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Evaluation of the Effectiveness of General Statute §87-97 on Water Quality Interventions  
among Private Well Owners in North Carolina

Interim Report

Prepared by

North Carolina Private Well and Health Program

Occupational and Environmental Epidemiology Branch

Epidemiology Section

North Carolina Division of Public Health

Raleigh, NC

North Carolina Department of Health and Human Services

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## 1. Introduction

### 1.1. Background

Approximately 2.4 million North Carolinians use private wells for their domestic drinking water. North Carolina ranks 5th among states for the number of people relying on private wells.<sup>1</sup> Unlike public water systems which are regulated under the Safe Drinking Water Act, there is no requirement for private wells to be routinely tested or treated for contamination. Private well owners are therefore solely responsible for monitoring the safety of their private well water.

Approximately 3,800 new wells are constructed in North Carolina every year.<sup>2</sup> In 2008, the North Carolina General Assembly enacted GS§ 87-97, which requires all newly constructed private wells to be tested (within 30 days of construction) for the following contaminants: arsenic, barium, cadmium, chromium, copper, fluoride, lead, iron, magnesium, manganese, mercury, nitrates, nitrites, selenium, silver, sodium, zinc, pH, and bacterial indicators. North Carolina Administrative Code (NCAC) Section 3800 specifies requirements for collecting and analyzing private well water samples, reporting the results of the analysis, reviewing data for contaminants detected at levels exceeding the maximum contaminant level (MCL) for public drinking water, and for communicating the results to the well user. Local health departments (LHDs) are responsible for collecting private well water samples, submitting samples to a certified laboratory for analysis, and providing guidance to the well owner.

The North Carolina Division of Public Health's Occupational and Environmental Epidemiology Branch (OEEB) is responsible for providing LHDs with information about contaminants exceeding MCLs, recommendations for water use limitations or treatment options, and recommendations on repeat testing. To streamline this process, OEEB staff developed a Health Risk Evaluation (HRE) form to provide the homeowner with guidance for the next steps based on their private well water test results. HRE forms are completed by local health department staff. An example HRE can be found in the Appendix. Once an HRE is provided to the private well owner at the time of construction, there is no follow-up requirement to determine whether re-testing and/or treatment recommendations were carried out.

### 1.2. Purpose

The objective of this study is to evaluate the impact of the 2008 mandatory testing law on the frequency and type of well-water interventions on newly constructed private wells by assessing the following overarching questions:

- Are residents receiving their test results?
- Are residents receiving their HREs?

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<sup>1</sup> Dieter, C.A., Maupin, M.A., Caldwell, R.R., Harris, M.A., Ivahnenko, T.I., Lovelace, J.K., Barber, N.L., and Linsey, K.S., 2018, Estimated use of water in the United States in 2015: U.S. Geological Survey Circular 1441, 65 p., <https://doi.org/10.3133/cir1441>.

<sup>2</sup> Jackson, C.L.P., & Zarate-Bermudez, M. (2019). Exposure to Contaminants Among Private Well Users in North Carolina: Enhancing the Role of Public Health. *Journal of Environmental Health*, 81(8), 36-39.

- What actions are taken after receiving HREs and/or test results?
- Why are actions taken after receiving HREs and/or test results?
- What concerns residents have about their private well water?

## 2. Methods

### 2.1. Recruitment

A list of unique residential addresses was developed from new private well tests conducted by the NC State Laboratory of Public Health from January 2015 to December 2019. Several filters were applied to verify addresses. First, addresses were geocoded using ArcGIS. Only geocoded addresses that matched the original address were kept. The remaining addresses were then entered into Google's "My Maps" platform or by searching for an address directly in the search engine. If the address was identifiable through Google's database, it was kept and otherwise, it was removed. Lastly, addresses were sent to an external company *USAData*, which utilized the United States Postal Service database to determine which addresses were mailable. After obtaining a final list of addresses, the most recently sampled private wells were selected starting from December 2019 and moving backward until 12,000 mailable addresses were identified. Each address that was mailed a survey was assigned a unique ID that was associated with their survey response. The recruitment pool included addresses in all of North Carolina's 100 counties.

Households were mailed a 12-page survey (see Appendix) that asked about private well users' actions, knowledge, and concerns regarding their private well, in addition, to select demographic information. A copy of the household's original/first private well water test results was also included in the survey package. Households were given the option of completing a paper survey or an online survey. Households were given approximately one month to complete the survey. To incentivize participation, households could opt into a random drawing to win one of five-hundred \$25 gift cards.

### 2.2. Analyses

Survey data were collected in REDCap (license citation) and analyzed in R (R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>). Summary statistics were calculated for all questions included in the survey. Percentages were calculated based on the number of respondents who responded to each question. If a respondent skipped a question they were not included in the analysis for the question. To understand what actions were taken after respondents received their test results when the private well was first constructed and tested, the analysis of questions 10-20 only included respondents who indicated they received their private well test results.

During the analysis, we made several decisions to account for inconsistencies within a single survey response. How respondents answered survey questions required three types of cleaning steps.

1. **Removing contradictory response pairs** – In the survey, some questions built off one another and requested that the respondent provide factors that were associated with deciding to take a particular action. For example, question 12 asked respondents “If you changed your drinking water source after testing, what alternative source did you use?” and question 13 asked, “If you changed your drinking water source after testing, what factors influenced your decision?” However, if the respondent indicated a factor influencing their decision without previously indicating the action was taken or if there was an inconsistency between these pairs of questions, then their response was removed from the analysis for those paired questions only. For example, if in question 12 a respondent indicated that they did not change their drinking water source, but then cited in question 13 that their reason for changing their drinking water source was taste and odor, then their response for only those two questions were not included in the analysis. The step was question and survey-dependent.
  
2. **Removing the first response option to question 20** – In the survey, question 20 asked respondents “If you took no action after testing, what factors influenced your decision?” The first response option for this question is “I did take action after testing.” During the analysis, it was found that the majority of the respondents who selected this response contradicted their responses to the other questions in this survey. For example, many respondents also selected the first response for questions 10-19, which confirmed that no action was taken (e.g, “I did not re-test water within one year of original test”). We suspect that because the pattern for question 20 did not match the previous questions that respondents were confused by the question. This step was taken for all survey responses.
  
3. **Accounting for free responses** – During the analysis of the free responses provided by respondents, it was found that responses fit more appropriately with one or more of the other response options. For example, in question 13, one respondent selected “Other factor(s) influenced my decision to change my drinking water source” and stated, “*My water has bad odor & taste,*” instead of selecting “Taste, odor, or appearance of water.” This response was categorized as a selection for “Taste, odor, or appearance of water” and not “other.” The step was question and survey-dependent.

### 3. Results

#### *3.1. Study Population and Background on Respondents’ Private Wells*

The survey response rate among delivered surveys was 12.01% (1,439 of 11,978), 22 mailed surveys were returned as undeliverable. 82.77% (1,191 of 1,439) of respondents completed and returned the paper survey, while 17.58% (253 of 1,439) completed the survey online. 27 records had a duplicated unique ID or did not include a unique ID so were not included in the analyses. This resulted in 98.47% (1,417 of 1,439) of the returned surveys being suitable for analysis. Respondents represented 90 of the 100 counties in North Carolina. The number of respondents from each county is shown in Table 1.

Table 1. Survey Respondents by county. The number of respondents from each county in parenthesis

Alamance (n=31)	Edgecombe (n=2)	Orange (n=77)
Alexander (n=4)	Franklin (n=28)	Pamlico (n=3)
Alleghany (n=2)	Gaston (n=29)	Pasquotank (n=1)
Anson (n=1)	Gates (n=1)	Pender (n=27)
Ashe (n=6)	Graham (n=1)	Perquimans (n=1)
Avery (n=5)	Granville (n=32)	Person (n=25)
Beaufort (n=3)	Guilford (n=26)	Pitt (n=8)
Bladen (n=4)	Halifax (n=4)	Polk (n=3)
Brunswick (n=13)	Harnett (n=6)	Randolph (n=9)
Buncombe (n=107)	Haywood (n=26)	Richmond (n=9)
Burke (n=11)	Henderson (n=28)	Rockingham (n=18)
Cabarrus (n=21)	Hertford (n=2)	Rowan (n=17)
Caldwell (n=12)	Hoke (n=8)	Rutherford (n=23)
Camden (n=4)	Iredell (n=51)	Sampson (n=14)
Carteret (n=34)	Jackson (n=15)	Scotland (n=3)
Caswell (n=2)	Johnston (n=18)	Stanly (n=9)
Catawba (n=41)	Lenoir (n=1)	Stokes (n=14)
Chatham (n=58)	Lincoln (n=24)	Surry (n=13)
Cherokee (n=18)	Macon (n=23)	Swain (n=7)
Chowan (n=1)	Madison (n=12)	Transylvania (n=11)
Clay (n=10)	Martin (n=3)	Union (n=66)
Cleveland (n=5)	Mcdowell (n=22)	Wake (n=3)
Columbus (n=15)	Mecklenburg (n=28)	Warren (n=2)
Craven (n=4)	Mitchell (n=5)	Washington (n=2)
Cumberland (n=37)	Montgomery (n=1)	Watauga (n=5)
Currituck (n=33)	Moore (n=13)	Wayne (n=3)
Davidson (n=3)	Nash (n=38)	Wilkes (n=5)
Davie (n=5)	New Hanover (n=37)	Wilson (n=15)
Duplin (n=14)	Northampton (n=3)	Yadkin (n=6)
Durham (n=13)	Onslow (n=4)	Yancey (n=10)

The average household size reported was 2.61. 98.48% (1,360 of 1,381) of respondents reported owning their property, while 1.01% (14 of 1,381) rented. 29.03% (400 of 1,377) reported having at least one child compared to 69.81% (962 of 1,378) of respondents who did not report the presence of children. When childhood age groups were stratified; 20.33% (280 of 1,377) of households reported the presence of children under the age of 12 and 14.40% (298 of 1,375) of households reported the presence of children between 12 and 18 years of age.

