Photographs of Colonial Spring circa 1910 and 1925 in order (Thomas S. Bronson Collection)

Inscribed on the stonework is “James Heaton, 1633”. In 1944, the Park Department disclosed that “all [they] know concerning this inscription is that it was paid for and developed by John Heaton in 1908 in memory of his ancestor, James” (Dana Collection, Vol 102A, 1910). It is theorized that the James Heaton memorialized here, is an England-born colonial who is listed to have owned 108 acres of land on the east side of the Mill River (Family Search, n.d.). No evidence has been found so far that demonstrates that Colonial Spring was used as a drinking water source.

This information and these photographs were sourced from the New Haven Museum with the help of Ed Surato.

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Postcard Collection. (1908). New Haven Museum

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Thomas S. Bronson Collection. (1925 and 1910) (Box 10). New Haven Museum

APPENDIX

Figure A: East Rock Park Map. Cold Spring can be found across orange street from Wilbur Cross High School (East Rock, 2021)

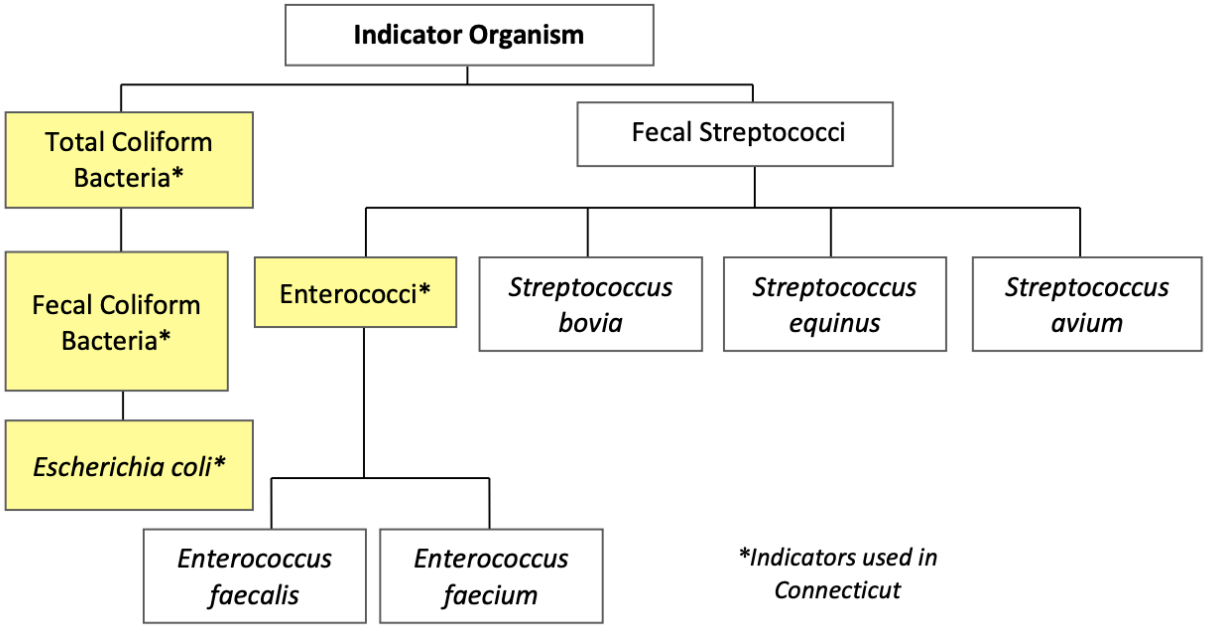


Figure X: Relationship among indicator organisms (CT TMDL, 2012)

