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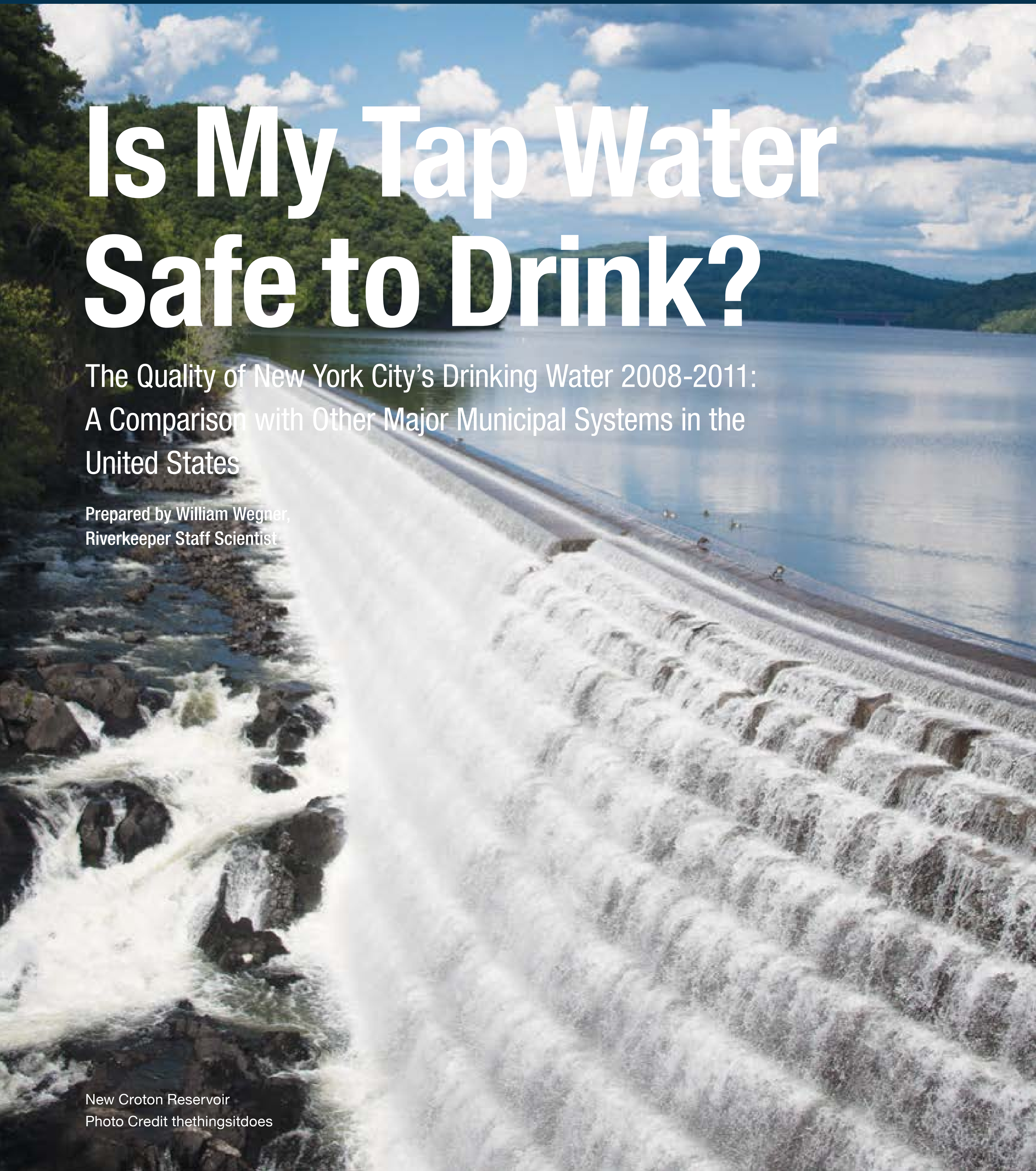

Is My Tap Water Safe to Drink?

The Quality of New York City's Drinking Water 2008-2011: A Comparison with Other Major Municipal Systems in the United States

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New Croton Reservoir
Photo Credit thethingsitdoes

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Executive Summary

Residents of New York City (NYC or the City) and the Hudson Valley who depend on the City's drinking water supply want to know whether their tap water is safe to drink. Riverkeeper's Watershed Team has undertaken a multi-year study, in terms of both present and future water quality, in order to answer that question.

Study Approach

The Safe Drinking Water Act requires all operators of municipal drinking water supplies to inventory contaminants and report the results to the public annually. Using data provided in these annual reports from 2008 through 2011, Riverkeeper examined and compared the drinking water quality of the ten largest U.S. cities, including New York, the largest by population and the only city among the ten largest that has an unfiltered drinking water supply. The City's drinking water quality was also compared to that of four other large cities with **unfiltered** water supplies.

Report Findings

Whether drinking water is consumed from the tap or from bottles, some impurities are always present. The key question is: do these impurities pose health risks—are they present in concentrations that exceed state and federal safety standards? Riverkeeper's survey revealed that, between 2008 and 2011, New York City's drinking water met state and federal water quality standards in most areas, but exceeded limits for lead at the tap and turbidity in source waters. Key findings of the study:

1. New York City's testing program is robust and comprehensive. In all four years reviewed, the City tested drinking water for more contaminants than any of the ten largest U.S. cities surveyed (an average of 266 over the study period), with the exception of San Francisco in 2008 (249 vs. 231 for New York).

2. With the exception of lead in New York and Boston, which is caused by lead-soldered plumbing in older buildings, all cities reviewed had very few exceedances, indicating that overall drinking water quality in the cities surveyed is very high. New York City's lead exceedances represented 7.5% of the households tested in 2008. The same data were not reported as a percentage for 2009 or 2010, but were reported numerically in 2010 (with 30 lead exceedances total). Beginning in November of 2010, the New York City Department of Environmental Protection (NYC DEP), the agency responsible for maintaining the drinking water supply, implemented a public awareness program to educate consumers about lead in drinking water and began replacing all City-owned lead service lines. In 2011, there were 20 reported lead exceedances. On average over the four-year study period, New York reported the highest number of lead exceedances—14.8 per year—with Boston reporting 11.5 and the remaining surveyed cities ranging lower: 0.0 (San Jose, Chicago, San Francisco) to 4.7 (Philadelphia).

3. New York City reported detection of waterborne pathogens in approximately 80% of the water samples tested. Two pathogens of concern to human health are the microscopic protozoa *Giardia* and *Cryptosporidium*. The number of positive *Giardia* samples detected ranged from 111 in 2008 to 40 in 2011; positive *Cryptosporidium* samples detected ranged from 9 in 2010 to 84 in 2011. The City's testing methods do not allow it to determine whether detected organisms were alive or capable of causing disease. However, DEP follow-up studies showed that the *Cryptosporidium* found were from wildlife sources and that most were not infectious to humans. Although the City concluded that low numbers of *Giardia* and *Cryptosporidium* required no action on the part of the NYCDEP, it elected to construct the Cat/Del UV disinfection facility, which came on line in December 2012, to address these and other pathogens. Although no waterborne disease outbreaks were attributed to these pathogens, the presence of any potentially disease-causing organisms in drinking water supplies is of concern. All cities surveyed reported detecting waterborne pathogens, but only a few exceeded health standards: one each for San Francisco and Boston and two each for Los Angeles and Philadelphia during the four-year study.

4. Turbidity in drinking water supplies can mask the presence of pathogens and inhibit chlorine disinfection. Because of this, there are both federal and state standards for turbidity in drinking water supplies. The federal Safe Drinking Water Act and NYS Department of Health (NYSDOH) regulations limit turbidity in public drinking water distribution systems to 5 nephelometric turbidity units (NTU) in the terminal reservoirs that directly feed the drinking water distribution system. Turbidity levels in upstream reservoirs that feed the terminal reservoir in the Cat/Del system (the Kensico) exceeded this standard on a number of occasions during the years surveyed,

causing DEP to minimize flow from the Catskill Aqueduct to the Kensico. If source water turbidity is not adequately mitigated in the near future, storm-driven increases in reservoir turbidity could require filtration of New York City drinking water.

