Fiscal Note for Adoption Amendment of 15A NCAC 02B .0200 and 15A NCAC 02B .0400

Rule Citation Number 15A NCAC 02B .0211, .0212, .0214, .0215, .0216, .0218, .0220, and .0404

Rule Topic: Surface Water Quality Standards – PFAS

DEQ Division: Division of Water Resources

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Impact Summary:

State government:	Yes
Local government:	Yes
Private Sector:	Yes
Substantial impact:	Yes

Authority: G.S. 143-214.1; 143-215.3(a)(1) (Water Quality Standards)
G.S. 143-214.2(c); 143-215; 143-215.1; 143-215.3(a)(1) (Surface Water Effluent Limitations)

Necessity: Rules .0211, .0212, .0214, .0215, .0216, .0218, and .0220 are proposed for amendment to set numeric water quality standards for eight PFAS chemicals based on the designated uses of the primary surface water classifications. Rule .0404 rule is proposed for amendment to specify the permitting timeline and process for issuing NPDES permits containing PFAS effluent limits.

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Acronyms

Abbreviation	Term
CapEx	Capital Expenditures
CFR	Code of Federal Regulations
CWA	Clean Water Act
DEQ	Department of Environmental Quality
DWI	Division of Water Infrastructure
DWR	Division of Water Resources
EMC	Environmental Management Commission
EPA	Environmental Protection Agency
GAC	Granular Activated Carbon
HFPO-DA (GenX)	Hexafluoropropylene oxide dimer acid
IRIS	Integrated Risk Information System
IX	Ion Exchange
LOQ	Limit of Quantitation
MCLs	Maximum contaminant level
MGD	Million Gallons per Day
NAICS	North American Industry Classification System
NC	North Carolina
NCAC	NC Administrative Code
NCGS	North Carolina General Statutes
NPDES	National Pollutant Discharge Elimination System
NPDWR	National Primary Drinking Water Regulations
NPV	Net present value
O&M	Operations and Maintenance
OSBM	Office of State Budget and Management
PCE	Tetrachloroethylene
PFAS	per- and polyfluoroalkyl substances
PFBA	Perfluorobutanoic acid
PFBS	Perfluorobutanesulfonic acid
PFHxA	Perfluorohexanoic acid
PFHxS	Perfluorohexanesulphonic acid
PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonic Acid
POTW	Publicly owned treatment works
RO	Reverse Osmosis
SDWA	Safe Drinking Water Act
SGA	Small for gestational age
SIC	Standard Industrial Classification
SIUs	Significant Industrial Users
TCE	Trichloroethylene
TMDL	Total Maximum Daily Load
WS	Water Supply

I. Executive Summary

An agency must prepare a regulatory impact analysis for permanent rule changes as required by G.S. 150B-21.4. The purpose of conducting a regulatory impact analysis is to improve rule design, inform decision-makers, and communicate with the regulated community and the public. These analyses identify, describe, and quantify the expected effects of the proposed rule changes to the extent possible. The purpose of this rulemaking effort is to protect the designated use (e.g., drinking water supply, swimming, fishing) of surface water bodies such as streams, rivers and lakes from PFAS pollution. Following are some of the key points that are further described throughout the analysis:

What are PFAS and Why are they Important?

- PFAS, or per- and polyfluoroalkyl substances, refers to a group of more than 14,000 man-made chemicals. They are widely used in commercial and consumer products such as food packaging, water- and stain-repellent fabrics, nonstick products and firefighting foams. They are also commonly used in industrial processes and manufacturing.

- PFAS are often called "forever chemicals" because they don't break down in the environment and can build up, or bioaccumulate, in humans and animals. Most Americans have been exposed to PFAS. Scientists have identified ingestion through food intake and drinking water as primary pathways for PFAS exposure in humans.

- Studies have shown that exposure to certain types and levels of PFAS can cause reproductive effects such as decreased fertility or increased high blood pressure in pregnant women; developmental effects or delays in children; increased risk of some cancers; reduced ability of the body's immune system to fight infections; and increased cholesterol levels and/or risk of obesity. The body of scientific information being produced by researchers is increasing at a rapid pace as more focus is placed on PFAS globally.

- Perfluorooctanoic Acid (PFOA) and Perfluorooctane Sulfonic Acid (PFOS) are two of the most widely used and studied PFAS chemicals. Some manufacturers are voluntarily phasing out these long-chain legacy chemicals and replacing with shorter chain PFAS. But manufacturers can, with approval from EPA, still import the discontinued chemicals for use in consumer goods, firefighting foams, and other applications. HFPO-DA or GenX, manufactured in North Carolina, is used as a replacement for PFOA and PFBS is a replacement for PFOS.

PFAS Drinking Water Regulations under the Safe Drinking Water Act

- EPA announced final Maximum Contaminant Levels (MCLs) to limit PFOA and PFOS, their replacement products (GenX and PFBS), and two other PFAS (PFNA and PFHxS) in drinking water. Public water systems are required to reduce the concentration of these chemicals in their finished water across the nation starting April 26, 2029.

- For PFOA and PFOS, EPA set the MCL goal to zero (indicating that there is no level of exposure without risk of health impacts) but set their MCLs to 4.0 parts per trillion (ppt) as being feasible for compliance purposes. EPA set an MCL defined as a Hazard Index of 1 for any mixture containing two or more of HFPO-DA, PFNA, PFHxS and PFBS to account for dose additive health concerns and likely co-occurrence of these chemicals in drinking water. The MCL for HFPO-DA (GenX) is set at 10 ppt.