85.21% (1,193 of 1,400) of respondents indicated that their well as their primary drinking water source. 81.85% (1,132 of 1,383) of households reported owning their own home when the well was constructed. Of the 244 respondents who reported not owning their home when the well was constructed, 54.10% (132 of 244) purchased the home from a developer, and 44.67% (109 of 244) purchased the home from a previous owner.

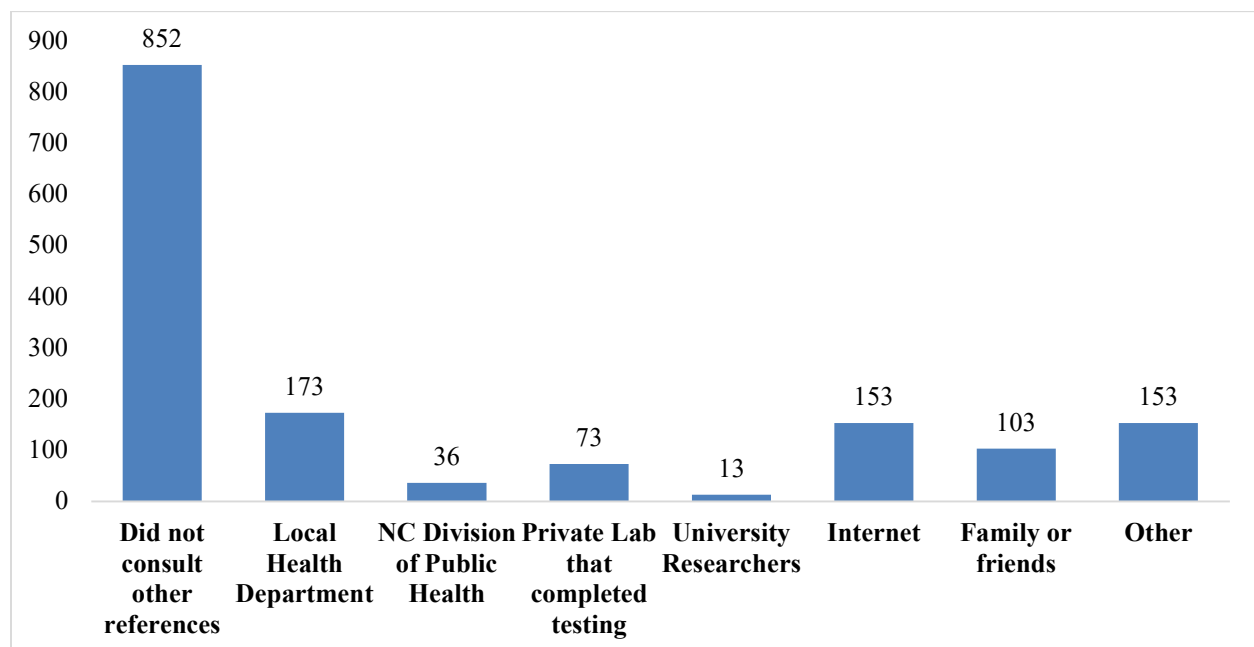
### 3.2. Private Well Testing and Results

88.43% (1,238 of 1,400) of respondents were aware that their private well was tested by the local health department after construction. 79.33% (1,094 of 1,379) of respondents reported receiving their original test results. 20.67% (285 of 1,379) of respondents reported they did not receive their original test results. Of the respondents that reported not receiving their original test results, 56.23% (158 of 281) owned their home when the private well was constructed, while 43.77% (123 of 281) did not own their home at the time of construction. Those who did not own their home at the time of construction reported that 50.41% (61 of 121) and 49.57% (60 of 121) of their homes were owned by a developer or previous owner, respectively.

61.28% (812 of 1,325) of all respondents reported receiving an HRE while 38.72% (513 of 1,325) reported they did not receive an HRE. Of the respondents that reported not receiving their HRE, 68.58% (347 of 506) owned their home when the private well was constructed, while 31.42% (159 of 506) did not own their home at the time of construction. Among those who did not own their home at the time of construction, 51.59% (81 of 157) and 48.41% (76 of 157) reported that their homes were owned by a developer or previous owner, respectively.

The majority of respondents who reported receiving their HRE found the document easy to understand; 94.03% (772 of 821) found the HRE easy or very easy to understand and 86.04% (684 of 795) reported understanding what steps (if any) were suggested to them based on their test results. This is supported by many respondents not consulting with other references for guidance, information, or recommendation. Figure 1 shows other resources respondents consulted with for other guidance, information, or recommendations to help understand their private well water test results.

Figure 1. Resources consulted for guidance, information, or recommendations to help respondents understand their private well water test results



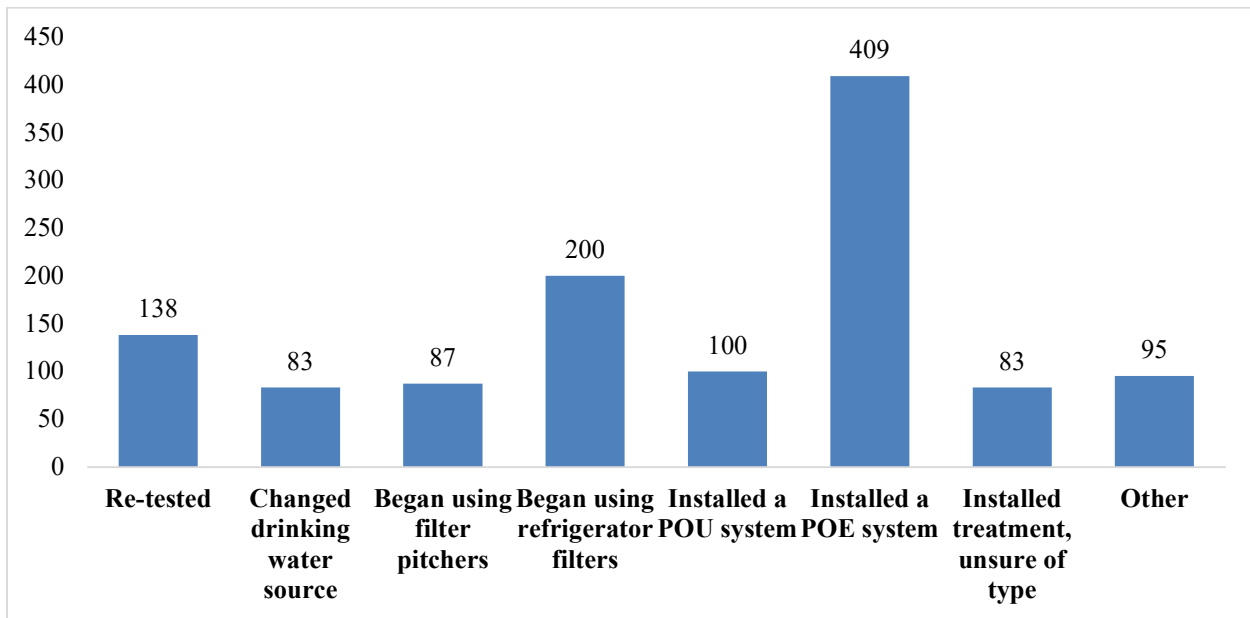
Less frequently respondents consulted their local health department, the internet, and family/friends or ‘other.’ Respondents rarely consulted the NC Division of Public Health, university researchers, or private labs. The 153 respondents who consulted ‘others’ for guidance, information, or recommendations commonly cited well contractors/drillers and water quality professionals/companies.