5. Pharmaceuticals and personal care products (PPCPs) in water supplies are contaminants of emerging concern due to their possible impacts on human health and aquatic ecosystems. Virtually all PPCPs are contaminants for which no state or federal drinking water standards have been established. The adverse effects of some hormones and endocrine disruptors on aquatic organisms are well documented; however, the health effects of long-term exposure to these compounds on humans are unknown and require further study. Widespread testing for these contaminants in municipal drinking water has only recently been implemented in some cities. Of the 14 filtered and unfiltered cities surveyed, only Seattle, WA and Portland, OR reported testing drinking water for PPCPs in 2008. In 2009 and 2010, New York, Chicago, and Boston also began testing for these contaminants. In 2010, New York conducted a follow up to its 2009 pilot study, which confirmed that some PPCPs are present in the City's surface water supplies, though only in trace concentrations. New York was the only one of the five that did not continue to test for PPCPs in 2011, because NYC and the NYSDOH concluded that such low concentrations in the City's water supply did not present public health concerns.

Conclusions

In summary, except for the presence of lead as a result of some antiquated plumbing fixtures, New York City's drinking water consistently meets federal and state regulatory safety standards. The number of lead exceedances in New York declined from 30 in 2010 to 20 in 2011. The prevalence of lead-soldered plumbing fixtures in New York City's older buildings, still poses a risk of lead exceedances in the future. In addition, although high turbidity in the distribution system has been in decline over the study period since 2009, turbidity in Catskill waters has increased during the same period. While we are encouraged that the quality of New York City's drinking water reservoirs remains high, in order to maintain this precious, high-quality municipal resource, DEP must continue to address threats to water quality that could pose risks to the City's water supply and its consumers now and into the future. These threats include turbidity in the Catskill Watershed and the occurrence of pathogens and PPCPs in all source waters. Based on the report findings, Riverkeeper recommends that NYCDEP take the following actions to address these threats.

Recommendations

1. Resume its PPCP testing program to monitor the presence of and changes in the concentrations of these compounds as other cities continue to do. In addition, we urge NYSDOH and the U.S. Environmental Protection Agency (EPA) to develop regulatory standards for these contaminants in municipal drinking water supplies.

2. Require retrofitting of lead-soldered plumbing in households reporting lead exceedances to reduce or eliminate exceedances of lead at the tap.

3. In order to continue to manage the presence of waterborne pathogens in terminal and upstream reservoirs, DEP should identify the sources of those pathogens and maintain and if necessary, enhance source controls, such as the Whole Farm Program and the Waterfowl Management Program, to address those causes.

4. Implement sound turbidity control measures to protect New York City's reservoirs, delivery system and consumers from inadequately detected and disinfected pathogens and, potentially, a filtration mandate that could result from increased turbidity associated with climate change and land use practices. These measures include but are not limited to: expanding DEP's Stream Management Plan to remediate more impaired Catskill stream reaches; re-evaluating and implementing structural control practices such as a multi-level intake in the Schoharie Reservoir; and/or a clarification facility downstream of the Ashokan Reservoir.

Is My Tap Water Safe to Drink?

This question is often on the minds of the nine million New York City and Hudson Valley residents who rely on New York City's reservoir system for the water that comes out of their taps every day. Based on the multi-year study undertaken by Riverkeeper's Watershed Team, the answer is a "conditional" yes.

The following discussion of the study undertaken and its findings expands on that answer and the reasons underlying it. This report:

- Describes where New York City's tap water comes from.
- Explains New York City's water protection measures and why they were established.
- Analyzes the results of New York City's drinking water quality reports from 2008-2011.
- Compares New York City's results to the drinking water quality of the 10 largest U.S. cities, all of which except New York have filtered drinking water supplies, and to four other large cities with unfiltered water supplies .
- Discusses present and future risks to New York City's drinking water supply.
- Provides recommendations based on the findings highlighted.

Where Does New York City's Tap Water Come From?

Three upstate New York City watersheds, the Catskill, Delaware and Croton Watersheds, supply nine million consumers with 1.2 billion gallons of high quality, unfiltered drinking water daily. The Catskill and Delaware Watersheds, which lie in the Catskill Mountains, supply 90% of that 1.2 billion gallons to New York City and more than 60 upstate municipalities. The New York City Department of Environmental Protection (NYCDEP) is the agency responsible for the operation of the City's drinking water supply system. In order to avoid the high cost of filtering this water, NYCDEP has put in place watershed protection programs to ensure that the drinking water supplied by this system meets state and federal drinking water quality criteria. However, the Croton Watershed has been offline since 2009 and is under a filtration order from EPA due to the potential for exceedance of standards governing chemical byproducts produced during the disinfection process (see discussion on page 9). If a filtration plant were ever required for the Catskill/Delaware Watersheds, it would cost New York City and upstate water ratepayers over $10 billion in capital costs and half a billion dollars a year for operation and maintenance.

How Does New York City Provide Safe Drinking Water?

The federal Safe Drinking Water Act's Surface Water Treatment Rule requires municipal drinking water suppliers to filter drinking water from surface water supplies unless good water quality can be maintained and watershed protection programs are implemented to minimize contamination of the source water. In 1997, New York City, the EPA, watershed towns, villages and counties, as well as environmental organizations (including Riverkeeper), forged the New York City Watershed Memorandum of Agreement (MOA), which established stringent regulations and watershed protection programs to protect the surface waters that provide unfiltered drinking water to the City and upstate consumers. The protection programs include land acquisition to protect buffer areas around streams and reservoirs, a strategy to reduce turbidity in the Catskill system, protective agricultural practices, and a stream management program to prevent the transport of sediment to reservoirs by restoring eroded watershed stream channels. The MOA allowed New York City to receive a Filtration Avoidance Determination (FAD) from EPA, which in turn allowed the City to continue providing unfiltered drinking water to consumers and avoid the costs of constructing and operating a multi-billion-dollar filtration plant.

With the MOA in place, EPA issued a five-year FAD in 1997. Based on NYCDEP's December 2001 Long-Term Watershed Protection Program, EPA issued another five-year FAD in November 2002, which included significant enhancements to the overall watershed protection program. In addition, the 2002 FAD highlighted two major themes in the City's program: a long-term commitment to watershed protection programs, and a reliance on watershed partners (such as the Catskill Watershed Corporation and the Watershed Agricultural Council) to enhance program acceptance and implementation.

In accordance with the provisions of the 2002 FAD, the 2007 FAD development process was initiated by the City's submittal of a report entitled "2006 Watershed Protection Program Summary and Assessment" in March 2006. In August 2006, EPA and NYSDOH completed an evaluation entitled *Report on the City of New York's Progress in Implementing the Watershed Protection Program, and Complying with the Filtration Avoidance Determination*. This report found that the City had successfully satisfied the obligations specified in the 2002 FAD. Highlighted strengths included the land acquisition and small farm programs, while certain delays were noted in the wastewater and stream management programs.[1]

Based on this report and NYCDEP's 2006 Long Term Watershed Program, in 2007, EPA approved a 10-year FAD for New York City's Catskill/Delaware Water Supply, with a mid-term review scheduled to occur in 2012. That review is currently ongoing. New York is one of the few large cities that continue to receive a FAD as a result of their ability to meet state and federal drinking water standards with unfiltered water supplies.

[1] USEPA, Filtration Avoidance, available at: http://www.epa.gov/region2/water/nycshed/filtad.htm.

Figure 1:

Map of Catskill/Delaware Watersheds

The Catskill and Delaware Watersheds encompass 1,600 square miles of the Catskill Mountains west of the Hudson River. This system supplies unfiltered drinking water to nearly half of New York State's population.