- North Carolina is the only known location where HFPO-DA (GenX) is manufactured. Its contamination (along with many other signature PFAS compounds unique to this site) are well documented in the Cape Fear River and at least an eight county area. The HFPO-DA (GenX) value above the MCL has qualified additional homeowners to receive alternate drinking water sources under a court ordered Consent Order with the company. Data collected under this effort suggests that many of these wells would also exceed the federal MCLs. To date, decades of contamination from this site has caused two downstream utilities to install multi-million dollar drinking water treatment systems and over 10,000 private well owners to be offered bottled water, in house filtration or municipal water connection. Additional homes are being qualified for replacement water daily, with some homes located 30 miles from the facility.

- DEQ estimates that 3.5 million residents' drinking water supplied by public water systems is exceeding one or more of the MCLs.

- An additional 797,396 of North Carolina's residents rely on private wells for drinking water. DEQ estimates that 25% of private wells may exceed the MCLs.

Surface Water Influences on Designated Uses

- Surface water is any body of water above ground, including streams, rivers, and lakes. The resource plays a key component of the hydrologic cycle and provides essential societal and ecosystem services such as drinking water, agriculture irrigation, habitat for aquatic plants and wildlife, recreation, and food source.

- PFAS enters surface water via discharges from industrial activities and publicly owned treatment works (POTWs). Due to its affinity to assimilate with water, PFAS enters other resources wherever the water flows. This causes further spread of the chemicals into drinking water supplies, tributaries, groundwater based drinking water supplies, land mass near flood plains, and eventually to the ocean.

- The North Carolina PFAS Testing Network, DEQ, Public Water Systems, and many industries have documented PFAS in the state's drinking water supply, groundwater, surface water, ambient air, soil and sediment. The state is pioneering groundbreaking research and understanding of PFAS in the environment and human health.

- Of the 171 Public Water Systems that rely on surface water based drinking water supply, 71 systems (supporting 2.3 million residents) are affected by MCL exceedances. An additional 248 groundwater-based systems (supporting about 177,000 residents) are also exceeding the MCLs.

Federal Clean Water Act

- The Clean Water Act (CWA) requires states to protect the designated best uses of a surface water body. Both the CWA and NC law and environmental regulations require that water quality standards must protect human health and welfare (among other things).

- States are responsible for adopting water quality standards that are based on scientific rationale, parameters that protect designated uses, and protection of the most sensitive use. These water quality standards must also be used to set National Pollutant Discharge Elimination System (NPDES) effluent limits that protect designated uses.

- Scientific data associated with human health effects from exposure to the six PFAS with MCLs and the two recently studied PFAS (PFBA and PFHxA) are publicly available. Their presence in NC's surface waters require the Division of Water Resources (DWR) to establish water quality standards to protect the designated waters.

- There are many other PFAS chemicals that are detected in drinking water and surface waters. However, due to limited or no scientific information available regarding their toxicological and human health effects, this rulemaking proposal does not consider them at this time.

North Carolina PFAS Rulemaking Proposal

- Surface water quality standards for eight PFAS are proposed under Rule .0200 based on the water supply and fish tissue consumption designated uses. The reasons for setting standards for these PFAS are: (1) they have a significant peer reviewed scientific publications from which health effects can be determined, (2) they have published scientific data to support the derivation of the necessary toxicological values, (3) they have been detected in NC's environmental media, and (4) there is a final EPA test method for measuring each compound in wastewater.

- Permitting rules for existing dischargers are proposed to be amended under Rule .0404 to include a timeline and process for issuing NPDES permits containing PFAS effluent limits.

- The first two years consists of a certified monitoring period for existing industrial direct dischargers and POTWs expected to contain PFAS in their discharges. Effluent limits will be added to permits through a two-tiered approach. Tier 1 generally covers sites that are contributing to PFAS in their discharges. Tier 2 covers remaining dischargers that are generally passive receivers or have lower discharge concentrations that could be further reduced from actions taken by upstream Tier 1 dischargers.

- The rules are being introduced through the public rule making process to enable public engagement on the best levels to protect the health of NC's residents and designated uses of our waters. The use of standalone numeric standard provides regulatory certainty regarding the specific concentration used to set effluent limits in discharge permits.

Affected NPDES Facilities

- POTWs with pretreatment programs and industrial direct dischargers were the primary sources that were identified to be affected by the proposed rules. Of the industrial direct dischargers, 22 of the 56 active permits were projected to receive an effluent limit. It was determined that out of the 126 active POTWs, all permittees were projected to be affected by the incorporation of at least one PFAS limit in their permit. These POTWs are associated with 606 significant industrial users and of these facilities 464 were potentially associated with PFAS and would require pretreatment if the associated POTW decides to require source reduction.

- The main treatment drivers for permittees needing treatment were PFOA, PFOS, PFHxS, HFPO-DA, and PFNA. The remaining three PFAS (PFBA, PFBS, and PFHxA) were not detected at levels high enough to have reasonable potential to exceed water quality standards.

Cost Summary
The total impacts associated with the proposed rule is $11,193,892,532 over a 36 year evaluation period (2024-2060). This equates to $310,941,459 per year and reflects costs to the private sector, NC local governments, and NC state government. Monitoring and treatment costs components are included in this total.

Benefits Summary

- The total benefits estimated from the proposed rule is $11,675,284,686 over a 36 year evaluation period (2024-2060). This equates to $324,312,464 per year and reflects human health benefits (ingestion of drinking water and food intakes), savings to downstream drinking water utilities, private well avoided treatment, federal and state infrastructure funding, and preservation of property value. This benefit estimate does not yet include the full valuation for the preservation of natural and resources of the state as it is anticipated to be released later. Its monetized benefit is expected to be significant and will further increase the total benefits reported here.