### 3.3. Actions Taken with Respondents’ Private Wells

#### 3.3.1 General Treatment Behaviors

When asked, what action was taken after a private well was originally tested (question 10), 55.39% (606 of 1,094) of respondents who received their original test results reported they took at least one action after receiving their results. 47.81% (523 of 1,094) reported taking no action after receiving their test results, while 28.24% (309 of 1,094) of respondents reported taking only one action after receiving their results. Figure 2 summarizes respondents reported treatment behaviors following a household receiving its original private well water test.

Figure 2. Self-Reported treatment behaviors following original test results



The most commonly reported treatment behavior after receiving well water test results was installing a point of entry (whole house) system. This was followed by began using a refrigerator filter and retested within one year. Among respondents who listed taking ‘others’ actions, shock chlorination of a private well was cited 61 times.

#### *Re-testing of Private Well*

When asked if a private well was re-tested (question 11), 17.82% (195 of 1,094) of respondents indicated that they re-tested their drinking water source after testing. Of those who retested, 33.33% (65 of 195) of respondents reported that the bacteria detection did not change, 37.44% (73 of 195) reported that the bacteria detection was different, 28.72% (56 of 195) reported that the chemical levels did not change, and 30.26% (59 of 195) reported that the chemical level was

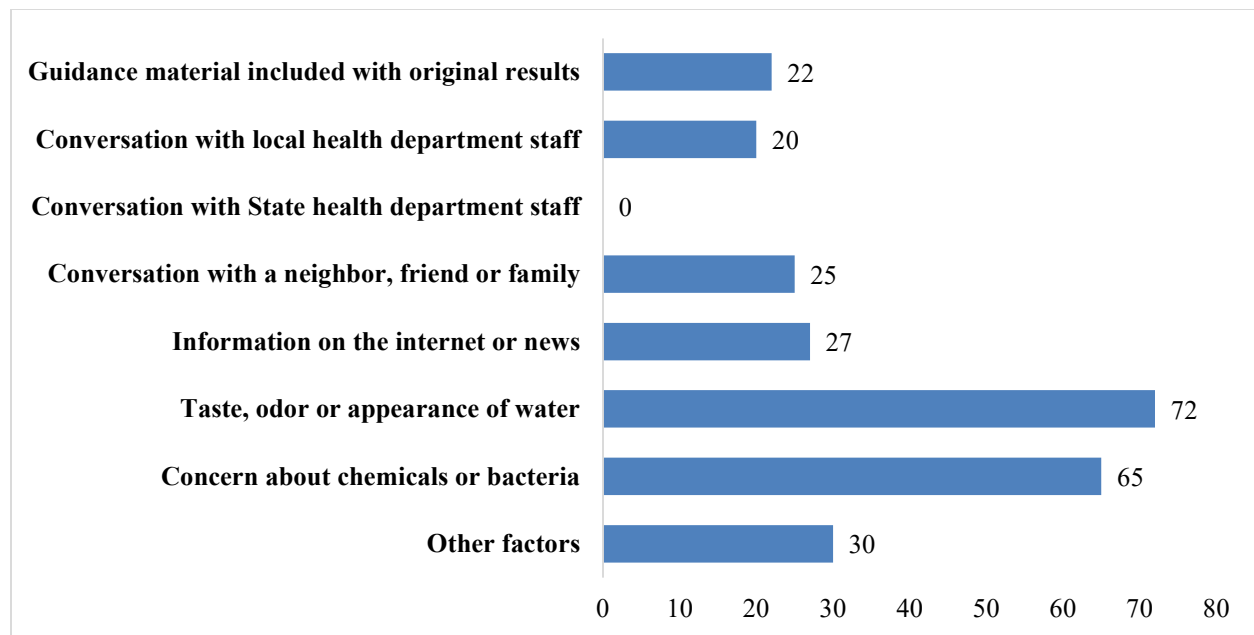


different. Respondents that saw a change in chemical levels reported 35.59% (21 of 59) increased levels and 64.41% (38 of 59) decreased levels.

### *Change in Drinking Water Source*

When asked if respondents changed their drinking water source (question 12), 15.58% (160 of 1,027) indicated that they changed their drinking water source after testing. Of those respondents that changed their drinking water source, 91.25% (146 of 160) began using bottled water, 4.38% (7 of 160) connected to a public water supply, 3.75% (6 of 160) drilled a new private well, 1.88% (3 of 160) began using another private well. Five respondents listed ‘other’ sources of drinking water and cited using rainwater, spring water, pre-existing use of bottled water, or filling bottles from a neighbor’s public water supply. One respondent stated they used bottled water until they retested and had a treatment system installed. For respondents who reported changing their drinking water source, the most frequently cited factor that influenced their decision was the taste, odor, or appearance of water (Figure 3).

Figure 3. Factors that influenced respondents’ decision to change their drinking water source after testing.



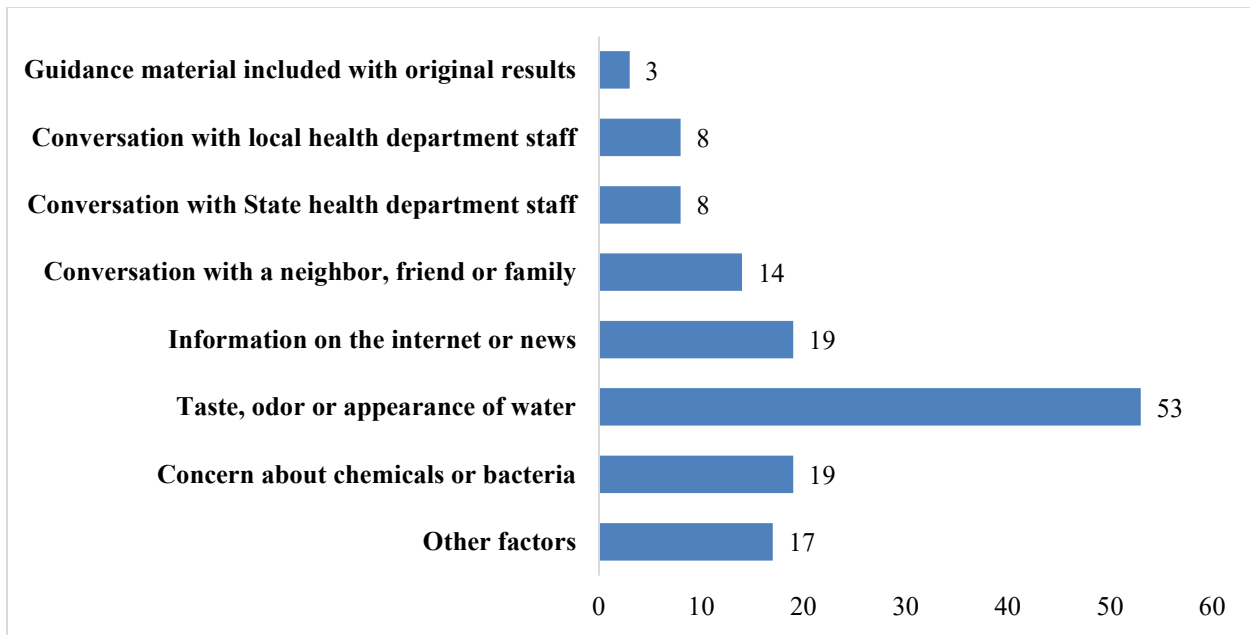
Respondents who were concerned about contaminants detected in their water frequently cited bacteria (*E. coli*, total coliform, and coliform bacteria). Other notable contaminants of concern included arsenic, manganese, iron, and lead. Among the 30 who reported ‘other’ factors influencing their decision to use an alternative drinking water source, respondents commonly cited reasons included the alternative source was preferred over private well water, the perception that the alternative source was safer, and concerns for the health of those drinking the water.

### *3.3.2 Filter Treatment Behaviors*

#### *Filter Pitchers*

When asked if respondents began using filter pitchers and if so what type (question 14), 11.28% (120 of 1,064) reported using filter pitchers after testing. Of those using filter pitchers, 62.50% (75 of 120) used a Brita filter, 18.33% (22 of 120) used a PUR filter, and 10.83% (13 of 120) used a ZeroWater filter. 13.33% (16 of 120) of respondents listed ‘other’ types of filter pitchers and included Aqua Gear, Berkey, Big Blue, GE, Kirkland, Levoit, Max Strength, Paragon, Shaklee, and Whirlpool filter pitchers. For respondents who reported using filter pitchers, the most frequently cited factor that influenced their decision was the taste, odor, or appearance of water (Figure 4).

Figure 4. Factors influencing the decision to begin using filter pitchers as reported by respondents.