Figure 2:

Map of Croton Watershed

East of the Hudson River, the 375-square-mile Croton Watershed typically supplies 10% of the City's daily water supply from sources in Westchester, Putnam and Dutchess Counties. The Croton system remains unfiltered and offline as of the release of this report, although a filtration plant for that system is currently under construction and scheduled to go on-line in August 2013.

Riverkeeper's Drinking Water Quality Survey: Methods Used

Riverkeeper compared the drinking water quality of the ten largest U.S. cities, in descending order of population size: (1) New York, (2) Los Angeles, (3) Chicago, (4) Houston, (5) Phoenix, (6) Philadelphia, (7) San Antonio, (8) Dallas, (9) San Diego, and (10) San Jose. Among these 10 cities, New York is the only city with an unfiltered drinking water supply. In addition, we compared the drinking water quality of New York with that of four other large cities that rely on unfiltered drinking water supplies: Boston, Seattle, San Francisco, and Portland, Oregon.

To keep consumers informed about the quality of their drinking water, the Safe Drinking Water Act requires all operators of municipal drinking water supplies, including New York City, to report the results of their water testing to the public. The annual water quality reports for all surveyed cities are available on their respective websites, although posted annual reports may contain only partial data or only report the contaminants the municipality detected rather than all that were tested for. For example, Seattle's 2008 website report lists only 11 detected contaminants, but noted that the city tested for "more than 179" others that were not detected. To enhance this data set, Riverkeeper directly contacted the drinking water utilities of all targeted cities to request comprehensive listings of each city's water quality testing and results.

Riverkeeper compiled data from the annual reports of the 14 selected municipalities from 2008 through 2011 and compared it to the six water quality categories that NYCDEP presents in its annual reports: conventional physical and chemical properties, organic contaminants, disinfection byproducts (DBPs), pathogens, radionuclides, and metals (which include lead and copper). We then analyzed these categories for each surveyed city to determine: (1) the number of contaminants tested for in each class; (2) the number detected in each class; and (3) the number that exceeded a state or federal standard in each class. In addition, we examined all available testing data related to pharmaceuticals and personal care products (PPCPs).

For the most part, utilities were cooperative in providing more comprehensive water quality data than what was reported on their websites. Any gaps in our reported data result from the failure of certain cities we surveyed to report the data on their websites and to provide missing data to us when we requested. To compensate for data gaps, the following graphs represent the average numbers reported in each of the above three categories. The complete data set we compiled, including gaps, is presented in Appendix B to this report.

What Contaminants Do Cities Test For?

Pure water—meaning H2O—does not occur in nature. All natural surface and groundwater supplies contain dissolved minerals, many of which are essential to support plant and animal life. Even harmful impurities, such as arsenic and radioactive minerals, can be present in natural water supplies, depending on the geology of any given region.

Across the United States, people are exposed on a daily basis to a wide array of contaminants in the food we eat, the air we breathe and the water we drink. Some of these contaminants are present in concentrations that pose human health hazards; others are present in trace amounts to which people can be exposed on a daily basis over their lifetime with no ill effects. Some contaminants that are present in municipal drinking water supplies are the unavoidable result of the natural geology underlying surface water supplies. For example, iron and other minerals, sodium, sulfur, and even radioactive minerals can leach from rocks and soils into streams, reservoirs and groundwater aquifers.

The presence of other contaminants in drinking water supply watersheds results from intensified land use such as urban development. Concentrations of organic carbon, pathogens, hydrocarbons, and nutrients such as phosphorus and nitrogen increase in water supplies as watershed lands become more heavily developed. Still other contaminants, known as disinfection byproducts (DBPs), are present as the result of the interaction of chlorine at drinking water treatment plants with organic carbon in the water being treated.

Based on health effects studies of specific contaminants, EPA sets a maximum contaminant level (MCL) which is the estimated amount of the chemical that will not pose health risks to people exposed to it on a daily basis. For certain contaminants, NYSDOH also establishes MCLs that may be more stringent than EPA standards for the same contaminants.

Municipal drinking water suppliers are required to test drinking water for the six specific water contaminant categories examined in this survey. These are the contaminants for which EPA and/or NYSDOH have established an MCL. Beyond what EPA and individual states require, water suppliers routinely test for a wide variety of unregulated physical, chemical and organic contaminants as a proactive approach to monitoring drinking water supplies for potential health risks. State and federal water quality regulations allow various combinations of regulated contaminants to be present in municipal drinking water supplies, but only at trace levels that have not been associated with health risks. Only recently have some municipal water suppliers begun testing for a variety of unregulated PPCPs in drinking water. The Riverkeeper survey focused on the following contaminants:

1. **Physical and Chemical Contaminants** - Physical and chemical contaminants are impurities that include solids, such as minerals, as well as physical characteristics of the water, such as temperature, turbidity, and pH. These are present in watershed streams and reservoirs as a result of the natural geology and environment, or are transported in stormwater runoff from various land use practices, such as phosphorus from fertilizer application. Many of these impurities are naturally occurring and present in all drinking water supplies.

2. **Organic Contaminants** - This category includes a wide variety of carbon-based compounds including landscaping products such as pesticides and herbicides, the hydrocarbons present in solvents and vehicle emissions, industrial byproducts, DBPs, and carbon from decomposing organic matter. Except for the DBPs, which are created during the water treatment process, the remaining organic contaminants enter watershed streams and reservoirs in highest concentrations from areas of intensive urban and agricultural land uses.

3. **Disinfection Byproducts** - When surface waters receive excessive phosphorus in stormwater runoff from fertilized landscapes such as farms and lawns, the increased phosphorus causes algae to grow and multiply. When the algae die off at the end of their life cycle, they release carbon into the water. At drinking water treatment plants, the carbon reacts with chlorine during the disinfection process to form DBPs, some of which are carcinogenic in high concentrations.

4. **Pathogens** - Pathogens are microscopic organisms, primarily bacteria and protozoa that shed from domestic livestock and wildlife into stormwater runoff and enter watershed streams and reservoirs. They can remain active for more than a month without a host organism, which poses human health risks if they escape detection and enter the distribution system of drinking water supplies. Two protozoa of special concern are *Cryptosporidium* and *Giardia*, which can cause intestinal waterborne disease outbreaks when introduced into a drinking water supply. EPA requires disinfection of drinking water to inactivate pathogens both at the point of entry to the system from source waters and within the distribution system. Disinfection may be accomplished with chlorination, UV or ozone disinfection, or a combination of these. Travel time from source waters to the distribution system in NYC also may render pathogenic organisms inactive.

5. **Radionuclides** - Radioactive minerals are naturally occurring elements that can leach from rocks and soils into surface and groundwater supplies. EPA requires testing of water for radiation levels to minimize exposure to consumers.

6. **Lead and Copper** - Lead impairs metabolic processes and is toxic to the human heart, kidneys, bones, reproductive organs and central nervous system, especially in children. Although NYCDEP has implemented a public awareness program to inform consumers how to properly flush their plumbing systems, the presence and toxicity of lead is not mitigated for consumers who have lead in their plumbing and are unaware of its presence or the flushing procedure. Chronic exposure to copper has been associated with liver, kidney, and intestinal disease. As with lead, copper can leach from plumbing into tap water. Also as with lead, copper may be flushed from household plumbing by running cold water before use.

7. **Pharmaceuticals and Personal Care Products** - Discarded prescription and over-the-counter medications, steroids and antibiotics administered to livestock, and excreted pharmaceuticals that enter wastewater treatment plants through sanitary sewers or are released by failing septic systems contribute PPCPs to surface water supplies. Virtually all PPCPs are unregulated contaminants for which no federal MCL has been established. Most wastewater treatment plants are not equipped to remove these compounds, so they enter receiving waters after treatment. PPCPs have recently garnered attention as contaminants of emerging concern due to potential health effects and documented impacts to aquatic organisms. It is also well documented that low-level introduction of antibiotics into the environment creates antibiotic-resistant genes in bacteria, which requires the development of new antibiotics to treat diseases caused by the resistant bacteria strains.