- The proposed rule is also associated with multiple qualitative benefit categories that has not been monetized for the purposes of this fiscal note. It is standard practice to include these qualitative categories and discussion in fiscal analysis. The categories discussed include additional non quantified human health impacts, co-pollutant removal via PFAS treatment, and shifting burden to polluters pay.

Conclusions

- The monetized benefits and non-quantified benefits to the state as a whole and over 10 million residents outweigh the costs of the rules through improvements in long-term health, quality of life, and preservation of property value.

- In the absence of water quality standards for the proposed eight PFAS, NPDES dischargers will continue to discharge these PFAS into the environment above the health-based standards. It is estimated that in the absence of these standards, the health impacts across NC from 2024-2060 would equate to approximately 44,925 cases which include cardiovascular diseases, renal cell carcinoma, and birth-weight related issues. Of these cases, it is estimated that 10,279 of these cases could result in death. Using the value of statistical life, the total valuation of health-related deaths in the absence of PFAS standards would equate to approximately $128.1 billion in costs to the public.

- The proposed rules represent our best analysis of available data and information for the protection of state’s waters.

- Based on DEQ's experience over many decades in implementing the CWA, the water quality standards setting approach used in this rulemaking package is designed to comply with federal program requirements.

II. Background

PFAS, or per- and polyfluoroalkyl substances, refers to a group of man-made chemicals. They are widely used in commercial and consumer products such as food packaging, water- and stain-repellent fabrics, nonstick products, and firefighting foams. They are also commonly used in industrial processes and manufacturing. As a result, these compounds are present in household and industrial wastes. In addition, industrial PFAS air emissions can deposit these compounds into surface water or soil and eventually reach groundwater. Regardless of how they enter the environment, the chemical structure of PFAS prevent them from breaking down easily, which is why they are known as "forever chemicals." They will continue to cycle through our environment indefinitely unless they are intercepted and removed through treatment.

PFAS can build up, or bioaccumulate, in humans and animals. Scientific studies have shown that exposure to certain PFAS have been linked to reproductive effects such as decreased fertility or increased high blood pressure in pregnant women; developmental effects or delays in children, including low birth weight, accelerated puberty, bone variations, or behavioral changes; increased risk of some cancers; reduced ability of the body's immune system to fight infections, including reduced vaccine response; interference with the body's natural hormones; and increased cholesterol levels and/or risk of obesity.

A. PFAS in Drinking Water

On April 25, 2024, the U.S. Environmental Protection Agency (EPA) published National Primary Drinking Water Regulations (NPDWR) for six PFAS under the Safe Drinking Water Act (SDWA).[1,2] This action set the Maximum Contaminant Level Goals (MCLGs) for PFOA and PFOS at zero. However, considering fand other technical feasibility, the promulgated Maximum Contaminant Levels (MCLs) or drinking water standards for PFOA and PFOS are set at 4.0 nanograms per liter (ng/L) or parts per trillion (ppt). The EPA also finalized individual MCLs for three other PFAS (HFPO-DA, PFNA, and PFHxS) in drinking water at 10 ng/L. In addition to these individual MCLs, EPA set an MCL defined as a Hazard Index of 1 for any mixture containing two or more of HFPO-DA, PFNA, PFHxS and PFBS to account for dose additive health concerns and likely co-occurrence of these chemicals in drinking water.

The six regulated PFAS under the SDWA have been detected in North Carolina's (NC) public water systems and private wells. Table 1 provides an estimate of the public water

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[1] 89 FR 32532

[2] For more information, see Division of Water Resources presentation to the Environmental Management Commission on May 9, 2024.
https://edocs.deq.nc.gov/WaterResources/DocView.aspx?id=3267517&dbid=0&repo=WaterResources

systems and population affected by the new PFAS drinking water regulations in NC.[3] Based on the data collected by DEQ and sampled by utilities, it is estimated that 3.5 million residents' drinking water is exceeding the MCLs. Over 40% of surface water-based public water systems (71 systems serving about 2.3 million residents) exceed the MCLs. The number of affected groundwater-based systems is three times as many, but these systems are found in non-urban parts of the state. Compared to the national average, NC had twice as many systems exceeding PFOS MCLs and ranked 21st for the maximum PFOS value. For GenX, NC had the greatest number of affected drinking water systems and had the highest measured concentration in the country.[4]

Table 1. Presence of Regulated PFAS in North Carolina's Public Water Systems

	Number of Systems	Number of Systems Estimated to Exceed MCLs	Population Estimated to be Affected by MCL Exceedances
Total Number Affected	1,961	320	3,445,635
Total Groundwater Based Sources	1,790	248*	177,716
Total Surface Water Based Sources	171	71	2,267,919

* 350 systems have not been sampled to date.

The estimates shown in Table 1 do not include about 25% of NC's residents who rely on groundwater based private wells (mostly in rural and suburban parts of the state). DEQ has tested about 20,000 private wells due to their proximity to sites with PFAS contamination and estimates that out of those sampled, 48% are exceeding MCLs. Most of these affected homeowners are on bottled water, are provided PFAS filtration systems, or are awaiting connection to municipal water systems based on available state resources.

B. Surface Water Influences on Drinking Water Supply

PFAS found in drinking water systems is brought in from surface water- and groundwater-based intakes, which in turn are affected by discharges from activities associated with PFAS use and manufacturing.[5] Figure 1 shows the influence of such sources on public water systems that will be required to comply with MCLs under the Safe Drinking Water Act and

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[3] Based on public water system data collected by DEQ in 2022, 2023 and 2024 and data provided by Investor-Owned Utilities and The NC Collaboratory.

[4] Based on two rounds of drinking water system data reported under the UCMR (Unregulated Contaminants Monitoring Rule).