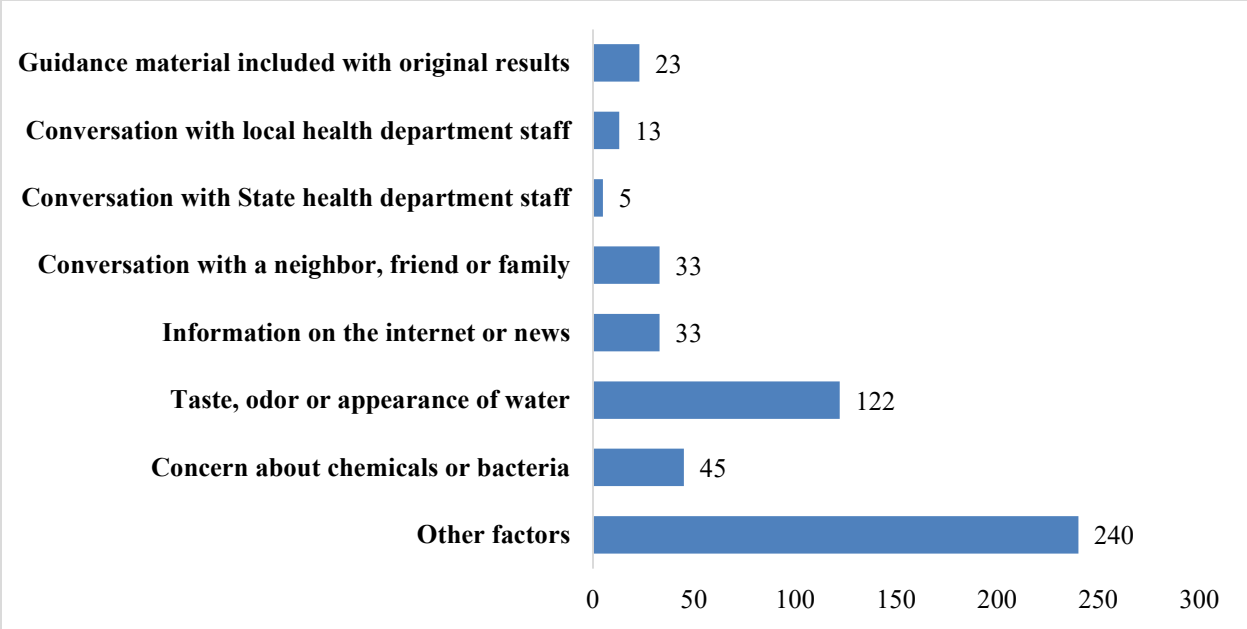


Respondents who used a pitcher filter and were concerned about the contaminants detected in their water frequently cited concerns about iron, bacteria, and particulates. Other notable contaminants included manganese, hardness, and per- and polyfluoroalkyl substances (PFAS). Among the 17 respondents who reported ‘other’ factors influencing their decision to use a pitcher filter, commonly cited reasons were pre-existing use of pitchers before testing and the perception of pitcher filters being safer than their private well water.

### *Refrigerator Filters*

When asked, if respondents began using refrigerator filters, what type of filter do you use (question 16), 29.08% (412 of 1,417) of respondents provided the type of refrigerator filter they began using after testing. Respondents noted the following brands most frequently: GE, Frigidaire, Samsung, and Whirlpool. Figure 5 shows the reported factors which influenced respondents’ decision to begin using a refrigerator filter.

Figure 5. Factors influencing the decision to begin using refrigerator filters as reported by respondents.



For respondents who reported using refrigerator filters, the most frequently cited factor that influenced their decision was ‘other’ factors. Among the 240 who reported ‘other’ factors influencing their decision to use refrigerator filters, respondents commonly cited reasons were pre-existing use of refrigerator filters before testing and their refrigerators coming with filter. Respondents who were concerned about the contaminants detected in their water frequently cited concerns about iron, bacteria, and arsenic.

*3.3.3. Treatment Systems Behaviors*

When asked if respondents installed a treatment system after testing, what type of treatment was used (question 18), 45.33% (461 of 1,017) of respondents indicated they did install a treatment system after testing. Figure 6 shows the types of treatment systems selected by respondents. The most commonly installed systems were filtration systems and water softeners. 60.30% (278 of 461) and 51.84% (239 of 461) of respondents installed a filtration or water softener, respectively. 12.15% (56 of 461) of the respondents listed ‘other’ types of treatment systems and stated installing specific brands (e.g., Culligan and Kinetico) or stated that they had a pre-existing system before private well testing. Figure 7 shows the various factors which respondents cited as reasons for installing a treatment system after testing.

Figure 6. Types of Treatment Systems installed after testing as reported by respondents.

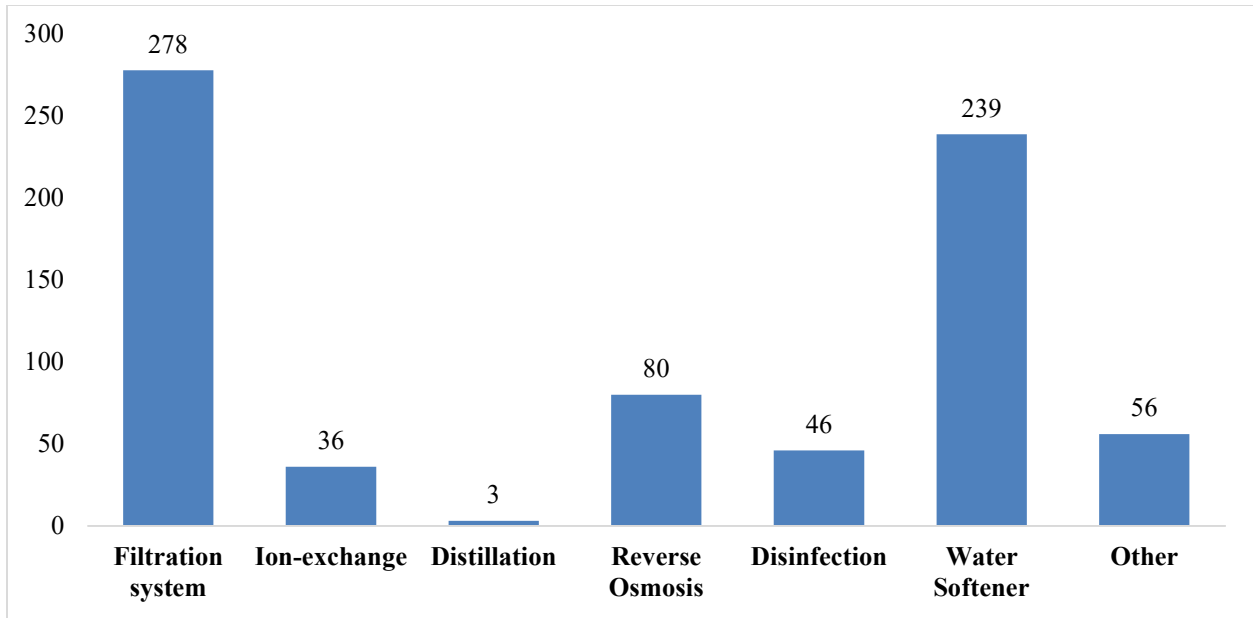
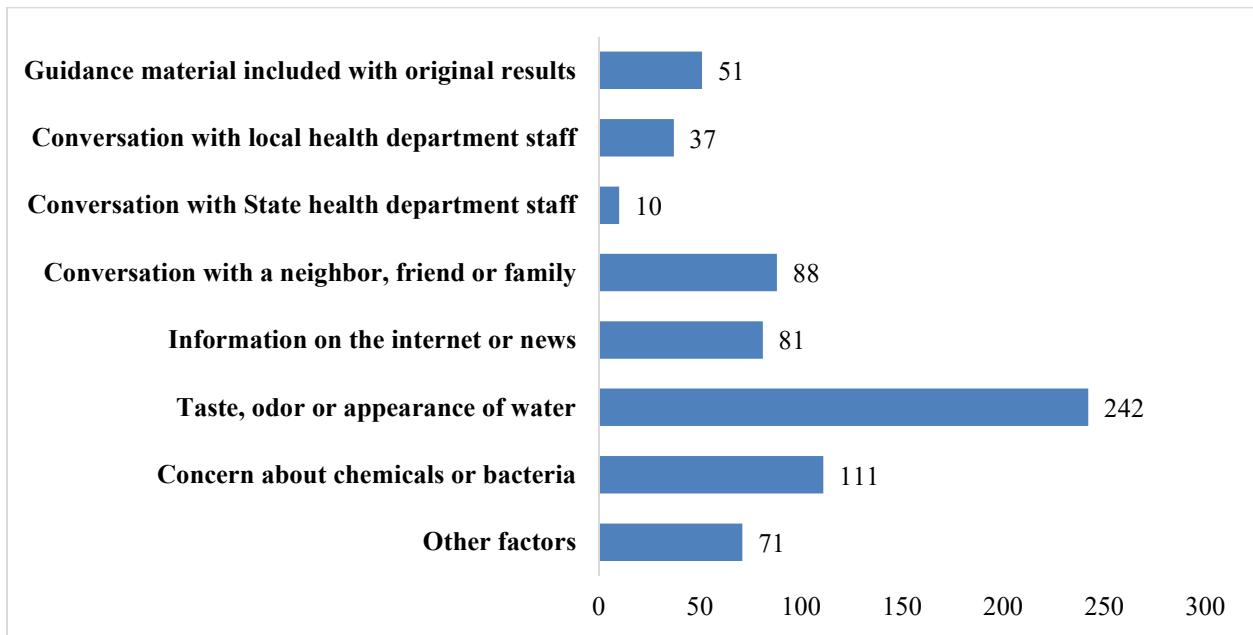


Figure 7. Factors influencing the decision to install a treatment system, as reported by respondents.