Waterbody Class *Designated Use*	**Total Coliform (MPN/100 mL)**		***E. coli* (colonies/100 mL)**		**Fecal Coliform (MPN/100mL)**		**Enterococci (MPN/100 mL)**	
	Monthly Moving Average[1]	*Single Sample Maximum*	*Geometric Mean*[1]	*Single Sample Maximum*	*Geometric Mean*[1]	*90% of samples less than*[1]	*Geometric Mean*[1]	*Single Sample Maximum*
Class AA *Public Drinking Water Supply (Existing and Proposed)*	**100**[2]	**500**[2]	--	--	--	--	--	--
Classes AA, A, B *Recreation*	--	--	**126**	**DS**[3]**: 235** **NDS**[4]**: 410** **Other: 576**	--	--	--	--
Classes SA[5] *Shellfish (Direct) Consumption*	--	--	--	--	**14**	**31**	--	--
Classes SB[5] *Shellfish (Indirect) Consumption*	--	--	--	--	**88**	**260**	--	--
Classes SA and SB *Recreation*	--	--	--	--	--	--	**35**	**DS**[3]**: 104** **Other: 500**

[1]The monthly moving average, geometric mean, and 90% of samples metrics are statistically based

[2]Only at the drinking water intake structure

[3]Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in: Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protection and the Department of Public Health, May 1989, revised April 2003 and updated December 2008.

[4]Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely

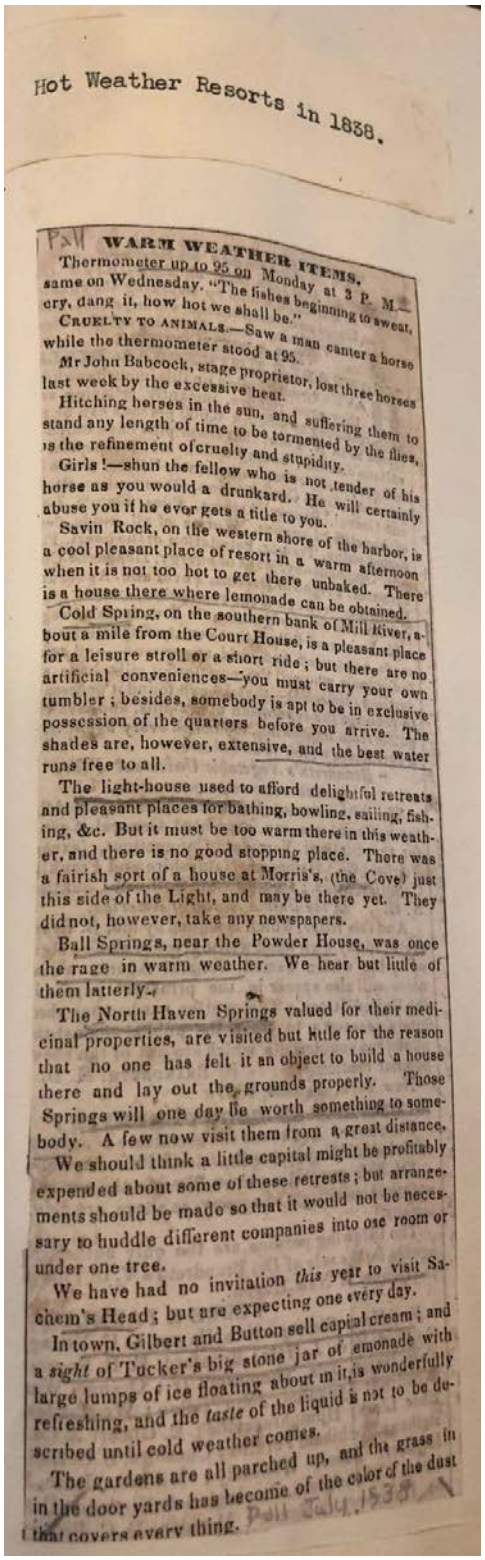
[5]Criteria are based on utilizing the mTec method as specified in the U.S. Food and Drug Administration National Shellfish Sanitation Program-Model Ordinance (NSSP-MO) document Guide for the Control of Molluscan Shellfish 2009.

DS denotes Designated Swimming Area

NDS denotes Non-Designated Swimming Area

Other denotes All Other Recreational Uses

Figure B: Numeric criteria for indicator bacteria by waterbody class and designated use in Connecticut (*CT TMDL*, 2012)



Hot Weather Resorts in 1838.

