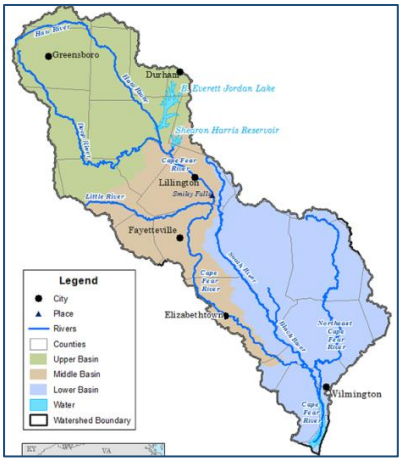
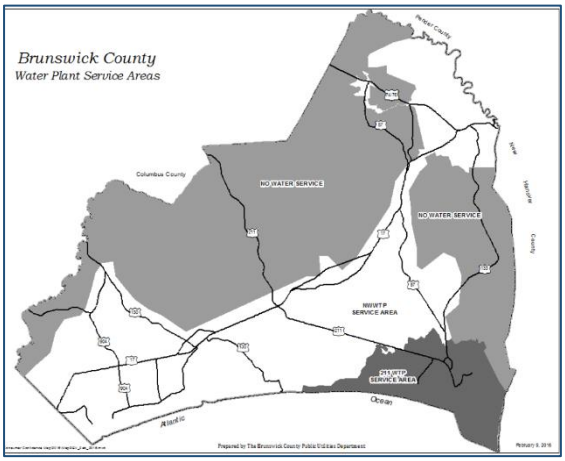
Summary of Questions and Answers on
Sources, Testing, and Quality of Water in the Lower Cape Fear Region
(Brunswick, New Hanover, and Pender Counties)



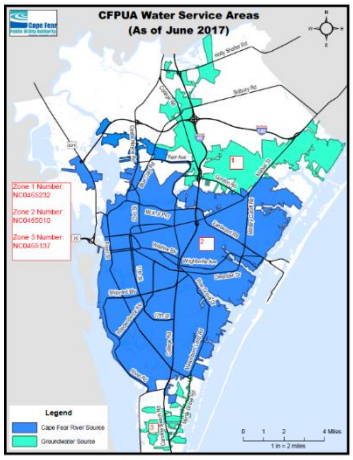
Cape Fear River Watershed Map (NOAA)

Surface Water Source Location just above Lock and Dam #1 (55 miles south of Chemours)

Locations of water test sites in the Lower Cape Fear Region
(from Department of Environmental Quality)

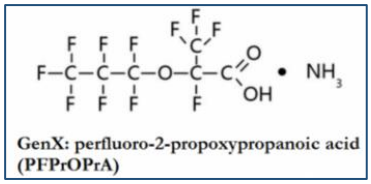


Brunswick County Water Use Map (white areas use Cape Fear River Water)
(from Brunswick County Water Quality Report)



New Hanover County Water Use Map (blue areas use Cape Fear River Water)
(from CFPUA)

GenX Formula



Department of Health and Human Services Health Assessment Calculation for GenX

DWEL = Drinking Water Equivalent Level
RfD = Reference Dose (daily oral exposure that is likely to be without an appreciable risk of deleterious effects during a lifetime); 0.0001 mg/day
BW = Body weight in kilograms (1 kg = 2.2 lbs); value used for infant 7.8 kg (17 lbs)
Intake = amount of water ingested from contaminant source daily (liters/day; one liter = 33.8 ounces); value used for infant 1.1 liters/day
RSC = Relative Source Contribution (amount coming from water; other sources are possible like air, soil); DHHS established 0.2 (20%)

Calculation from DHHS: DWEL = 0.0001 mg/day x 7.8 kg ÷ 1.1 L/day x 0.2 x 10^6 ng/mg = 141.8 ng/l or ppt (DHHS used 140 ppt)

Comment from Roger Shew:

There are currently many questions about our water. Several answers are straightforward, while others are more equivocal as there is insufficient information available to address everyone's concerns about the contaminants in our water. Our utilities (CFPUA/Brunswick Public Utility), local (County Commissioners and Councils), state (Department of Environmental Quality, Dept. of Health and Human Services), and even federal (Environmental Protection Agency) government are working to find answers, but it is not easy. Health assessment guidelines require years of testing and assessment. With this in mind, the following questions and answers are an attempt to address some of the more commonly asked questions that Roger Shew (Dept. of Earth and Ocean Sciences/Dept. of Environmental Sciences: UNCWilmington; shewr@uncw.edu) heard at forums, in the press, and in community discussions. The answers are as short and direct as possible. Please realize there is a lot more to each answer including detailed references about them. For the details, please see some of the supporting documentation that is posted on the UNCW Community Engagement Website (http://uncw.edu/engagement/).

Water is our most precious commodity and everyone deserves safe water (stay informed and involved)

Cape Fear River Water: Questions and Answers (data as of 8/7/17)

1. Where is the water intake/source on the Cape Fear River that provides surface water for the Brunswick Northwest Water Treatment Plant, CFPUA Sweeney Water Plant, and the Pender 421 Water Treatment Plant?

Answer: Water intake is located in Bladen County on the Cape Fear River just upstream of Lock and Dam #1. The water is piped approximately 24 miles (38 km) to these water treatment plants.

2. Where is DuPont/Chemours located relative to this water intake?

Answer: These plants are located on the west side of the Cape Fear River approximately 55 river miles (88 km)upstream of the intake pipes at Lock and Dam #1.

3. Does everyone in Brunswick, New Hanover, and Pender County use water from the Cape Fear River?

Answer: NO. You can go to the county websites to find service areas (see below) and determine the source of your water or you can contact the utilities for the areas served by the Water Treatment Plants (WTP) mentioned above as well. Parts of all of these counties use groundwater sources for significant numbers of the population. A short summary for each county is given:

a. Brunswick County: The NWWTP provides Cape Fear River water to areas in the northern part of the county down through central to southern parts of the county. The remainder uses groundwater with southeastern Brunswick having a Castle Hayne groundwater source on HWY 211.
Brunswick County Water Quality Report: http://www.brunswickcountync.gov/wp-content/uploads/2015/02/CCR-2016.pdf
NWWTP: Glenn Walker, Water Plant Superintendent, 910-371-3490

b. New Hanover County: The CFPUA (Cape Fear Public Utility Authority) Sweeney WTP primarily serves Wilmington and some surrounding areas in New Hanover County. Groundwater is the water source for most areas outside of Wilmington.
New Hanover/CFPUA Water Quality Report: http://www.cfpua.org/Archive.aspx?AMID=54; Website: www.cfpua.org
CFPUA contact: Water Treatment Division (910) 332-6769; 235 Government Center Dr. Wilmington; (910) 332-6550

c. Pender County: The HWY 421 WTP is a 2 mgd plant serving ~10,000 residents. http://www.pendercountync.gov/utl/

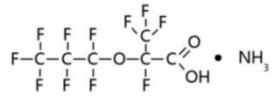
4. If I am using groundwater in these other locations, do I need to worry about the contaminants from the Cape Fear River or are there other perfluorinated contaminants in the groundwater?

Answer: Groundwater, particularly that obtained from our primary aquifers like the Castle Hayne and Peedee, should be free of these types of contaminants. There have been a small number of tests that have confirmed the groundwater is not contaminated.

5. I heard there is an Aquifer Storage and Recovery (ASR) project (underground water source) that is contaminated with GenX? Is that true and is this a concern for our groundwater?