[5] U.S. Geological Survey Circular 1139 - Ground Water and Surface Water a Single Resource: https://pubs.usgs.gov/circ/circ1139/pdf/circ1139.pdf

may require the installation and operation of PFAS treatment systems by April 26, 2029. The figure also shows similar influences on private wells which are not regulated by either state or federal authorities.

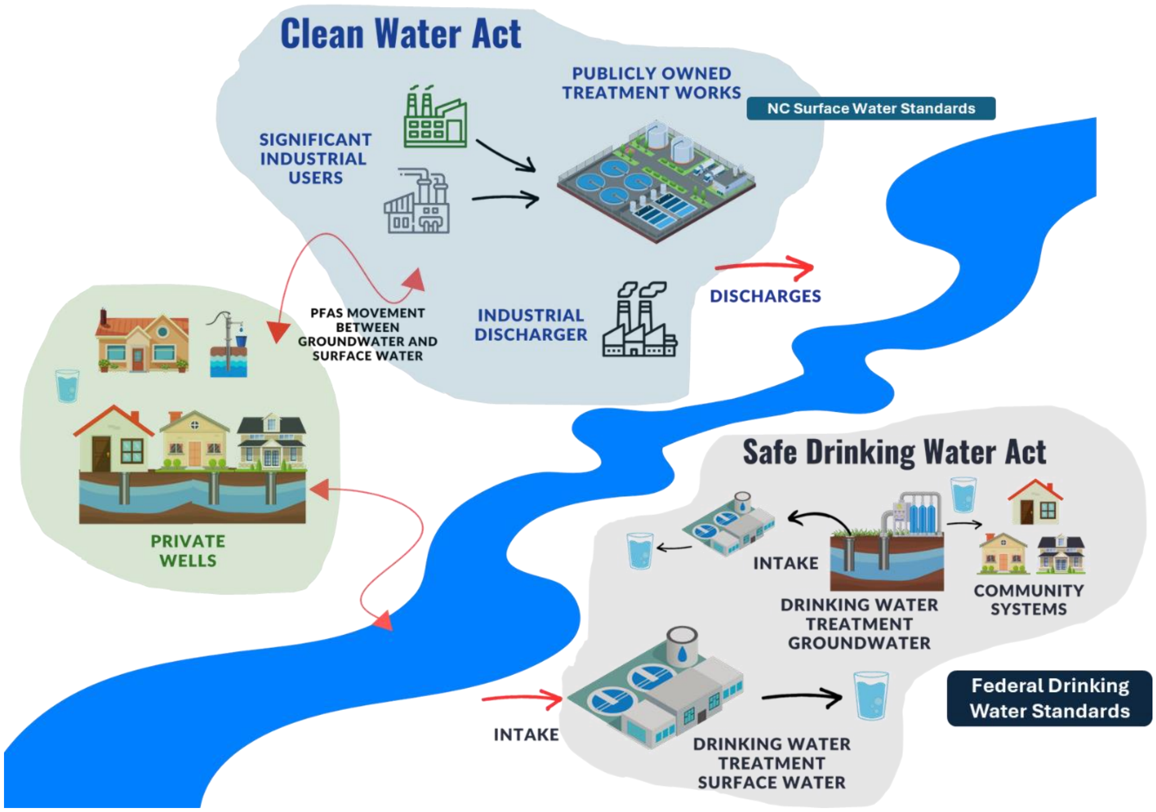

Figure 1. Discharges of PFAS Affecting Drinking Water Supplies

The purpose of the proposed rules is to establish numeric water quality standards that will then protect designated uses (e.g., drinking water supply, swimming, fishing) of surface water bodies such as streams, rivers, and lakes from the deleterious effects of PFAS. These designated uses are described in NC's surface water classifications, which also define the numeric and narrative criteria required to protect these uses. The designated uses and criteria combined make up the water quality standards in 15A NCAC 02B .0200.[6]

C. Mandate to Protect Designated Uses Under the Clean Water Act

Under Section 303 of the Clean Water Act (CWA) and Title 40 of the Code of Federal Regulations (40 CFR), states are responsible for adopting water quality standards necessary

[6] For more information, see DEQ's Classification site at https://www.deq.nc.gov/about/divisions/water-resources/water-planning/classification-standards/classifications

to protect designated best uses of a surface water body (e.g., drinking water supply, fish consumption, recreation). Both the CWA, 40 CFR, and NC law and regulations require that water quality standards must, among other things, "protect human health and welfare" (CWA 303(c)(2)(A), 40 CFR 131.2, NCGS 143-211(c)). The standards consist of three required components:

- designated uses of a water body such as aquatic life propagation and survival, recreation, shellfishing, drinking water, etc. Designated uses are communicated through the waterbody's classification;
- water quality standards necessary to protect the designated uses; and
- antidegradation requirements.

The human health effects from exposure to the six PFAS with MCLs and the two recently analyzed PFAS are known, and their presence in NC's surface waters requires the Division of Water Resources (DWR) to specify water quality standards[7] to protect the designated waters.

Per 40 CFR 131.11(a)(1), such numeric criteria must be based on scientific rationale, must contain parameters to protect designated uses, and must protect the most sensitive use. Furthermore, Section 301(b)(1)(C) of the CWA, 40 CFR 122.44 (another CWA implementing regulation), and 15A NCAC 02H .0112(c) require that the numeric criteria must be used to set National Pollutant Discharge Elimination System (NPDES) effluent limits that protect designated uses.