WARM WEATHER ITEMS.

Thermometer up to 95 on Monday at 3 P. M.—same on Wednesday. "The fishes beginning to sweat, ery, dang it, how hot we shall be."

CRUELTY TO ANIMALS.—Saw a man canter a horse while the thermometer stood at 95.

Mr John Babcock, stage proprietor, lost three horses last week by the excessive heat.

Hitching horses in the sun, and suffering them to stand any length of time to be tormented by the flies, is the refinement of cruelty and stupidity.

Girls!—shun the fellow who is not tender of his horse as you would a drunkard. He will certainly abuse you if he ever gets a title to you.

Savin Rock, on the western shore of the harbor, is a cool pleasant place of resort in a warm afternoon when it is not too hot to get there unbaked. There is a house there where lemonade can be obtained.

Cold Spring, on the southern bank of Mill River, about a mile from the Court House, is a pleasant place for a leisure stroll or a short ride; but there are no artificial conveniences—you must carry your own tumbler; besides, somebody is apt to be in exclusive possession of the quarters before you arrive. The shades are, however, extensive, and the best water runs free to all.

The light-house used to afford delightful retreats and pleasant places for bathing, bowling, sailing, fishing, &c. But it must be too warm there in this weather, and there is no good stopping place. There was a fairish sort of a house at Morris's, (the Cove) just this side of the Light, and may be there yet. They did not, however, take any newspapers.

Ball Springs, near the Powder House, was once the rage in warm weather. We hear but little of them latterly.

The North Haven Springs valued for their medicinal properties, are visited but little for the reason that no one has felt it an object to build a house there and lay out the grounds properly. Those Springs will one day be worth something to somebody. A few now visit them from a great distance.

We should think a little capital might be profitably expended about some of these retreats; but arrangements should be made so that it would not be necessary to huddle different companies into one room or under one tree.

We have had no invitation *this* year to visit Sachem's Head; but are expecting one every day.

In town, Gilbert and Button sell capital cream; and a *sight* of Tucker's big stone jar of emonade with large lumps of ice floating about in it, is wonderfully refreshing, and the *taste* of the liquid is not to be described until cold weather comes.

The gardens are all parched up, and the grass in the door yards has become of the color of the dust that covers every thing.

Ball July 1838

Figure C: An article on places to seek refuge from hot weather in New Haven (Dana Collection (Vol 96), 1838)

Cold Spring restored

Cold Spring Found During Park Cleanup

Some 40 members of the East Rock Neighborhood Association and Cub Scout Pack 36 recently blazed the trail under the steep bluff in College Woods Park to uncover an historic cold spring smothered under more than half a century of sediment and refuse.

The spring, for which Cold Spring Street was named, was built before 1900 and has not been used since World War I.

The work team, after a picnic lunch, climbed westward from the south side of the Orange Street Bridge through a tangled, overgrown trail leading to the clogged spring.

The cleanup was part of the East Rock Neighborhood Association's annual work day, which also included the picking up of trash in the park and an attempt to piece together fragments of the Farnham Drive Plaque, which had been decimated by vandals.

Workers dug and cleaned for about three hours at the spring site before the cold water began to flow.

Efforts of the group then turned toward the muddy task of clearing a channel for the spring water to flow unimpeded into the Mill River.

The pipe from the spring extends out of the base of a vertical niche which is recessed in a four foot wall constructed out of rusticated stones.

The niche stands about three and one half feet tall and is arched at the top and has a flat stone terrace and two stone stairs at the front.

On this terrace the thirsty wanderer used to kneel down and fill his canisters from the ample flow. In the past, the spring was provided with a tin cup on a chain for drinking. The hook for the chain can still be seen in the wall.

Association members said the spring site is still covered with mud and is not yet safe for drinking. Whether the spring can be restored to the state of purity required for drinking has not yet been determined, a spokesman said.

The group is planning a second day of work sometime in June to complete the restoration of the spring.

Figure D: Newspaper article on rediscovering Cold Spring. Estimated date 1972. (East Rock Microfilm, n.d.)