Answer: The ASR is located in New Hanover County; the storage aquifer is the Peedee. ASR is designed to pump water into the ground that will then be pumped back out later when there is increased water demand, as in the summer. The water that was pumped into the storage well was Cape Fear River water and testing has shown that it does contain GenX. The well is not being used as a source of water currently. However, CFPUA has contracted to pump the contaminated water out. It is highly unlikely that contaminants have gone far from this well, certainly not to the nano-filtration plant near Ogden. On 8/7 CFPUA announced it will pump out all ~48 million gallons of the previously injected water to ensure no contamination. All GenX values are below 140 ppt.

6. What is GenX and other perfluorinated (PFAS) compounds?



GenX: perfluoro-2-propoxypropanoic acid (PFPrOPrA)

Answer: Perfluorinated compounds, produced since the 1950s, are synthetic compounds formed from carbon atoms with fluorine atoms attached. These are stable molecules that are widely used in non-stick cookware, food packaging, waterproof clothing and stain resistant fabrics, firefighting foams, etc. However, EPA decided to phase out the longer chain (C8) perfluorinated compounds because they are persistent, bioaccumulative, and toxic in the environment. Two of these that have been in the news are perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS). GenX was produced to be a replacement compound for C8; it is a shorter chain (6 carbons versus 8) chemical that was thought to have less negative health impacts. However, there are few studies on GenX.
Note: The Sun et al. 2016 study listed at least 6 other perfluorinated compounds in the water, at possibly higher levels than GenX. This is the subject of continued studies as the properties of these chemicals are poorly known.

7. Why is GenX in the river if Chemours states that it didn't discharge it in the processing of the above products?

Answer: Chemours stated GenX is a by-product in the production of vinyl ether, etc. so it was discharged into the river as an unregulated byproduct. Investigations are underway to address the discharges and source. Since DuPont/Chemours has manufactured these products since the 1980's, it is likely that GenX has been discharged into the river since that time at unknown levels. There are no published data on amounts of these substances discharged into the river before 2013.

8. What health issues are associated with PFAS/C8? Are they the same for GenX?

Answer: Studies on C8 have shown "changes in the liver, thyroid, and pancreatic function, as well as some changes in hormone levels". Some PFAS accumulate in the human body and levels decrease slowly over time. Some studies have shown that exposure may **"affect the developing fetus/child, decrease fertility, interfere with bodily hormones, increase cholesterol, affect the immune system, and increase cancer risk."** Dupont/Chemours settled a $670 class action lawsuit over contaminated waters in the Ohio Valley because of this type of contamination. EPA established a lifetime health advisory level of 70 ppt (70 ng/L) for the sum of PFOA and PFOS concentrations in drinking water.
There are fewer and less complete studies on GenX impacts on health. However, some studies indicate that it may have similar effects to other PFAS including "liver and red blood cell non-cancer effects and pancreas, liver, and testicular cancer effects."

9. What is known about the level of contamination of GenX in the river?

Answer: The original study (Sun et al., 2016; water samples collected in 2013) found 630 ppt in Cape Fear River water that is used for drinking water at the Sweeney Water Treatment Plant in Wilmington. When the news was posted to the public in the Star News in June 2017, this precipitated a move to collect more samples to determine levels of GenX in the river at multiple sites. Thirteen different sites are being tested from the Chemours plant to the water intake above Lock and Dam #1 to the water treatment plants in Brunswick, New Hanover, and Pender counties. Groundwater sources have also been tested. As stated above, with the exception of the Aquifer Storage and Recovery site, no groundwater has been found to be contaminated.

After Chemours agreed to stop discharging GenX, another source of discharge was found on the plant grounds. According to DEQ, this other discharge was halted on July 12th; this latter discharge may have been the source of higher GenX values recorded by CFPUA at Sweeney on July 16th. Overall, GenX is in lower concentrations in the river now, but the values are variable. Selected values are listed below.
Testing is continuing. CFPUA is testing every day for GenX; values are posted on their website at http://www.cfpua.org/ . The NC Department of Environmental Quality (DEQ) post their results at https://deq.nc.gov/news/hot-topics/genx-investigation . Brunswick County test results may be found at http://www.brunswickcountync.gov/genx/ .