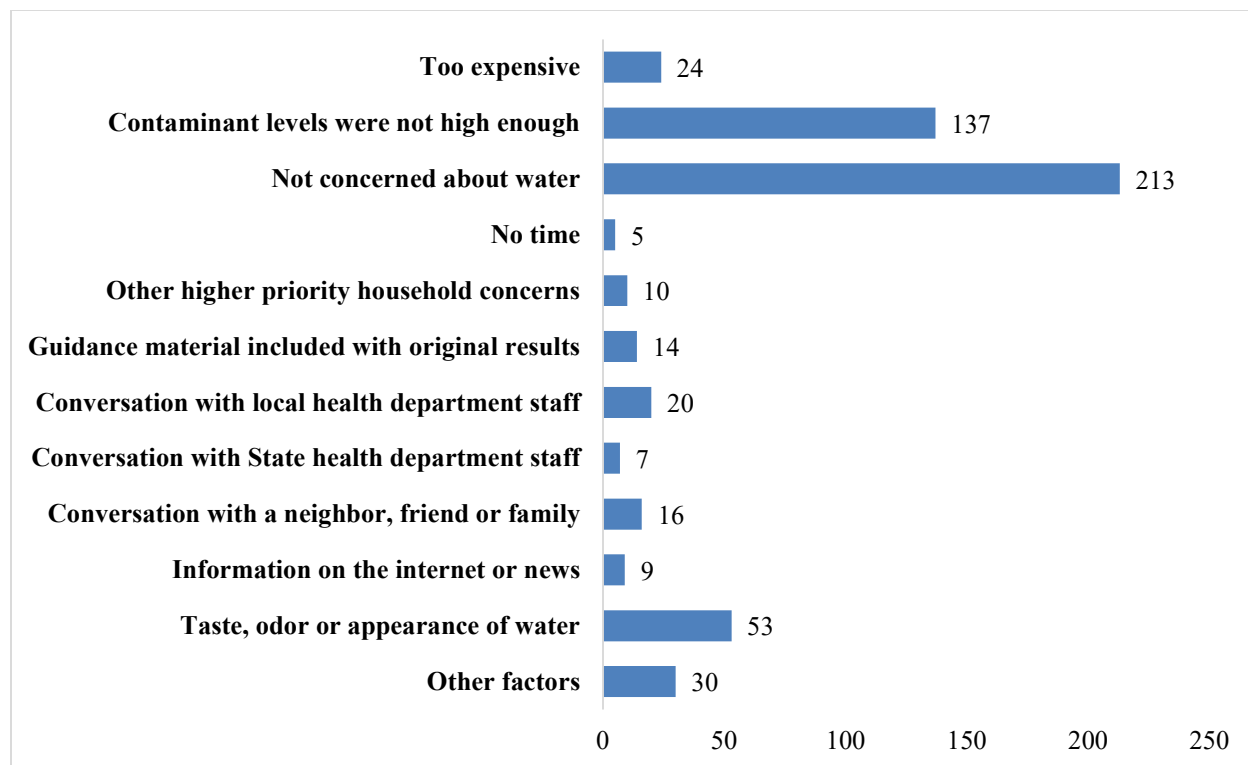


For respondents who reported installing a treatment system, the most frequently cited factor that influenced their decision was the taste, odor, or appearance of water. Respondents who were concerned about the contaminants detected in their water frequently cited concerns about iron/rust and particulates. Among the 71 respondents who reported ‘other’ factors influencing their decision to use a treatment system, respondents commonly cited that it was recommended by a plumber, well driller, home builder, or water quality professional/company.

### 3.4. Factors Influencing Private Well Treatment Behavior

When asked what factors influenced respondents who took no action (question 20), 43.97% (481 of 1,094) of respondents provided a reason for not taking any action. Figure 8 shows what factors influenced respondents to take no action after the original test. The most frequently cited factor that influenced respondents' decision to take no action was that contaminants levels were not high enough or respondents were not concerned about their water. Among the 30 respondents who reported 'other' factors influencing their decision to take no action, respondents commonly cited that they had a pre-existing system or used bottled water before the private well was ever tested.

Figure 8. Factors influencing the decision to take no action, as reported by respondents.



### 3.5. Additional Testing Behavior

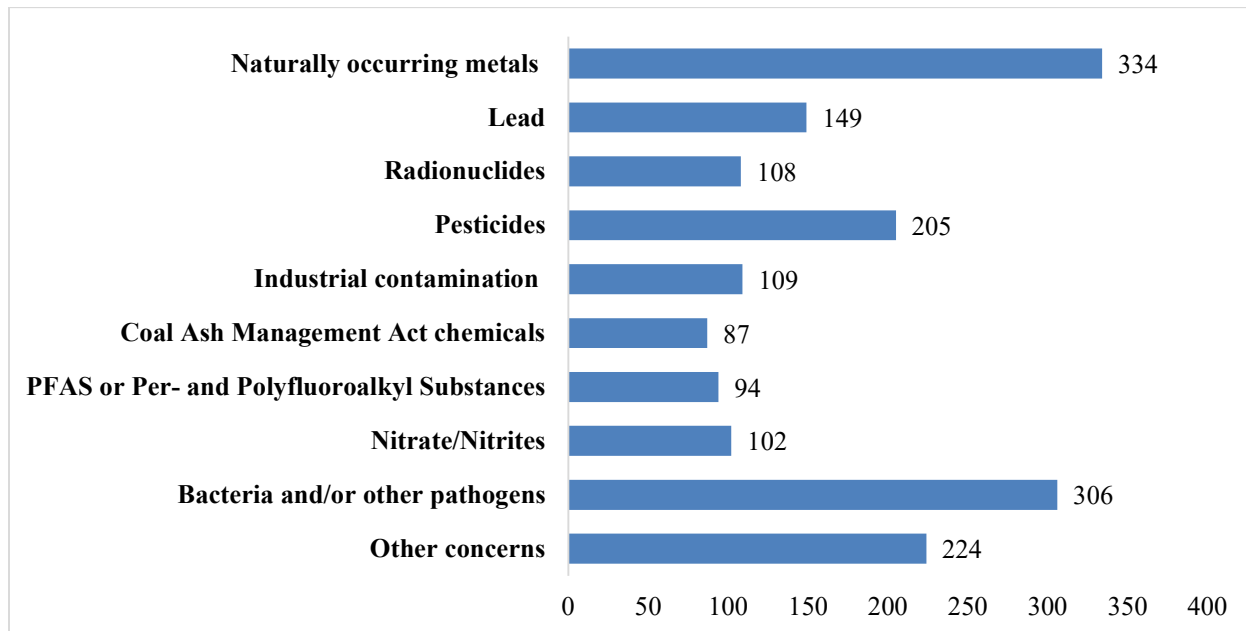
When asked if any more tests have been done on respondents' private wells since the original test or any initial re-test, 18.43% (254 of 1,378) of respondents reported that another test has been done on their private well since it was originally tested or retested, while 4.21% (58 of 1,378) were unsure if there was any additional testing. When asked how likely a respondent will be to test their private well in the future, 64.50% (885 of 1,372) of respondents indicated that they are highly likely or likely to test their private well water in the future, compared to 35.50% (487 of 1,372) who indicated they were highly unlikely or unlikely to retest.

### 3.6. Respondents' Concerns about their Private Wells

When asked if respondents have concerns about their private well water quality (question 23), 37.46% (499 of 1,332) of respondents reported having concerns. However, 88.50% (1,254 of

1,417) of all respondents listed at least one water quality issue of concern. The most commonly reported water quality concerns included naturally occurring metals, bacteria and/or other pathogens, and pesticides (Figure 9).

Figure 9. Private water quality concerns among private well users



Among the 224 who reported having ‘other’ water quality concerns, respondents commonly cited taste, odor, or appearance as being a concern.

When asked if respondents have concerns about the amount of water coming from their private well (question 25) or the age of their private well (question 26), few respondents had concerns about their private well’s yield (11.74%; 160 of 1,363) and even less had concerns about the age of their private well (1.61%; 22 of 1,370). When asked if respondents have any other concerns regarding their private well (question 27), 7.30% (98 of 1,342) of respondents reported having other concerns about their private well water quality. Respondents most frequently cited concerns about well construction/well driller competencies and expressed a desire to know more about proper private well maintenance, testing, and general private well stewardship practices.