More about PPCPs

A 2000 United States Geological Survey(USGS) report on PPCPs in U.S. streams included 11 sampling sites in the Croton watershed. All 11 streams contained detectable levels of 10 selected human pharmaceutical compounds, including hormones and pain relievers. Although not currently required by law, cities have begun to test for PPCPs due to increasing concern about the potential health and environmental issues associated with these compounds.

How Does New York's Drinking Water Compare to Other Large Cities?

Summary of Findings

Riverkeeper's comparison of New York City's drinking water to the filtered and unfiltered water supplies of other cities surveyed revealed the following:

1. Overall, New York City's drinking water met state and federal water quality standards in most areas, but fell short in some others.

2. Drinking water quality data from all 14 cities surveyed showed variability in the number of contaminants tested for and detected. Despite this variability, a consistent finding among the cities surveyed was the extremely low number of exceedances reported. Raw and treated water can and does contain numerous impurities. Even bottled water contains trace concentrations of a variety of contaminants. However, the low number of exceedances reported is based on state and federal drinking water quality standards, which reflect determinations by regulators that the levels of contaminants found in drinking water supplies are in concentrations that do not pose health risks to consumers.

3. One exception to the low exceedance rates reported is the exceedance of lead concentrations at the end of the distribution systems of older cities. This does not indicate contamination of underlying surface water supplies, but can be a cause for concern at the tap if lead-soldered plumbing systems are not flushed prior to use.

Table 1: Selected Filtered and Unfiltered Cities Surveyed, Listed by Population Size (2010 census)

Filtered								
Los Angeles	Chicago	Houston	Philadelphia	Phoenix	San Antonio	San Diego	Dallas	San Jose
3,792,621	2,695,598	2,099,451	1,526,006	1,445,632	1,327,407	1,307,402	1,197,816	967,942

Unfiltered				
New York	San Francisco	Boston	Seattle	Portland, OR
8,175,133	805,235	617,594	608,660	583,776

Is Bottled Water Better?
Until recently there has been little evidence to refute the claims of superior purity by the bottled water industry. However, an October 2008 study by the Environmental Working Group (EWG), a non-profit environmental organization dedicated to disseminating public information to protect public health and the environment, published a survey identifying 38 pollutants in 10 major brands of bottled water. Those pollutants included DBPs and fluoride – chemical signatures of the chlorine disinfection used by operators of municipal water supplies. Pharmaceuticals, heavy metals, arsenic, organic contaminants, bacteria, and radionuclides also were detected.

EWG's report noted that all municipal drinking water supplies are tested by certified labs under the authority of state and federal regulatory agencies, whereas the bottled water industry conducts unregulated, in-house water quality testing that can vary significantly in standards and quality control. For all of these reasons, EWG recommended that consumers drink filtered tap water rather than bottled water.

Specific Study Findings: Contaminants Tested for and Detected

1. **Testing and Detection Totals**—Comparing New York to both filtered and unfiltered cities, NYCDEP's testing and detection numbers were at the high end of the range. In all four years surveyed, New York tested drinking water for more contaminants than any other city surveyed (average 266), with the exception of San Francisco in 2008. The data also suggest that more robust testing programs such as New York's result in a higher level of reported detections than less aggressive programs.

Detection Limits and Trace Concentrations
EPA periodically develops new testing methods that have more sensitive detection limits, some as low as concentrations of nanograms per liter. One nanogram per liter is equivalent to one part per trillion (ppt). A common analogy used to demonstrate the relative concentration of one ppt is the concentration of one drop of water added to a volume of water needed to fill 26 Olympic-size swimming pools. As technology develops analytical methods capable of increasingly lower detection limits, it is likely that trace amounts of more compounds will be detected in drinking water supplies in the future.

Figure 3: Average Number of Contaminants Tested for 2008-2011 in Filtered Cities

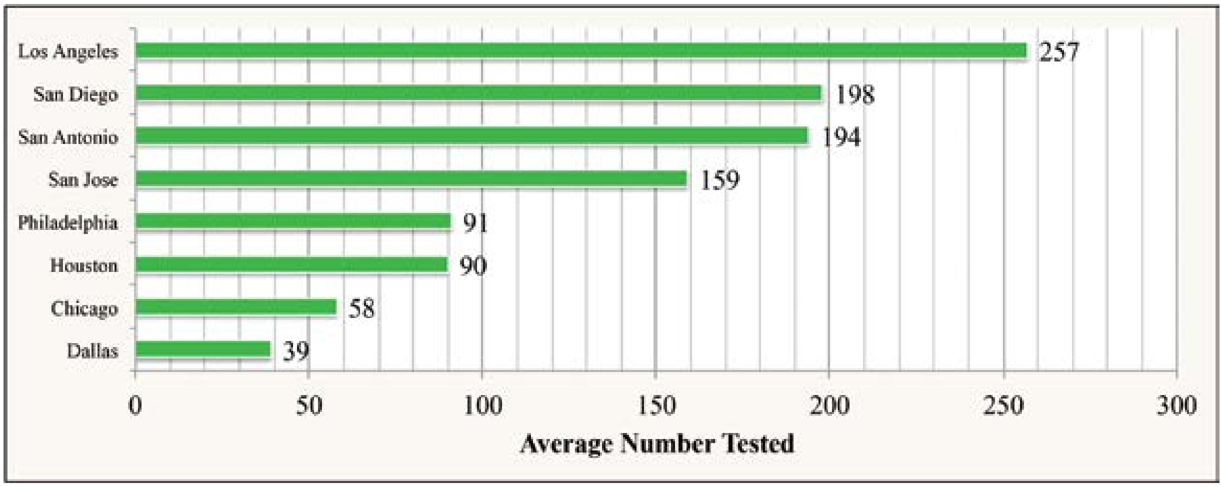


Figure 4: Average Number of Contaminants Tested For 2008-2011 in Unfiltered Cities