Select Test Locations

Location	6/22/17 (ppt)		6/29/17 (ppt)		7/6/17 (ppt)		7/12/17 (ppt)	
	Test America	EPA	Test America	EPA	Test America	EPA	Test America	EPA
Chemours Outfall	39000	21760	19000	15250	30000 (7/3)	21530	3300	2430
Water Intake L&D#1 (LCFWSA)	830	639	67	72	150	119	130	67
NWWTP (finished)	910	695	51	52	150	125	110	69
Sweeny WTP (finished)	1100	726	110	100	97	87	110	95
Pender County WTP (finished)	340	269	160	112	81	68	100	100
ASR (Stored Water)	820	588	400	336	190	148	120	120
Wrightsville Beach (GW)	26	27	24	28	28	24	29	<10

CFPUA has reported additional test data (at right) for GenX at the Sweeney Plant. The spike at 7/16 has not been explained but 7/12 was the last discharge as mentioned above. It takes 4 to 5 days for the water to flow the 55 miles from Chemours to L&D#1. Levels appear to be dropping after that date.

CFPUA Data

Date	GenX (ppt) untreated
6/26	149
6/30	69
7/5	94
710	102
7/14	114
7/16	336
7/18	128
7/20	85
7/22	53
7/25	97
7/27	55

The latest data from the Chemours site on 7/24/17 shows a GenX value of 150 ppt; all other sites below 140 ppt on 7/20/17

10. What is a "safe" level of GenX?

Answer: The real answer is that there have been few studies to determine a safe level. However, the NC Department of Health and Human Services has now established a life-time **health risk level of "140 ppt for the most vulnerable population – i.e. bottle-fed infants, the population that drinks the largest volume of water per body weight."** DHHS originally provided a high value of 70,909 ppt but revised this downward based on additional studies. It should be noted that there are many assumptions in these data. Important factors in the calculation are body weight, water intake, and percent coming from water versus other sources. Of high importance is the establishment of a reference dose which is a "daily exposure level without appreciable risk". These values are used to determine a Drinking Water Equivalent Level (DWEL), which is a provisional health goal. Adults have a higher DWEL.

The formula is: **DWEL = RfD x BW ÷ Intake x RSC x Unit Conversion**
Where the variables for the DWEL = Drinking Water Equivalent Level are:
RfD = Reference Dose (daily oral exposure that is likely to be without an appreciable risk of deleterious effects during a lifetime); 0.0001 mg/day
BW = Body weight in kilograms (1 kg = 2.2 lbs); value used for infant 7.8 kg (17 lbs)
Intake = amount of water ingested from contaminant source daily (liters/day; one liter = 33.8 ounces); value used for infant 1.1 liters/day
RSC = Relative Source Contribution (amount coming from water; other sources are possible like air, soil); DHHS established 0.2 (20%)

Calculation from DHHS: DWEL = 0.0001 mg/day x 7.8 kg ÷ 1.1 L/day x 0.2 x 10^6 ng/mg = 141.8 ng/l or ppt (DHHS used 140 ppt).

11. Are there any increased health issues (cancer) in Brunswick, New Hanover, and Pender counties?

Answer: DHHS released a cancer study summary of selected cancer rates for Bladen, Brunswick, New Hanover, and Pender Counties and their comparison to NC statewide rates in the period 1996 to 2015. The rates do not ascribe causality, just rates of occurrence. Therefore, the rates cannot be linked to GenX or other contaminants. The results only show any abnormalities in rates of liver, pancreatic, testicular, kidney, and uterine cancer incidence in the four counties relative to reported rates statewide. (https://www.ncdhhs.gov/news/press-releases/nc-dhhs-releases-summary-selected-cancer-rates-counties-cape-fear-region)

In summary, the "county-specific cancer rates examined were not significantly higher than state rates, with the exception of testicular and liver cancers in New Hanover County during specific periods." The testicular cancer rate was higher during the entire 20-year period and the liver rate was higher during the 2006-2010 period. Additional detailed work is needed to assess if there are any intake related correlations.