D. Methodology for Deriving Surface Water Quality Standards

Water quality standards can take the form of numeric values that represent the concentrations of a pollutant in ambient waters that are protective of human health. EPA routinely develops National Recommended Water Quality Criteria under section 304(a) of the CWA, which are provided as guidelines for states to use in the development of their own water quality standards. These criteria are based solely on information and scientific data representative of the relationship between pollutant concentrations, the environment and human health effects. The EPA uses the "Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000)" (hereafter ''2000 Water Quality Methodology'' or "Methodology"), published pursuant to section 304(a)(1) of the CWA, to set or revise water

[7] Because a water quality standard is a designated use and the criterion necessary to protect that use, the terms "standard" and "criterion" are used interchangeably when the designated use is specified (e.g., water supply).

quality criteria for human health protection.[8,9] According to the federal notice, the methodology incorporates many significant scientific advances that have occurred over the past decades and reflects the latest approach for assessing the extent of identifiable effects on health and welfare that may be expected from the presence of pollutants in a water body. Among other updates, EPA notes the use of 10^{-6} lifetime excess cancer risk level when developing national 304(a) water quality criteria, which the agency considers appropriate for the general population. The 2000 Water Quality Methodology replaced EPA's previous methodology published in 1980 and has formed the basis for EPA's subsequent regulatory actions. Examples of key differences are that the 2000 Water Quality Methodology provides guidance on using risk and exposure information for assessing noncancer and cancer outcomes for the general population as well as sensitive groups such as children, consideration of non-water sources of exposure, and consistent use of scientific data in derivation of a water quality criteria under the authority of the CWA.

The 2000 Water Quality Methodology is also intended for States and authorized Tribes to develop their own water quality criteria. The analytical procedures contained in the Methodology are comparable to those established in the current NC .0200 rules (effective November 2019) and the input values are identical to those currently proposed to be updated in the 2023-2025 Surface Water Standards Triennial Review.

Since PFAS are a new type of pollutant for which EPA has not yet published national CWA criteria and since states are required to establish criteria protective of the designated uses as discussed above, this rulemaking approach uses the 2000 Water Quality Methodology and EPA's Safe Drinking Water Act MCLGs and MCLs to inform the establishment of NC's numeric surface water quality standards for PFAS.

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[8] 65 FR 66444, https://www.federalregister.gov/documents/2000/11/03/00-27924/revisions-to-the-methodology-for-deriving-ambient-water-quality-criteria-for-the-protection-of-human

[9] EPA 2000. Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (2000), EPA Office of Water, Office of Science and Technology, EPA-822-B-00-004, October 2000. https://www.epa.gov/sites/default/files/2018-10/documents/methodology-wqc-protection-hh-2000.pdf

III. Reason for Rule Adoption

The purpose of the proposed rules is to fulfill DEQ's core obligation under the CWA to protect the designated uses of the waters of the State from discharge of the following eight PFAS compounds.

1. Perfluorooctanoic Acid (PFOA)
2. Perfluorooctanesulfonic Acid (PFOS)
3. Hexafluoropropylene Oxide Dimer Acid (HFPO-DA; GenX)
4. Perfluorobutane Sulfonic Acid (PFBS)
5. Perfluorohexane Sulfonic Acid (PFHxS)
6. Perfluorononanoic Acid (PFNA)
7. Perfluorobutanoic Acid (PFBA)
8. Perfluorohexanoic Acid (PFHxA)

The first six PFAS compounds are included in the NPDWR (i.e., PFOA, PFOS, HFPO-DA, PFBS, PFHxS, and PFNA). Public drinking water systems must comply with the MCLs by 2029. The remaining two PFAS compounds (PFBA and PFHxA) are the newest PFAS evaluated under the Integrated Risk Information System (IRIS), which were not finalized during the noticing of the NPDWR and are now available for states to use. All eight PFAS are proposed with numeric water quality standards for the following reasons: (1) they have a significant scientific literature base from which health effects can be determined, (2) they have published scientific data to support the derivation of the necessary toxicological values, (3) they have been detected in NC's environmental media, and (4) there is a final EPA test method for measuring each compound in wastewater.

There are many other PFAS chemicals that are detected in drinking water and surface waters. However, due to limited or no scientific information available regarding their toxicological and human health effects, this rulemaking proposal does not consider them at this time.

The eight PFAS water quality standards are being introduced through the public rulemaking process to enable public engagement on the best levels to protect the health of NC's residents and designated uses of our waters. The benefit of this approach is that it provides regulatory certainty regarding the specific health-based criteria used to set effluent limitations in discharge permits. In the event new scientific data becomes available in the future, additional rulemaking would be required to update the defined numeric criteria.

The Environmental Management Commission (EMC) may adopt different numeric criteria than those proposed here provided they are sufficiently protective of human health in water supply waters (and other designated uses), the inputs are of acceptable scientific quality, and they are approvable by EPA as being consistent with the CWA and its implementing regulations (including 40 CFR Part 131 and 40 CFR 122.44). If the state-proposed criterion is not consistent with the CWA and its implementing regulations, EPA can formally disapprove the standard.[10] In this case, the state must make appropriate corrections and resubmit.

It should be noted that the EMC can require the use of an alternate procedure, toxicity values, or other inputs in deriving the water quality standards. Similarly, the public can recommend other data or information be used during the public comment period. Regardless of which approach is used to compute the numeric water quality standards, NC's submittal must demonstrate that the numeric criteria are sufficiently protective of human health and designated uses from toxic pollutants and the inputs are of acceptable scientific quality to be deemed approvable by the EPA for being consistent with the CWA and its implementing regulations. Based on DEQ's experience over many decades in implementing the CWA, the water quality standards setting approach used in this rulemaking package (using the 2000 Water Quality Methodology) complies with federal program requirements.