#### 4. Limitations

Respondents were recruited using addresses obtained from private well testing conducted by the NC State Laboratory of Public Health. This method of address selection excluded any newly constructed private well that was not tested through the State Lab. NC DHHS is aware that at least one county in North Carolina, Wake County, conducts its own private well testing.

Survey packages were sent with a copy of the original testing results at the time the private well was constructed. However, it is possible that due to typos and human errors in address entry that recipients did not receive their original test report.

Through analysis of survey responses, there were several cases where respondents provided contradictory and/or inconsistent responses. This suggests that there were differences in the way respondents interpreted the survey questions.

Several respondents contacted the NC Department of Health and Human Services indicating that they had never received their original test results. Many of these people followed up with their Local Health Department or other resources. These recipients of the survey may have put their energy toward investigating why they never received the original test results and did not have time to complete the survey. This may result in a response bias towards respondents that had already received their private well testing results.

## 5. Conclusion

### *5.1. Are residents receiving their HREs?*

The majority (61-79%) of respondents indicated that they did receive their original test and HRE. However, some (21-39%) respondents had never received the original test results or guidance document. More than half the respondents reported they did not receive the original test results or HRE owned their private well at the time of construction.

The majority (94%) of the respondents who received their HRE found it easy or very easy to understand and understood what steps (if any) were suggested to them based on their test results. This was affirmed when most respondents indicated they did not consult with other references for guidance, information, or recommendation. When respondents did seek further information from other sources, they consulted their local health department, the internet, and family/friends, or 'other.' Respondents rarely consulted the NC Division of Public Health, university researchers, or private labs. The 153 respondents who consulted 'others' for guidance, information, or recommendations commonly cited well contractors/drillers and water quality professionals/companies.

### *5.2. What actions are taken after receiving HREs and/or test results and why?*

The most commonly reported treatment behavior after receiving test results was the installation of a point of entry (whole house) system. This was followed by began using a refrigerator filter and retested within one year. However, many respondents stated that the use of their refrigerator filter was not because of their test results, but because they installed a refrigerator filter prior to testing or their refrigerators came with a filter.

Commonly cited reasons for taking any action after receiving HREs and/or test results among respondents was taste, odor, or appearance of water. Respondents who took action due to concerns for contaminants in their drinking water often reported concerns for bacteria regardless of which action was taken. (Figure 3).

### *5.3. What concerns do residents have about their private well water?*

Respondents seemed most concerned about naturally occurring metals (lead, arsenic, manganese) and bacteria. Most respondents did not express concern for the age of their private well or yield/quantity of water they obtain from their private well. Among those who expressed other concerns regarding their private well, concerns included well construction/well driller

competencies, and a desire to know proper private well maintenance, testing, and general private well stewardship practices.

## **6. Next Steps**

Many respondents stated that actions were taken because of concerns for the taste, odor, or appearance of water. A common misconception among the general public is that if your water looks, tastes, or smells fine, it is safe. However, many contaminants like arsenic and lead do not have an odor, appearance, or taste. In the past, NC DHHS has developed messaging to eliminate this misconception and will continue to educate private well users on the health benefits of yearly testing.

A small proportion of the respondents were unaware that their private well was ever tested during initial construction, and never received their original test results or the HRE. NCDHHS staff will investigate solutions to provide those private well users access to the original test results and HRE.

There were a few respondents that stated the HRE was difficult or very difficult to read. NC DHHS has been working to develop an online tool to aid in the interpretation of private well testing results. Work will continue with partners to pilot the tool among private well owners to help ensure ease of use and increase well owners' understanding of the message.

Many respondents stated concerns about their lack of knowledge regarding proper private well maintenance, testing, and general private well stewardship practices. NCDHHS is working to develop an online repository of information that will include guidance on private well maintenance, testing, and other private well stewardship information.

NCDHHS would like to further analyze survey data to understand if there are geospatial patterns among responses, i.e. are households with children likely to test in the future and how test results from initial testing may influence future testing behaviors.



## Appendix



# Private Well Information and Use Recommendations

## For Inorganic Chemical Contaminants

County:  Name:

Sample ID #:  Reviewer:

### TEST RESULTS AND USE RECOMMENDATIONS

- Your well water meets federal drinking water standards *for inorganic chemicals*. Your water can be used for drinking, cooking, washing, cleaning, bathing, and showering based on the *inorganic chemical results only*. You may have other water sampling results that are not taken into account in this report.
- The following substance(s) exceeded federal drinking water standards or the North Carolina 2L calculated health levels. The North Carolina Division of Public Health recommends that your well water not be used for drinking and cooking, unless you install a water treatment system to remove the circled substance(s). However, it may be used for washing, cleaning, bathing and showering based on the *inorganic chemical results only*.

Arsenic	Barium	Cadmium	Chromium	Copper	Fluoride	Lead	Iron	
Manganese	Mercury	Nitrate/Nitrite	Selenium	Silver	Magnesium	Zinc	pH	

3.  a. Sodium levels exceed the U.S. Environmental Protection Agency's (USEPA) Health Advisory level for sodium of 20 mg/l. The North Carolina Division of Public Health recommends that only individuals on no or low sodium restricted diets not use this water for drinking or cooking. It may be used for washing, cleaning, bathing, and showering based on the *inorganic chemical results only*.

b. Levels over 30 mg/l may pose aesthetic problems such as bad taste, odor, staining of porcelain, etc.

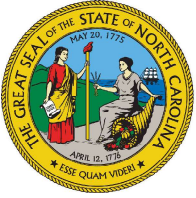
4.  Re-sampling is recommended in \_\_\_\_\_ months.

5.  Re-sample for lead and /or copper. Take a first draw, 5 minute, and 15 minute sample inside the house (preferably the kitchen) and if possible a first draw, 5 minute and a 15 minute sample at the well head to determine the source of the lead and/or copper.

6.  The following substance(s) exceeded federal drinking water standards. Your water can be used for drinking, cooking, washing, cleaning, bathing, and showering based on the *inorganic chemical results only*, but aesthetic problems such as bad taste, odor, staining of porcelain, etc. may occur. You may want to install a household water treatment system to address aesthetic problems.

Barium	Cadmium	Chromium	Fluoride	Iron	Magnesium
Manganese	Selenium	Silver	pH	Zinc	

For more information regarding your well water results, please call the North Carolina Division of Public Health at 919-707-5900.



NC DEPARTMENT OF  
**HEALTH AND  
HUMAN SERVICES**

ROY COOPER • Governor

MANDY COHEN, MD, MPH • Secretary

MARK BENTON • Assistant Secretary for Public Health

November 12, 2020

105 Libby Lane  
Wilmington, NC 28409

Dear resident,

You are receiving this letter and survey because you had a private well that was tested by your local health department when it was newly constructed. Testing new wells is required by North Carolina law (GS § 87-97). For the North Carolina Department of Health and Human Services to learn more about your private well and the information you received when your private well was constructed, we invite you to complete a survey.

This survey is intended for private drinking well owners in North Carolina or their representatives who may be familiar with the maintenance of their wells. The respondent to this survey should be the person within your household who knows the most about your well.

This survey asks about a well that was constructed at your address and water quality testing that was conducted for that well. If you did not live at your address at the time that the well was constructed and tested, then you may not have received a copy of the results from the well water testing that was done. A copy of those test results is included in this survey package.

The information obtained in this survey will help guide health education activities for private well owners across North Carolina. We will report what we learn to our funding agency, the Centers for Disease Control and Prevention (CDC), and we may publish the aggregated results in a scientific journal. For information about recommended practices for well water testing and safety, please visit our web page at <http://epi.publichealth.nc.gov/oe/programs/wellwater.html>.

The survey is completely voluntary. It is expected that you will need 20 minutes to finish. If you have any questions about this survey, please contact the NC Private Well and Health Program at (919) 707-5911.