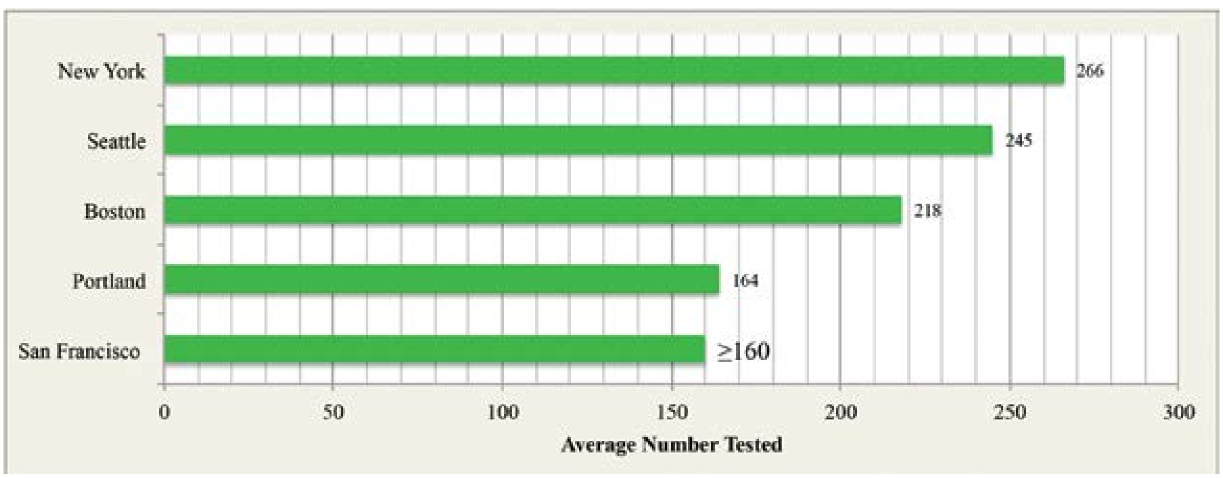


Figure 5: Average Number of Contaminants Detected 2008-2011 in Filtered Cities

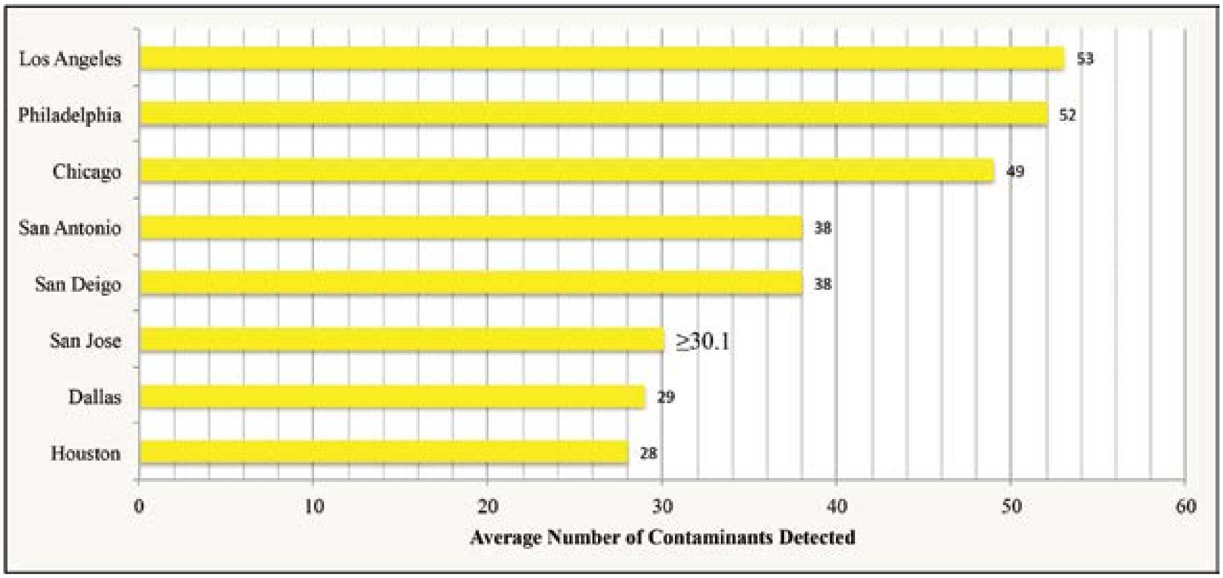
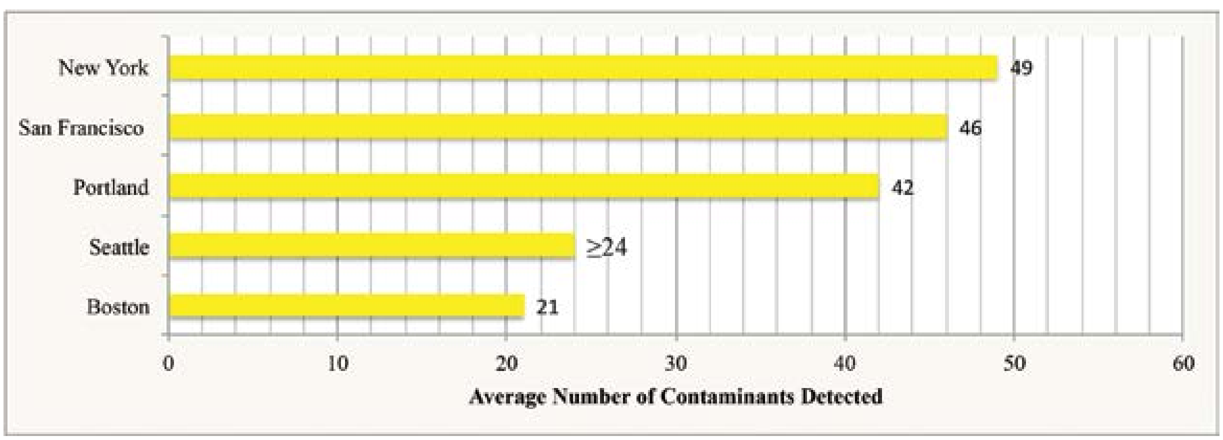


Figure 6: Average Number of Contaminants Detected 2008-2011 in Unfiltered Cities



2. **Pathogens Detected**—In New York, the number of samples that tested positive for *Giardia* and *Cryptosporidium* fluctuated between the reporting years, with *Giardia* detected at higher frequencies in both reservoir systems in all years surveyed. A positive test indicating the presence of these pathogens does not indicate whether they are alive or potentially infectious, but neither does it indicate that the pathogens are not alive. The data also indicated that E. coli, which has in the past occurred in very small numbers in the City's drinking water supply, more recently has not been detected at all in thousands of samples. NYCDEP's 2010 and 2011 reports also note that the Cat/Del UV disinfection facility is due to come online in 2013. This facility, located in Westchester County, did come on line in December 2012 and will add an additional barrier for waters from the Catskill and Delaware watersheds to inactivate these and other pathogens by exposing the water to UV radiation in addition to chlorine.

Table 2: *Cryptosporidium* and *Giardia* in the Croton and Cat/Del Systems 2008-2011

Pathogen	2008	2009	2010	2011
Cryptosporidium				
Croton	8	4	5	1
Cat/Del	11	5	4	3
Giardia				
Croton	26	22	30	39
Cat/Del	85	82	68	81

3. **Organics Detected**—NYCDEP detected DBPs in both the Croton and Cat/Del system water; however, concentrations were consistently below the allowable MCL. In addition, of the other 200+ organic compounds NYCDEP tested for annually, only one pesticide, one herbicide, and one solvent were detected, all at concentrations well below the regulated MCL.

Specific Study Findings: Exceedances

Discounting exceedances for lead, which occurred locally at the end of the distribution system and not in the source water, New York City's average number of exceedances dropped from 15 to 1.5 during the four-year sampling period. Figures 7 and 8 indicate that other cities' exceedances dropped significantly as well when lead is discounted. It is noteworthy that except for lead at the tap, New York reported exceedances for only two parameters, both aesthetic—color and turbidity—which by themselves pose no direct health risks to consumers.

1. **Turbidity**— Although turbidity in drinking water supplies is primarily an aesthetic concern, suspended solids in turbid water may mask the presence of waterborne pathogens such as *Cryptosporidium* and *Giardia*. Although the testing methods were not capable of determining whether these pathogens were alive or infectious and no waterborne disease outbreaks were attributed to the City's drinking water supplies, the presence of any potentially disease-causing organisms in drinking water supplies is of concern.

   In fact, EPA considers turbidity to be the greatest threat to New York City's FAD due to the potential health risks associated with pathogens in drinking water reservoirs that may be masked by elevated levels of turbidity. The Catskill Watershed has clay soils that scour from streambanks and streambeds during heavy rains. The suspended clay particles are carried downstream and deposited in reservoirs, where it may take weeks or months to settle before the water is clear enough to divert to the Catskill Aqueduct and send to consumers. In addition to turbidity in upstream reservoirs, turbidity in the distribution system, caused by localized disturbances such as water main breaks or construction, ranged, during the study period, from as high as 19.2 NTU in 2008, 22.5 NTU in 2009, 18.4 NTU in 2010 to a low of 7.4 NTU in 2011. The federal Safe Drinking Water Act limits turbidity in public drinking water distribution systems to 5 nephelometric turbidity units (NTU).