A. Prevalence of the Eight PFAS Compounds in NC Surface Waters

Through the current NC river basin-specific water quality sampling program, PFAS were added as analytes in recent measurement campaigns. The river basins supply water to public water systems that serve North Carolinians across the state. The sampling locations represent lakes and other areas that qualify as surface water greater than 10 acres in size and are a source of water for public water systems. Table 2 summarizes the breakdown of the minimum, maximum, and average PFAS concentrations across each basin sampled. At least one PFAS compound was detected in all basins except the French Broad. The Cape Fear River basin had the highest concentration for all eight PFAS relative to the others. Comparing the proposed PFAS numeric criteria for water supply sources to the concentrations presented in Table 2, only PFOA, PFOS, and PFHxS exceeded the proposed values.

[10] Because a water quality standard is a designated use and the criterion necessary to protect that use, the terms "standard" and "criterion" are used interchangeably when the designated use is specified (e.g., water supply).

Table 2. Summary of PFAS Data for North Carolina Public Water Supply Reservoirs

<table>
<tr><th colspan="2" rowspan="2">PFAS Concentration (ng/L)</th><th colspan="10">River Basins</th></tr>
<tr><th>Cape Fear</th><th>Watauga</th><th>New</th><th>Jordan Lake</th><th>Neuse</th><th>Yadkin</th><th>Broad</th><th>Catawba</th><th>French Broad</th><th>Tar</th></tr>
<tr><td rowspan="2">PFOS</td><td>Min-Max</td><td>2.9-110</td><td>ND</td><td rowspan="2">4.1</td><td>4.0-26</td><td>2.07-22.7</td><td>2.3-34</td><td>2.1-3.4</td><td>2-2.5</td><td>ND</td><td rowspan="2">5.9</td></tr>
<tr><td>Average</td><td>18.2</td><td>ND</td><td>10.2</td><td>5.82</td><td>6.35</td><td>2.68</td><td>2.13</td><td>ND</td></tr>
<tr><td rowspan="2">PFOA</td><td>Min-Max</td><td>2.2-86</td><td>ND</td><td>ND</td><td>2.9-17</td><td>2.10-9.28</td><td>2.1-11.3</td><td>2.3-2.6</td><td rowspan="2">5.3</td><td>ND</td><td rowspan="2">3.7</td></tr>
<tr><td>Average</td><td>11.1</td><td>ND</td><td>ND</td><td>7.4</td><td>4.13</td><td>3.70</td><td>2.43</td><td>ND</td></tr>
<tr><td rowspan="2">HFPO-DA</td><td>Min-Max</td><td rowspan="2">4.2</td><td>ND</td><td>ND</td><td rowspan="2">2</td><td>ND</td><td rowspan="2">2.1</td><td>ND</td><td>ND</td><td>ND</td><td rowspan="2">ND</td></tr>
<tr><td>Average</td><td>ND</td><td>ND</td><td>ND</td><td>ND</td><td>ND</td><td>ND</td></tr>
<tr><td rowspan="2">PFBS</td><td>Min-Max</td><td>2-16</td><td>5.3</td><td>3.6-6.8</td><td>2.6-52</td><td>2.01-7.58</td><td>2.07-11</td><td>ND</td><td>ND</td><td>ND</td><td rowspan="2">2.1</td></tr>
<tr><td>Average</td><td>5.33</td><td>5.30</td><td>5.20</td><td>9.5</td><td>4.08</td><td>3.89</td><td>ND</td><td>ND</td><td>ND</td></tr>
<tr><td rowspan="2">PFBA</td><td>Min-Max</td><td>2-8.7</td><td>ND</td><td>ND</td><td>3-28</td><td>2.06-22.7</td><td>2.1-5.1</td><td>ND</td><td>6</td><td>ND</td><td rowspan="2">2.9</td></tr>
<tr><td>Average</td><td>3.78</td><td>ND</td><td>ND</td><td>8.2</td><td>4.42</td><td>3.24</td><td>ND</td><td>6</td><td>ND</td></tr>
<tr><td rowspan="2">PFHxA</td><td>Min-Max</td><td>1.9-18</td><td>ND</td><td>ND</td><td>1-36</td><td>2.50-2.70</td><td>2.1-9.7</td><td>2.5-2.8</td><td>2.1-10</td><td>ND</td><td rowspan="2">2.0</td></tr>
<tr><td>Average</td><td>6.12</td><td>ND</td><td>ND</td><td>10.8</td><td>2.59</td><td>4.18</td><td>2.65</td><td>4.73</td><td>ND</td></tr>
<tr><td rowspan="2">PFNA</td><td>Min-Max</td><td>2-3.5</td><td>ND</td><td>ND</td><td>2.0-6.0</td><td>ND</td><td>ND</td><td>ND</td><td>2.2</td><td>ND</td><td>ND</td></tr>
<tr><td>Average</td><td>3.03</td><td>ND</td><td>ND</td><td>3.0</td><td>ND</td><td>ND</td><td>ND</td><td>2.20</td><td>ND</td><td>ND</td></tr>
<tr><td rowspan="2">PFHxS</td><td>Min-Max</td><td>1.8-25</td><td>ND</td><td>ND</td><td>2.1-13</td><td>2.1-13</td><td>2.13-36.7</td><td>ND</td><td>ND</td><td>ND</td><td>ND</td></tr>
<tr><td>Average</td><td>7.35</td><td>ND</td><td>ND</td><td>3.8</td><td>2.49</td><td>7.18</td><td>ND</td><td>ND</td><td>ND</td><td>ND</td></tr>
</table>

ND | Indicates that the analyte was analyzed for, but not detected above the reported practical quantitation limit

A comprehensive analysis conducted to support this rulemaking suggests that approximately 22 of 56 direct industrial dischargers regulated through the DWR NPDES program may exceed one or more of the proposed water quality standards and require treatment before discharging to designated waters. All 126 publicly owned treatment works (POTWs) regulated through DWR may also require treatment as they are influenced by receiving flows from residential households, commercial entities, and industrial users. A POTW can reduce this burden through source control by working with their significant industrial users (SIUs) to pretreat for PFAS and only take on the burden of treating background sources (primarily residential and light commercial uses) at the plant. We estimate that 464 of 606 SIUs permitted through POTWs (over 75% of SIUs) may require PFAS effluent limits through their respective pretreatment programs.