Please enclose your completed survey in the pre-stamped envelope provided and drop it in the mail. We will award \$25 gift cards to 500 survey participants, using a random drawing. **This survey ends December 7, 2020. Surveys received after this date will not be considered for the \$25 gift card.**

Sincerely,

Crystal Lee Pow Jackson, PhD  
Environmental Toxicologist  
North Carolina Division of Public Health

NC DEPARTMENT OF HEALTH AND HUMAN SERVICES • DIVISION OF PUBLIC HEALTH

LOCATION: 5605 Six Forks Rd. Raleigh, NC 27609  
MAILING ADDRESS: 1931 Mail Service Center, Raleigh, NC 27699-1931  
www.ncdhhs.gov • TEL: 919-707-5000 • FAX: 919-870-4829

AN EQUAL OPPORTUNITY / AFFIRMATIVE ACTION EMPLOYER

**COPY OF YOUR ORIGINAL TEST**

**North Carolina State Laboratory of Public Health**  
*Environmental Sciences*  
**Inorganic Chemistry**

4312 District Drive  
 MSC 1918  
 Raleigh, NC 27699-1918

http://slph.ncpublichealth.com  
 Phone: 919-733-7308  
 Fax: 919-715-8611

**Certificate of Analysis****FINAL REPORT****Report to:** Jessica Wyatt**Name of System:**

**NEW HANOVER CO ENVIRONMENTAL HEALTH**  
 230 GOVERNMENT CTR DR, STE 140  
 WILMINGTON, NC 28403

**Richard Dixon**  
 105 Libby Ln  
 Wilmington, NC 28409

**EIN:** 566000324EH**Delivery:** NC CourierStarLiMS ID: **ES191231-0014**

Date Collected: 12/30/2019

Time Collected: 10:45 By: J Wyatt

Date Received: 12/31/2019

Time Received: 07:37

Sample Type: Raw

Sampling Point: Well

Well Permit No. WP-19-0233

Sample Source: New Well

Receipt Temp.: 1.5 °C

GPS Number:

**Profile: New Well I**

Analyte	Test Result	Allowable Limit	Unit	Qualifier(s)
Arsenic	<0.005	0.010	mg/L	
Barium	<0.1	2.0	mg/L	
Cadmium	<0.001	0.005	mg/L	
Calcium	48		mg/L	
Chloride	138	250	mg/L	
Chromium	<0.01	0.10	mg/L	
Copper	<0.05	1.3	mg/L	
Fluoride	0.33	4	mg/L	
Iron	0.15	0.30	mg/L	
Lead	<0.005	0.015	mg/L	
Magnesium	27		mg/L	
Manganese	0.01	0.05	mg/L	
Mercury	<0.0005	0.002	mg/L	
Nitrate	<1	10.0	mg/L	
Nitrite	<0.1	1.00	mg/L	
pH	7.7		N/A	
Selenium	<0.005	0.05	mg/L	
Silver	<0.01	0.10	mg/L	
Sodium	98.9		mg/L	
Sulfate	<5	250	mg/L	
Total Alkalinity	240		mg/L	
Total Hardness	230		mg/L	
Zinc	0.07	5.00	mg/L	

**Report Date:** 01/14/2020**Reported By:**
**Marc Komlos**



NC DEPARTMENT OF  
**HEALTH AND  
HUMAN SERVICES**

## Private Well User Survey

Thank you for taking the time to complete this survey. Your responses will help guide health education activities for private well owners across North Carolina.

This survey is intended for private drinking well owners in North Carolina or their representatives who may be familiar with the maintenance of their wells. The respondent to this survey should be the person within your household who knows the most about your well.

This survey asks about a well that was constructed at your address and water quality testing that was conducted for that well. If you did not live at your address at the time that the well was constructed and tested, then you may not have received a copy of the results from the well water testing that was done. A copy of those test results is included in this survey package.

Taking part in this survey is completely voluntary. You may skip any question or stop at any time. A summary of participants' aggregated responses will be published on the NC Department of Health and Human Services (NCDHHS) website. The survey and responses received may be considered public records.

**If you would prefer to complete the survey online,  
please visit <https://is.gd/NCPublicHealthWellSurvey> and  
enter the Unique ID number provided at the bottom of this page.**

The survey questions are divided into five sections:

- Background about Your Private Well
- Private Well Testing and Results
- Actions Taken with Your Private Well
- Your Concerns about Your Private Well
- Demographics

We estimate that this survey will take about 20 minutes to complete. You may skip any question you do not want to answer. When you have completed the survey, please place it in the pre-stamped envelope provided and put in the mail.

We will award \$25 gift cards to 500 survey participants, using a random drawing. **This survey ends December 7, 2020. Any surveys received after this date will not be considered for the \$25 gift card award.**

By proceeding with this survey and mailing it back, you indicate that you are 18 years of age or older and consent to participate in this survey.

**YOUR UNIQUE ID** 50005

## Background about Your Private Well

In this section we will ask questions about your private well. You may skip any questions you do not want to answer. Please fill in the bubble next to your responses below.

1. Do you use your well as your main drinking water source?  Yes  No
2. Were you the owner of this home when the well was constructed?  Yes  No

➤ If your response to Question 2 was "Yes," please mark N/A as your response for Question 3


3. If you did not own your home when the well was constructed, did you purchase your home from a developer or previous owner?
  - N/A, I owned my home when the well was constructed
  - Developer
  - Previous owner

## Private Well Testing and Results

In this section we are asking about materials you may have received when your private well was originally tested. You may skip any questions you do not want to answer. Please fill in the bubble next to your responses below.

4. Were you aware that your private well was tested by your local health department after construction?
  - Yes  No
5. Did you receive your original private well water results after it was tested?
  - Yes  No
6. Did you receive a document that looks like the form in Figure 1 with your original test results?
  - Yes  No

N O R T H C A R O L I N A



### Private Well Information and Use Recommendations

For Inorganic Chemical Contaminants

County:  Name:

Sample ID #:  Reviewer:

TEST RESULTS AND USE RECOMMENDATIONS

1.  Your well water meets federal drinking water standards for *inorganic chemicals*. Your water can be used for drinking, cooking, washing, cleaning, bathing, and showering based on the *inorganic chemical results only*. You may have other water sampling results that are not taken into account in this report.

2.  The following substance(s) exceeded federal drinking water standards or the North Carolina 2L calculated health levels. The North Carolina Division of Public Health recommends that your well water not be used for drinking and cooking, unless you install a water treatment system to remove the circled substance(s). However, it may be used for washing, cleaning, bathing and showering based on the *inorganic chemical results only*.

Arsenic	Barium	Cadmium	Chromium	Copper	Fluoride	Lead	Iron	
Manganese	Mercury	Nitrate/Nitrite	Selenium	Silver	Magnesium	Zinc	pH	

3.  a. Sodium levels exceed the U.S. Environmental Protection Agency's (USEPA) Health Advisory level for sodium of 20 mg/l. The North Carolina Division of Public Health recommends that only individuals on no or low sodium restricted diets not use this water for drinking or cooking. It may be used for washing, cleaning, bathing, and showering based on the *inorganic chemical results only*.

b. Levels over 30 mg/l may pose aesthetic problems such as bad taste, odor, staining of porcelain, etc.

4.  Re-sampling is recommended in \_\_\_\_\_ months.

5.  Re-sample for lead and/or copper. Take a first draw, 5 minute, and 15 minute sample inside the house (preferably the kitchen) and if possible a first draw, 5 minute and a 15 minute sample at the well head to determine the source of the lead and/or copper.

6.  The following substance(s) exceeded federal drinking water standards. Your water can be used for drinking, cooking, washing, cleaning, bathing, and showering based on the *inorganic chemical results only*, but aesthetic problems such as bad taste, odor, staining of porcelain, etc. may occur. You may want to install a household water treatment system to address aesthetic problems.

Barium	Cadmium	Chromium	Fluoride	Iron	Magnesium
Manganese	Selenium	Silver	pH	Zinc	

For more information regarding your well water results, please call the North Carolina Division of Public Health at 919-707-5900.

Figure 1: Private well guidance document

➤ If your response to Question 6 was "No," please mark N/A as your response for Question 7

7. If you received a document that looks like this form (Figure 1), how easy was it to understand?

- N/A, I did not receive a form that looks like Figure 1
- Very easy to understand
- Somewhat easy to understand
- Somewhat difficult to understand
- Very difficult to understand

➤ If your response to Question 6 was "No," please mark N/A as your response for Question 8

8. If you received a document that looks like this form (Figure 1), did you understand what steps, if any, were suggested due to your results?

- N/A, I did not receive a form that looks like Figure 1
- Yes, I understood what steps (if any) were suggested due to my results
- No, I did not understand what steps (if any) were suggested due to my results

9. Did you consult with any other guidance, information, or use recommendations to help understand your private well water test results? Please select all that apply.

- I did not consult other references to help understand my private well water test results
- Local Health Department
- NC Division of Public Health (State Health Department)
- Private Lab that completed the testing
- University Researchers
- Internet
- Family or friends
- Other (*please provide information*): \_\_\_\_\_

## Actions Taken with Your Private Well

In this section we are asking about actions you may have taken after receiving your original test results. If you did not live at your address at the time the well was constructed and tested, then you may not have received a copy of the original results from the well water testing that was done. A copy of those test results is included in this survey package.

You may skip any questions you do not want to answer. Please fill in the bubble next to your responses below.

10. What actions, if any, did you take after your private well water system was originally tested? Please select all that apply.