Figure 7: Average Number of Exceedances Reported 2008-2011 in Filtered Cities

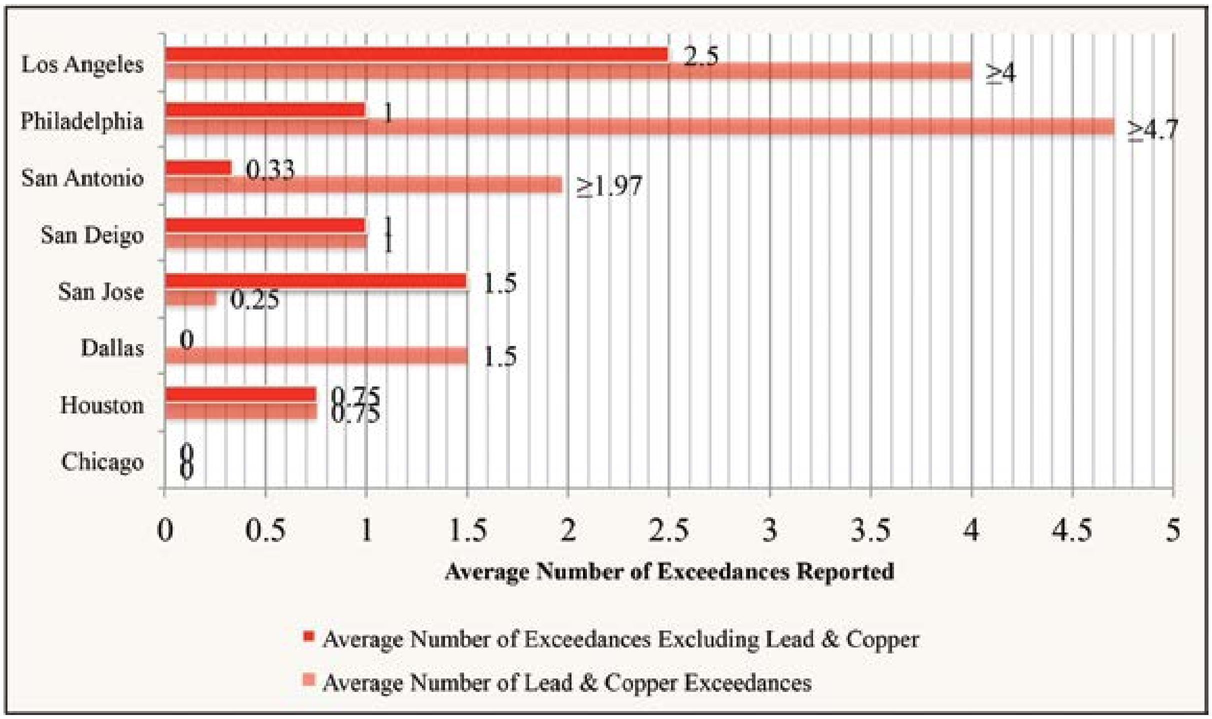
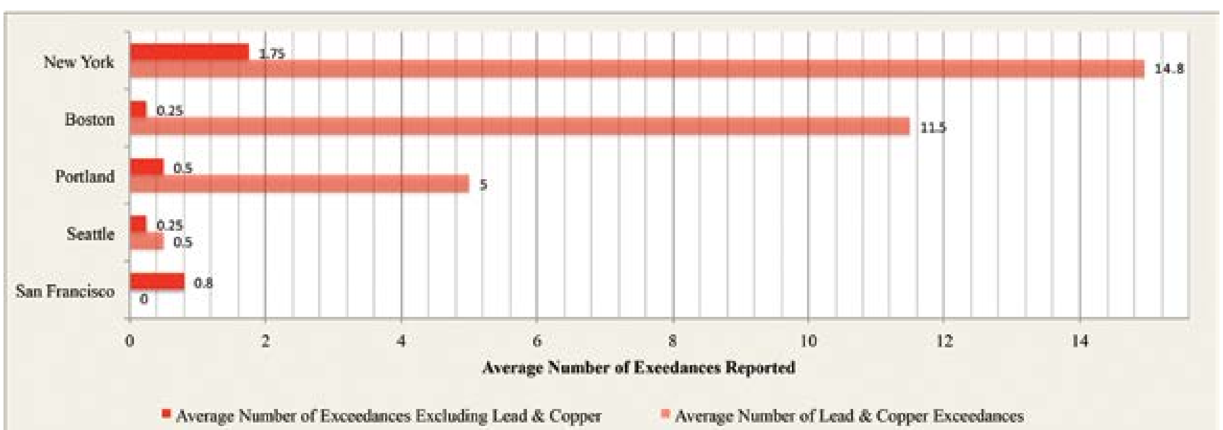


Figure 8: Average Number of Exceedances Reported 2008-2011 in Unfiltered Cities



2. **Lead Exceedances**—Because the use of lead-solder joints in domestic plumbing was not banned until the Safe Drinking Water Act took effect in 1986, any plumbing installed prior to that date has the potential to leach lead into tap water. Running tap water for 30 seconds effectively flushes lead from household plumbing. Lead can also be removed by a variety of countertop filter systems. However, some consumers may be unaware of these procedures and, as a result, may be ingesting lead at levels above federally regulated health thresholds. New York City's lead exceedances represented 7.5% of the households tested in 2008; the same data was not reported as a percentage for 2009 or 2010, although 30 lead exceedances were reported in 2010. In November of 2010, NYCDEP implemented a public awareness program to educate consumers about lead in drinking water. In addition, as a result of the lead exceedances in 2010, NYCDEP began replacing all City-owned lead service lines. In 2011, there were 20 reported lead exceedances.

Present and Future Risks to New York City Drinking Water Supply

Turbidity

As discussed above, turbidity in the Catskill Watershed poses a risk to New York City's drinking water supply if it cannot be reduced through structural and non-structural management practices. State and federal standards for turbidity were periodically exceeded in upstream reservoirs, including the Ashokan, during the years surveyed, requiring DEP to minimize the use of Catskill waters to supply NYC drinking water. In addition to turbidity in upstream reservoirs, 2008, 2009 and 2010, turbidity in the Ashokan Reservoir was periodically too high to allow diversion of water to the Kensico Reservoir. In an attempt to address this persistent problem, in 2008, the City's consultants evaluated 26 operational alternatives designed to control turbidity in the Catskill reservoir system. Those alternatives included constructing diversion walls, additional reservoir outlets, and improvements to the Catskill Aqueduct, among others. In addition, NYCDEP's Catskill Turbidity Control Study evaluated a multi-level intake at the Schoharie Reservoir to allow operators to select the least turbid water from the water column. The City selected four alternatives: the repair of stop shutters in the Catskill Aqueduct, the construction of an interconnection between the Catskill and Delaware Aqueducts, the diversion of turbid Catskill system water to a waste channel and the use of modeling to balance water levels in the Catskill reservoirs. To date, the City has implemented only two alternatives evaluated from the study: a waste channel diverts turbid water from the Ashokan Reservoir to the Lower Esopus Creek and an Operations Support Tool (OST) uses computer modeling to balance the level of water in the Catskill reservoirs. All of these practices have drawbacks. The turbid waste channel releases have impacted the ecology of the Lower Esopus Creek and diminished the economic and recreational values the creek provides to local communities. The OST modeling predicts the probability of filling City reservoirs based on historic rainfall data, but cannot currently forecast future rain events that should be factored into those predictions. This is significant considering the increasing frequency of severe storm events that may be associated with climate change. As the Catskill Region experiences more frequent and intense rainstorms into the future, computer models driven by historical data from the last century become less reliable.

In addition, the New York City MOA required NYCDEP to develop a Stream Management Program to protect and enhance the integrity of the watershed stream systems. Although NYCDEP prioritizes problem areas and has restored some impacted reaches in the vast Catskill Watershed stream system, restoration of all existing and future impaired streams is not practical or sustainable as a regional solution. NYCDEP has reviewed other measures to reduce Catskill turbidity, but to date has implemented only the OST, the waste channel, and some in-reservoir practices to repair and/or upgrade infrastructure.

In spite of implementing these turbidity management practices, NYCDEP has been unable to deliver water that meets turbidity standards from the Catskill system for periods of days or weeks following significant storm events during the last several years without the use of alum treatment at the Kensico Reservoir, a practice that EPA, DOH and DEC have sought to limit. Additional measures will almost certainly be required to protect the Catskill reservoirs from sediment loading (turbidity) and thereby maintain the City's FAD into the future.