All permittees expected to receive one or more effluent limits in their NPDES permit as described above will trigger the requirement based on their reasonable potential to exceed PFOA and PFOS water quality standards. Approximately three permittees will have the potential to exceed HFPO-DA (GenX) standards and 15 permittees could exceed standards for PFHxS and PFNA only. None of the current NPDES permittees have the potential to exceed PFBA, PFBS, or PFHxA water quality standards due to their discharge concentrations being less than the proposed health-based water quality standards.

A detailed discussion of sources affected by the proposed standards and their regulatory and fiscal impacts are presented in Section V along with treatment requirements and estimated costs.

IV. Proposed Rules

The proposed rules are intended to achieve two key objectives:

1. Define numeric water quality standards for the following eight PFAS compounds based on the fish tissue consumption and water supply designated uses as follows: water-supply (Class WS I, II, III, IV and V - Rules .0212, .0214, .0215, .0216, .0218, respectively); fish tissue consumption (Carcinogens in all waters - Rule .0208; Class C - Rule .0211; Class SC - Rule .0220).

2. Specify the permitting timeline and process for issuing NPDES permits containing PFAS effluent limits in Rule .0404.

A. Numeric Water Quality Standards for Fish Consumption and Water Consumption

The CWA requires the water quality standards to be based on a health-protective toxicological value. The information used in this rulemaking was obtained from toxicological evaluations and reports issued by a federal agency, specifically the EPA or the Centers for Disease Control and Prevention's (CDC) Agency for Toxic Substances and Disease Registry (ATSDR). All evaluations were published in 2021 or more recently. Toxicological information for six PFAS are included in the NPDWR rulemaking docket. The information for the remaining two PFAS compounds were published through the EPA's Integrated Risk Information System (IRIS), which is listed in the NC rules as acceptable reference material for water quality standard setting. In addition to these reviews, DEQ obtained technical advice from the Secretaries' Science Advisory Board to ensure the best available scientific information is used.

PFOA and PFOS are the only two of the eight PFAS chemicals classified as likely carcinogens. Furthermore, significant scientific data have been published on PFOA and PFOS that also demonstrate non-carcinogenic health effects. The calculated water quality standards based on the published cancer slope factor and reference dose produce nearly identical values as shown in Appendix A. Table 3 lists the numeric water quality standards by classification level.

Table 3. Summary of Proposed PFAS Numeric Water Quality Standards

PFAS Compound	Water Supply Class WS I through V[a] (ng/L)	Non-Water Supply Class C and SC Waters[b] (ng/L)
PFOS	0.06[c]	0.06[c]
PFOA	0.001[c]	0.01[c]
HFPO-DA (GenX)	10	500
PFBS	2,000	10,000
PFBA	6,000	200,000
PFHxA	3,000	200,000
PFNA	9	20
PFHxS	10	70

[a] Water supply standards to be added to Rules .0212, .0214, .0215, .0216 and .0218
[b] Fish consumption standards to be added to Rules .0211 and .0220
[c] Health-based standards for PFOA and PFOS are below laboratory analytical capability. Rule .0404 is amended to address test Method 1633 Limit of Quantitation and uses 4.0 ng/L as the effluent limit for PFOA or PFOS in NPDES permits when the calculated effluent limit for a facility's discharge is less than 4.0 ng/L.

For detailed discussion of the principal studies and health effects data used, a complete description of the assigned toxicological values, and derivation of the numeric water quality standards for the eight PFAS compounds, see Appendix A. The rule text is provided in Appendix B, and a brief summary for each rule is listed below Table 4.

Table 4. Proposed Rule Amendments to Incorporate PFAS Water Quality Standards

Rule	Rule Purpose	Rule Amendment
15A NCAC 02B .0211 *FRESH SURFACE WATER QUALITY STANDARDS FOR CLASS C WATERS*	Defines standards for carcinogens and non-carcinogens that apply to all Class C waters which includes best usage of aquatic life propagation, survival, and maintenance of biological integrity (including fishing and fish); wildlife; secondary contact recreation; agriculture; and any other usage except for primary contact recreation or as a source of water supply for drinking, culinary, and food processing purposes. PFOA and PFOS are the only two compounds labeled as carcinogens (see Appendix A for supporting information).	• Rule .0211(13) is also amended to include water quality standards for PFOA and PFOS.* • Rule .0211(14) is added to include water quality standards for HFPO-DA, PFBS, PFBA, PFHxS, PFHxA, and PFNA.
15A NCAC 02B .0212 *FRESH SURFACE WATER QUALITY*	Defines water quality standards for surface waters within water supply watersheds classified as WS-I. Specifies that following approved treatment, the waters must meet the MCL concentrations considered safe for	• Rule .0212 (3) (f) for non-carcinogens is amended to include water quality standards for HFPO-DA, PFBS, PFBA, PFHxS, PFHxA, and PFNA.