12. What methods remove or reduce GenX and other perfluorinated compounds from water?

Answer: The best way is not to allow any discharges of these chemicals. However, there are ways to remove and/or reduce the amount of these chemicals as shown in numerous studies. CFPUA is testing some of these methods.

First, conventional water treatment methods (coagulation, ozonation, aeration, chlorination, and simple granular filtration) do not work to remove any of these chemicals. Boiling the water does not help either. The four techniques that have been most commonly cited and reviewed are: Reverse Osmosis (RO), Nano-filtration (NF), Granulated Activated Carbon (GAC), and Ion Exchange (IX). Studies suggest this order reflects the likely efficacy of these treatments at removing the subject contaminants.

RO: Found to be the most effective method. It is also the most expensive. One issue with this method is that for every gallon of water made available for drinking 1 to 4 gallons of waste water is generated. This waste water goes back to the river. Of course the contaminants are already in the water.
NF: Process currently used for the groundwater filtration at the CFPUA Ogden plant
GAC: Effectiveness likely depends on the type of activated carbon and maintenance of it. Knappe reports this to be ineffective but other studies have shown it to be effective to a degree
IX: Likely to be helpful as some of these ions could be removed in the exchange process

13. Should I drink the water? Should I avoid it entirely?

Answer: The answer to this question is indeed a personal one. GenX levels are falling and hopefully will remain low or fall further. DHHS has issued their health assessment that states if GenX levels are below 140 ppt, then the water is safe to drink. They state the calculation is a conservative value as it considers a life-time of use and the most vulnerable population – the young. However, there are other perfluorinated compounds in the water that should be investigated. Testing has only indicated their presence in the water, not the level of contamination. These contaminants have not been studied and "safe" levels have not been determined for them. If you are concerned you may want to consider alternatives until more information is available.

There is little evidence to suggest that bathing, washing, and/or other external uses are harmful, as ingesting water is the real way that the contaminants enter your body. Again, this is your personal decision, however.

Note: CFPUA is currently providing free water from the groundwater source at Ogden. They are also working with 3 churches in Wilmington to provide water free of charge (You may also obtain RO water from some local sources (in-store units) at reduced prices.

14. What efforts are currently underway in regards to GenX and other contaminants?

Answer: There is a long list of activitites but a few include:

1. Water testing is ongoing. CFPUA is testing everyday (http://www.cfpua.org/) and the North Carolina Department of Environmental Quality (NCDEQ) (https://deq.nc.gov/news/hot-topics/genx-investigation) is continuing testing. NCDEQ posts the testing sites on a map at the above website.
2. CFPUA is providing free water from their Nano-filtration groundwater source and churches are helping distribute it.
3. Chemours has promised and to DEQ knowledge has stopped discharging GenX as of 7/12. NCDEQ/Governor has said (7/24) that the Chemours permit to discharge any GenX will be denied.
4. We don't have much data on other perfluorinated chemicals in the river; remember there were 6 others found in the original report; NCDEQ has promised to pursue the amounts and impacts of these other chemicals
5. DHHS confirmed (7/24) their calculation of 140 ppt as a reasonable health assessment limit as it is for a lifetime of use and the assessment assumes most conservative values (using an infant with large intake vs body weight – see above calculation).
6. Additional studies on health effects will be initiated by the Center for Disease Control/DHHS.
7. An investigation has been initiated to determine if any violations have occurred with the discharge of GenX. These efforts, as stated by Governor Cooper (7/24), will be conducted by the State Bureau of Investigation and the Environmental Protection Agency will be involved as well.