Natural Gas Extraction using High Volume Hydraulic Fracturing

The prospect of high-volume hydraulic fracturing (fracking) for natural gas in New York State also poses a potential future threat to the New York City drinking water supply. Although presently there is no proposal to allow surface drilling to enable fracking within the boundaries of the New York City Watershed, fracking activity outside of the watershed, in particular, horizontal drilling under the City's aqueducts and other infrastructure—if New York State approves fracking—may compromise the integrity of that infrastructure, which was not designed to withstand the physical stresses of subsurface activity associated with fracking.

Conclusions and Recommendations

Conclusions

In almost every respect, New York City's municipal drinking water currently meets regulatory safety standards. New York's testing program is robust and more comprehensive than other large U.S. cities. In response to recognition by the scientific community that trace concentrations of PPCPs pose potential risks to aquatic life and human health, New York, Portland, Seattle, Boston and Chicago have adopted a more responsible and proactive testing approach than that of the other cities surveyed, although New York suspended testing for PPCPs in 2011.

Examination of New York City's annual reports on drinking water quality from 2008–2011 reveal several concerns. First, while the source waters for New York City's drinking water meet all state and federal water quality standards except for turbidity, it is concerning that at the endpoint of the distribution system, drinking water from the tap for some households contains lead concentrations that exceed regulatory health standards due to leaching from aging plumbing systems. Also of concern is the intermittent incidence of *Cryptosporidium* and *Giardia* detection in New York City's drinking water supplies. Finally, although only trace amounts of PPCPs are currently found in public drinking water supplies, it is unclear whether health impacts may be associated with long-term exposure to trace concentrations of PPCPs.

In addition, there are a number of potential future threats to the quality of New York City's drinking water. Continued urbanization and its associated stormwater impacts, forest clearing for agriculture and other changes in land use can, in the future, degrade water quality in receiving waters and ultimately contribute to impaired drinking water quality in New York City's 19 reservoirs. The prospect of continued or increased turbidity in Catskill source waters also threatens the long-term protection of drinking water quality and the ability of the City to avoid filtering the Catskill system. Finally, fracking in close proximity to the Catskill and Delaware Watersheds would pose a significant threat to the City's drinking water supply infrastructure.

The high quality of NYC's unfiltered drinking water supply constitutes a precious and irreplaceable resource, particularly in light of the substantial cost that filtration would impose on the City's water users should that quality be allowed to deteriorate. Consequently, New York City's drinking water supply warrants heightened protection measures to safeguard its high quality from degradation. While it is encouraging that overall the City's drinking water quality remains high, NYCDEP should address threats to water quality that could pose health risks to consumers now and in the future.

Recommendations

Riverkeeper offers the following recommendations to ensure the continued availability of high-quality drinking water for New York City and Hudson Valley residents:

1. The issue of turbidity in the Catskill Watershed should be addressed swiftly and decisively. As storm frequency and intensity apparently are increasing in the Northeast, it is critical that turbidity control measures are enhanced to address increased storm flows in the Catskills. NYCDEP should reconsider alternative turbidity control measures it has rejected in the past and implement the most effective measures possible to protect Catskill reservoirs from excessive sediment loading in order to protect drinking water quality and preserve New York City's FAD.

2. Pathogen monitoring in the New York City Watershed should be enhanced to trace and eliminate sources of *Cryptosporidium*, *Giardia*, and Coliform bacteria in drinking water supplies. The inability of testing protocols to determine whether some pathogens are alive and the resistance of some to chlorine disinfection increases the risk of waterborne disease outbreaks among New York City and upstate residents. Although the City's UV disinfection plant will add another layer of protection against waterborne pathogens when it comes online, hundreds of thousands of consumers in Westchester County and other upstream communities will draw drinking water from the Cat/Del system that has not been treated by DEP's UV plant. Effective control of Coliform bacteria and *Cryptosporidium* in source water supplies to protect upstate consumers should continue to be an integral component of NYCDEP's watershed protection programs, including the farm management practices implemented pursuant to its Watershed Agricultural Program. In addition, if it becomes necessary to effectively control pathogen levels in the future, DEP should make efforts to increase the number of farms enrolled in the Whole Farm Program and expand the City's Waterfowl Management Program to other Cat/Del system reservoirs where needed.

3. NYCDEP should resume monitoring source and distribution waters for PPCPs to determine whether concentrations are stable or increasing. Pharmaceuticals, which are designed to alter human physiology, persist in surface waters through human excretion and wastewater disposal. Some breakdown products of these compounds are highly toxic to human cells and cause DNA damage. Physiological impacts to aquatic organisms from exposure to excreted PPCPs are also well-documented.[2] Although PPCPs are present in New York City drinking water reservoirs only in trace amounts and NYCDEP and NYSDOH do not consider these amounts sufficient to present a potential health concern as a result of long-term exposure, that conclusion is not supported by any long-term medical studies. Until such information becomes available, NYCDEP should be proactive and resume monitoring of PPCPs. In addition, NYCDEP should implement a public information program to educate consumers on the proper disposal of medical wastes, prescription and non-prescription medications, and personal care products. Finally, we urge NYSDOH and the U.S. Environmental Protection Agency (EPA) to develop regulatory standards for these contaminants in municipal drinking water supplies.

4. NYCDEP should continue and enhance its public education program to inform consumers of potential lead contamination from older household plumbing fixtures. In addition, if lead exceedances continue to be detected in the future, NYCDEP should implement more retrofitting of aging lead-and-copper plumbing systems in affected areas. New York City and/or NYSDOH should subsidize or at least require the retrofitting of lead-soldered plumbing with lead-free solder in households where lead levels are detected.

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[2] NYSDEC, Drugs in New York's Waters, available at: http://www.dec.ny.gov/chemical/45083.html.

Appendix A

Statutes, Regulations, Agency Acronyms, Studies Referenced, and Glossary

Statutes and Regulations

Safe Drinking Water Act (SDWA) 42 U.S.C. §300f et seq (1974)

Agency Acronyms

(NYCDEP) .... New York City Department of Environmental Protection
(NYSDOH) .... New York State Department of Health
(EPA) U.S. .... Environmental Protection Agency

Studies Referenced

United States Geological Survey (USGS): Heisig, P.M. *Effects of Residential and Agricultural Land Uses on the Chemical Quality of Baseflow of Small Streams in the Croton Watershed, Southeastern New York.* U.S. Geological Survey (USGS) Water-Resources Investigations Report 99-4173. (2000), available at http://ny.water.usgs.gov/pubs/wri/wri994173/WRIR99-4173.pdf.

Environmental Working Group (EWG): *Bottled Water Quality Investigation: 10 Major Brands, 38 Pollutants* (2008), available at http://www.ewg.org/reports/BottledWater/Bottled-Water-Quality-Investigation.

Glossary

Cryptosporidium – a waterborne microorganism that causes intestinal disease and enters water supplies primarily from contact with infected wildlife.

Disinfection byproducts (DBPs) – secondary chemical compounds formed when chlorine used in disinfection reacts with organic carbon in the water.

Giardia – a waterborne microorganism that causes intestinal disease and enters water supplies primarily from contact with infected wildlife.

Groundwater – water held underground in the soil or bedrock.

Hydrocarbon – a chemical compound containing hydrogen and carbon, and often other elements.

Maximum Contaminant Level (MCL) – the maximum permissible concentration of a contaminant in water that is delivered to any user of a public water system.

Organic carbon – carbon available as a food source for aquatic food webs.

Pathogens – bacteria, viruses, or other microorganisms that can cause disease.

Radionuclides – Any man-made or natural element that emits radioactivity.

Turbidity – cloudiness created by sediment particles suspended in water.