- No action was taken after receiving original test results
- I did not receive my original test results
- This private well was never a drinking water source
- Re-tested water within one year of original test
- Changed drinking water source
- Began using filter pitchers such as Brita® or PUR®
- Began using refrigerator filters
- Installed a point-of-use treatment system (a system installed where water is used in the home, like kitchen sinks or bathroom sinks)
- Installed a point-of-entry or whole house treatment system (a system installed where water enters house)
- Installed a treatment system, but unsure of the type
- Other actions were taken after receiving my original test results (*please list*):  
\_\_\_\_\_

11. If you **re-tested your water** within one year of the original test, what did the results show? Please select all that apply.

- I did not re-test water within one year of original test
- I did not receive my original test results
- Bacteria detection did not change
- Bacteria detection was different
- Chemical levels did not change
- Some chemical levels were **higher** (*Please list the specific chemicals that were higher than the original test*): \_\_\_\_\_
- Some chemical levels were **lower** (*Please list the specific chemicals that were lower than the original test*): \_\_\_\_\_



12. If you **changed your drinking water source** after testing, what alternative source did you use?  
Please select all that apply.

- I did not change my drinking water source after testing
- I did not receive my original test results
- Bottled water
- Connected to public water supply
- Drilled a new private well
- Used another private well
- Other source (*please provide information*): \_\_\_\_\_

13. If you **changed all your drinking water source** after testing, what factors influenced your decision?  
Please select all that apply.

- I did not change my drinking water source after testing
- I did not receive my original test results
- Guidance material included with my original test results
- Conversation with local health department staff
- Conversation with State health department staff (NC Division of Public Health)
- Conversation with a neighbor, friend, or family
- Information on the internet or in the news
- Taste, odor, or appearance of water
- Concern about chemicals or bacteria detected in my original test results  
*Please list the specific chemicals or bacteria in your test results that you were concerned about:*  
\_\_\_\_\_
- Other factor(s) influenced my decision to change my drinking water source  
*Please list other factors that influenced your decision to change your drinking water source:*  
\_\_\_\_\_

14. If you began using **filter pitchers** after testing, what type(s) of filter do you use? Please select all that apply.

- I did not begin using filter pitchers after testing
- I did not receive my original test results
- Brita®
- PUR®
- ZeroWater®
- Other filter pitcher (*please list*): \_\_\_\_\_

15. If you began using **filter pitchers** after testing, what factors influenced your decision? Please select all that apply.

- I did not begin using filter pitchers after testing
- I did not receive my original test results
- Guidance material included with my original test results
- Conversation with local health department staff
- Conversation with State health department staff (NC Division of Public Health)
- Conversation with a neighbor, friend, or with family
- Information on the internet or in the news
- Taste, odor, or appearance of water
- Concern about chemicals or bacteria detected in my original test results  
*Please list the specific chemicals or bacteria in your test results that you were concerned about:*  
\_\_\_\_\_
- Other factor(s) influenced my decision to begin using filter pitchers  
*Please list other factors that influenced your decision to begin using filter pitchers:*  
\_\_\_\_\_

16. If you began using **refrigerator filters** after testing, what brand(s) and model number(s) do you use?

➤ *Please note: this information can be found on the filter cartridge in your refrigerator*

- I did not begin using refrigerator filters after testing
- I did not receive my original test results
- Please list what brand(s) of refrigerator filter you use, include information on model number(s), if available:

---

17. If you began using **refrigerator filters** after testing, what factors influenced your decision? Please select all that apply.

- I did not begin using refrigerator filters after testing
- I did not receive my original test results
- Guidance material included with my original test results
- Conversation with local health department staff
- Conversation with State health department staff (NC Division of Public Health)
- Conversation with a neighbor, friend, or with family
- Information on the internet or in the news
- Taste, odor, or appearance of water
- Concern about chemicals or bacteria detected in my original test results  
*Please list the specific chemicals or bacteria in your test results that you were concerned about:*

---

- Other factor(s) influenced my decision to begin using refrigerator filters  
*Please list other factors that influenced your decision to begin using refrigerator filters:*

---

18. If you **installed a treatment system** after testing, what specific types of treatment were used? Please select all that apply.

➤ *Please note: "treatment system" refers to point-of-use treatment or point-of-entry treatment; this does not include filter pitchers or refrigerator filters*

- I did not install a treatment system after testing
- I did not receive my original test results
- Filtration system
- Ion-exchange
- Distillation
- Reverse osmosis
- Disinfection - using chlorine, chlorine dioxide, and ozone
- Water softening
- Other treatment system, or unsure of the type of treatment system  
*Please list or describe the treatment system:*

---

19. If you **installed a treatment system** after testing, what factors influenced your decision? Please select all that apply.

➤ *Please note: "treatment system" refers to point-of-use treatment or point-of-entry treatment; this does not include filter pitchers or refrigerator filters*

- I did not install a treatment system after testing
- I did not receive my original test results
- Guidance material included with my original test results
- Conversation with local health department staff
- Conversation with State health department staff (NC Division of Public Health)
- Conversation with a neighbor, friend, or with family
- Information on the internet or in the news
- Taste, odor, or appearance of water
- Concern about chemicals or bacteria detected in my original test results  
*Please list the specific chemicals or bacteria in your test results that you were concerned about:*

---

- Other factor(s) influenced my decision to install a treatment system  
*Please list other factors that influenced your decision to install a treatment system:*

---

20. If you **took no actions** after testing, what factors influenced your decision? Please select all that apply.

- I did take action after testing
  - I did not receive my original test results
  - Too expensive
  - The levels of contaminants were not high enough
  - I was not concerned about my water
  - No time to take care of it
  - Other household concerns are a higher priority
  - Guidance material included with test results
  - Conversation with local health department staff
  - Conversation with State health department staff (NC Division of Public Health)
  - Conversation with a neighbor, friend, or with family
  - Information on the internet or in the news
  - Taste, odor, or appearance of water
  - Other factors influenced my decision to not take action after testing  
*Please list other factors that influenced your decision to not take action*
- 

21. Have any more tests been done on this private well since it was originally tested, or since it was re-tested (within a year of original test)?

- Yes       No       Unsure

22. How likely are you to test your private well water in the future?

- Highly Likely       Likely       Unlikely       Highly Unlikely

## Your Concerns about your Private Well

In this section we are asking about concerns you may have with your private well. **Please note: this is a list of all the issues a private well owner may face in North Carolina and these topics may not be a concern to you or your community.** You may skip any questions you do not want to answer. Please fill in the bubble next to your responses below.

23. Do you have concerns about your private well water quality?  Yes  No

24. If you do have concerns about your private well water quality, what issues are you specifically concerned about? Please select all that apply.

- I do not have concerns about my private well water quality
  - Naturally occurring metals like arsenic, manganese, copper, etc.
  - Lead
  - Radionuclides like uranium, radium and radon
  - Pesticides
  - Industrial contamination including pollution from manufacturing and commercial facilities or large-scale livestock operations
  - Coal Ash Management Act chemicals, like hexavalent chromium, vanadium etc.
  - PFAS or Per- and Polyfluoroalkyl Substances like PFOA, PFOS and GenX
  - Nitrates/Nitrites
  - Bacteria and/or other pathogens
  - I have other concerns about my private well water quality (*please list*):
- 

25. Do you have concerns about the amount of water coming from your private well?  Yes  No

26. Do you have concerns about the age of your private well?  Yes  No

27. Do you have any other concerns regarding your private well?  Yes \*  No

*\*If Yes, please describe your concerns*

---

## Demographics

In this section we are asking about you and your household. You may skip any questions you do not want to answer. Please fill in the bubble next to your responses below.

28. How many people typically live in your home? \_\_\_\_\_

29. Do you own or rent the property that this private well serves?

- I own this property       I rent this property       Prefer not to answer

30. Are there any children **under the age of 12** years old living in your home?

- Yes       No       Prefer not to answer

31. Are there any children **between the ages of 12 and 18** years old living in your home?

- Yes       No       Prefer not to answer

# Thank you for taking this survey!

**Survey ends December 7, 2020. Surveys received after this date will not be considered for a \$25 gift card.** Your input is important to ensure we are providing you and other private well users in North Carolina with the best services possible.

If you have any questions, please contact: NC Private Well and Health Program  
Telephone: (919) 707-5911

If you would like to be entered into the drawing for one of the \$25 gift cards, or if you would like to receive information about the survey and a copy of the final report, please check the appropriate box(es) below and fill out your contact information. You can detach this contact card and place it in the return envelope with your completed survey. This information will not be kept with your responses to the survey.

Yes, I would like to be entered into the drawing for one of 500 \$25 gift cards *(please fill out your contact information below)*.

Yes, I would like to receive information about this survey and a copy of the report after it is complete *(please fill out your contact information below)*.

Name: \_\_\_\_\_

Phone: \_\_\_\_\_ Email: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ Zip Code: \_\_\_\_\_

Preferred contact method:  Email  Phone  Mail



NC DEPARTMENT OF  
**HEALTH AND  
HUMAN SERVICES**  
Division of Public Health

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