Appendix B

Drinking Water Quality Data

Drinking Water Quality of Selected Filtered Cities 2008-2011

	New York			Los Angeles			Chicago			Houston		
2008	T	D	Ex	T	D	Ex	T	D	Ex	T	D	Ex
Inorganics[1]	49	35	2	54	32	≥3	54	6	0		10	0
Organics	165	2	0	144	4	0					8	0
DBPs	9	9	0	16	14	≥2		13	0		9	0
Pathogens	3	3	0	3	3	0		3	0		3	0
Metals[2]	2	2	14	4	2	2	3	3	0		2	1
Radionuclides	3	0	0	7	4	0	2	1	0		4	0
SUM	231	51	16	228	59	≥7	59	26	0	0	36	1
2009												
Inorganics[1]	46	31	2	57	26	1	54	52	0		7	1
Organics	211	1	0	172	2	0					1	0
DBPs	8	8	0	10	9	3				6	6	0
Pathogens	5	2		5	0	1				2	2	0
Metals[2]	2	2	9	2	2	2	2	2	0	2	2	1
Radionuclides	3	1	0	10	3	0	2	2	0	4	4	1
SUM	275	45	11	256	42	7	58	56	0	14	22	3
2010												
Inorganics[1]	46	31	2	56	35	1	53	41	0	30	5	0
Organics	211	1	0	174	2	0		20		173	8	0
DBPs	8	8	0	18	15	2				13	3	0
Pathogens	5	3		9	3	0				5	5	0
Metals[2]	2	2	31	2	2	3	2	2	0	2	2	1
Radionuclides	3	0	0	9	3	0	2	2	0	4	4	1
SUM	275	45	33	268	60	6	57	65	0	227	27	2
2011												
Inorganics[1]	46	33	1	54	38	1				9	9	0
Organics	217	5	0	199	0	0				3	3	0
DBPs	9	10	0	12	9	≥1				8	8	0
Pathognes	5	4	0	4	1	1				2	1	0
Metals[2]	2	2	20	2	2	3				2	2	0
Radionuclides	3	0	0	5	0	0				4	4	0
SUM	282	54	1	276	50	≥6				28	27	0
Grand Sum	1063	195	61	1028	211	≥26	174	147	0	269	112	6
AVERAGE	266	49	15.25	257	53	≥6.5	58	49	0	90	28	1.5
Metals Sum			54			10			0			3
Metals Av			13.5			2.5			0			0.75

	Philadelphia			San Antonio			Dallas			San Diego			San Jose		
2008	T	D	Ex	T	D	Ex	T	D	Ex	T	D	EX	T	D	Ex
Inorganics[1]	34	7	3	34	21	≥5	33	33	1	58	38	0	54	9	0
Organics	51	4	0	118	1	0				125	3	0	105	1	0
DBPs	11	2	≥4	5	5	0	2	2	0	6	5	0	3	2	0
Pathogens	3	1	0				2	1	0	3	1	0		1	0
Metals[2]	2	2	3	2	2	0	2	2	0	2	2	0	2	2	5
Radionuclides	4	0	0	3	3	0				5	2	0		4	0
SUM	105	16	≥10	162	32	≥5	39	38	1	199	51	0	164	19	5
2009															
Inorganics[1]	30	30	1							62	32	1	52	29	0
Organics	38	38	1							88	1	0	106		0
DBPs	3	2	0							2	2	0		0.5	
Pathogens	3	3	0							3	3	0			
Metals[2]	2	3	0							2	2	1	2	0	0
Radionuclides										7	1	0	5	4	0
SUM	76	76	2							164	41	2	165	33.5	0
2010															
Inorganics[1]	31	18	0		22	0		7	1	55	13	0	51	34	0
Organics	53	38	0		3	0		3	0	166	1	0	106	5	0
DBPs	2	2	3		2	1		5	1	3	3	2			
Pathogens	5	3	2		3	0		1	0	3	1	0	5	0	0
Metals[2]	2	2	0		2	0		2	0	2	2	2	2	2	0
Radionuclides					3	0		1	0	2	1	0	8	0	0
SUM	93	63	5		35	1		19	2	231	21	4	172	41	0
2011															
Inorganics[1]				22	28	0							51	≥20	0
Organics				192	6	0							67	≥3	1
DBPs				5	6	0							11	≥1	0
Pathognes				1	1	0							1	≥1	0
Metals[2]				2	2	0							2	2	1
Radionuclides				4	4	1							4	0	0
SUM				226	47	1							136	≥27	2
Grand Sum	274	155	≥17	388	114	≥7	39	57	3	594	113	6	637	≥121	7
AVERAGE	91	52	≥5.7	194	38	≥2.3	39	29	1.5	198	38	2	159	≥30.1	1.75
Metals Sum			3			1			0			3			6
Metals Av			1.00			0.33			0			1			1.5

[1]Includes physical and chemical
[2]Includes Lead and Copper

Drinking Water Quality of Selected Unfiltered Cities 2008-2011

	New York			Boston			San Francisco			Portland			Seattle		
2008	T	D	Ex	T	D	Ex	T	D	Ex	T	D	Ex	T	D	Ex
Inorganics[1]	49	35	2	52	4	0	44	16	0	.	49	1	12	5	0
Organics	165	2	0	135	0	0	175	1	0	.	1	0	183	1	0
DBPs	9	9	0	15	3	0	4	3	0	.	3	0	5	3	0
Pathogens	3	3	0	14	0	0	16	2	0	.	3	0	2	2	0
Metals[2]	2	2	14	4	2	26	2	2	0	.	2	0	2	2	1
Radionuclides	3	0	0	7	0	0	8	.	.	.	2	0	3	.	.
Sum	231	51	16	227	9	26	249	24	0	.	60	1	207	13	1
2009															
Inorganics[1]	46	31	2	55	4	0	≥53	53	0	.	.	.	42	30	0
Organics	211	1	0	135	0	0	≥53	53	0	.	.	.	190	0	0
DBPs	8	8	0	11	2	0	≥13	13	0	.	.	.	6	2	0
Pathogens	5	2	.	14	2	0	2	2	1	.	.	.	.	.	.
Metals[2]	2	2	9	2	2	9	2	2	0	.	.	.	2	1	1
Radionuclides	3	1	0	9	0	0	.	.	.	.	.	.	3	0	0
Sum	275	45	11	226	10	9	≥123	123	1	.	.	.	243	33	1
2010															
Inorganics[1]	46	31	2	55	33	0	38	18	0	49	10	0	42	28	1
Organics	211	1	0	135	0	0	138	.	0	104	2	0	208	0	0
DBPs	8	8	0	11	5	0	3	2	0	5	5	0	2	2	0
Pathogens	5	3	.	14	3	1	3	2	0	3	3	0	4	4	0
Metals[2]	2	2	31	2	2	10	2	2	1	2	2	10	2	2	0
Radionuclides	3	0	0	2	0	0	5	0	0	1	1	0	2	0	0
Sum	275	45	33	219	43	11	189	24	1	164	23	10	260	36	1
2011															
Inorganics[1]	46	33	1	40	15	0	36	6	0	.	.	.	41	≥9	0
Organics	217	5	0	132	0	0	30	1	0	.	.	.	219	≥2	0
DBPs	9	10	0	12	2	0	2	3	0	.	.	.	2	≥0	0
Pathogens	5	4	0	6	1	0	3	2	0	.	.	.	2	≥0	0
Metals[2]	2	2	20	2	2	1	2	2	1	.	.	.	2	2	0
Radionuclides	3	0	0	6	1	0	5	.	.	.	.	.	4	≥0	0
Sum	282	54	1	198	21	1	78	14	1	.	.	.	270	≥13	0
Grand Sum	1063	195	61	870	83	47	639	185	3	164	83	11	980	≥95	3
Average	266	49	15.25	218	21	11.750	≥160	46	0.75	164	41.5	5.50	245	≥24	0.75
Lead and Copper Sum			54			46			0			10			2
Average			13.5			11.5			0			5			0.5

[1]Includes physical and chemical

[2]Includes Lead and Copper