Rule	Rule Purpose	Rule Amendment
STANDARDS FOR CLASS WS I WATERS	drinking, culinary, and food processing purposes that are specified in 40 CFR Part 141 National Primary Drinking Water Regulations.	• Rule .0212 (3) (g) for carcinogens is amended to include water quality standards for PFOA and PFOS.
15A NCAC 02B .0214 *FRESH SURFACE WATER QUALITY STANDARDS FOR CLASS WS II WATERS*	Defines water quality standards for surface waters within water supply watersheds classified as WS-II. Requirements are similar to WS-I.	• Rule .0214 (3) (f) for non-carcinogens is amended to include water quality standards for HFPO-DA, PFBS, PFBA, PFHxS, PFHxA, and PFNA. • Rule .0214 (3) (g) for carcinogens is amended to include water quality standards for PFOA and PFOS.
15A NCAC 02B .0215 *FRESH SURFACE WATER QUALITY STANDARDS FOR CLASS WS III WATERS*	Defines water quality standards for surface waters within water supply watersheds classified as WS-III. Requirements are similar to WS-I.	• Rule .0215 (3) (f) for non-carcinogens is amended to include water quality standards for HFPO-DA, PFBS, PFBA, PFHxS, PFHxA, and PFNA. • Rule .0215 (3) (g) for carcinogens is amended to include water quality standards for PFOA and PFOS.
15A NCAC 02B .0216 *FRESH SURFACE WATER QUALITY STANDARDS FOR CLASS WS-IV WATERS*	Defines water quality standards for surface waters within water supply watersheds classified as WS-IV. Requirements are similar to WS-I.	• Rule .0216 (3) (f) for non-carcinogens is amended to include water quality standards for HFPO-DA, PFBS, PFBA, PFHxS, PFHxA, and PFNA. • Rule .0216 (3) (g) for carcinogens is amended to include water quality standards for PFOA and PFOS.
15A NCAC 02B .0218 *FRESH SURFACE WATER QUALITY STANDARDS FOR CLASS WS V WATERS*	Defines water quality standards for surface waters within water supply watersheds classified as WS-V. Requirements are similar to WS-I.	• Rule .0218 (3) (f) for non-carcinogens is amended to include water quality standards for HFPO-DA, PFBS, PFBA, PFHxS, PFHxA, and PFNA. • Rule .0218 (3) (g) for carcinogens is amended to include water quality standards for PFOA and PFOS.
15A NCAC 02B .0220 *TIDAL SALT WATER QUALITY STANDARDS FOR CLASS SC WATERS*	Defines standards for Class SC waters used for aquatic life propagation, survival, and maintenance of biological integrity (including fishing, fish, and Primary Nursery Areas (PNAs)); wildlife.	• Rule .0220(11) is also amended to include water quality standards for PFOA and PFOS. • Rule .0220(12) is added to include water quality standards for HFPO-DA, PFBS, PFBA, PFHxS, PFHxA, and PFNA.

* Laboratory instruments are not currently able to reliably detect concentrations at the low health protective levels using both drinking water and wastewater test methods. This is one of the reasons the EPA set the MCLs for drinking water at 4.0 ng/L even though the MCLG was determined to be no level is safe for human consumption. For wastewater applications, which is the intended scope of the surface water standards, test Method 1633 determined that the Limit of Quantitation based on multi-laboratory validation study across the

Rule	Rule Purpose	Rule Amendment
U.S. spans 1-4 ng/L. Recognizing this analytical limitation, Rule .0404 is amended to define the Limit of Quantitation as 4.0 ng/L and states that effluent limits for PFOA or PFOS in NPDES permits that are calculated to be less than the Limit of Quantitation shall be given a permitted effluent limit of the Limit of Quantitation.		

B. NPDES Permitting Schedule for Implementing PFAS Water Quality Standards

Section 301(b)(1)(C) of the CWA, 40 CFR 122.44 (another CWA implementing regulation), and 15A NCAC 02H .0112(c) require that the numeric criteria must be used to set NPDES effluent limits that protect designated uses. The CWA in 40 CFR § 131.11 (a)(1) requires numeric water quality standards to be set at a level that protects the designated uses (e.g., water supply use for human consumption).

Considering PFAS water quality standards will affect an estimated 81% of NPDES wastewater permit holders[11] (POTWs with pretreatment programs and industrial direct dischargers evaluated in this fiscal note), a timeline-based permit review and issuance approach is proposed through amendment of Rule 15A NCAC 02B .0404. The goal of this amendment is to focus on prioritizing dischargers that have the greatest potential to affect water quality (i.e., greater mass/concentration of PFAS in effluent). For this reason, Rule .0404 is amended to specify that PFAS water quality standards will apply only to existing industrial direct dischargers, Major POTWs, and Minor POTWs with pretreatment programs at this time since these permit programs have been identified as having potential for impacting surface water quality relative to other permit types. New NPDES permits for new sources or new dischargers will include PFAS effluent limits and compliance schedules at the time of issuance for facilities that have a reasonable potential to cause or contribute to exceedance of any PFAS water quality standards.

The overall timeline starts in January 2024 and continues beyond 2035 as shown in Figure 2. The assessment monitoring period occurs while the EMC evaluates the merits of this rule proposal. It allows discharge concentrations to be measured and reported while the water quality standards are being considered by the EMC through 2024 and 2025. Rule implementation starts with certified monitoring which will be initiated for existing industrial direct dischargers, Major POTWs, and Minor POTWs with pretreatment programs when EPA test Method 1633 for PFAS is promulgated in 40 CFR Part 136. The figure below illustrates a high-level snapshot of the timeline for effluent discharge monitoring and when permit limits would be added to existing permits based on their significant levels of PFOA or PFOS or reasonable potential to affect designated uses.

[11] The breakdown of the affected permit holders is discussed further in Section V.A and Table 4.

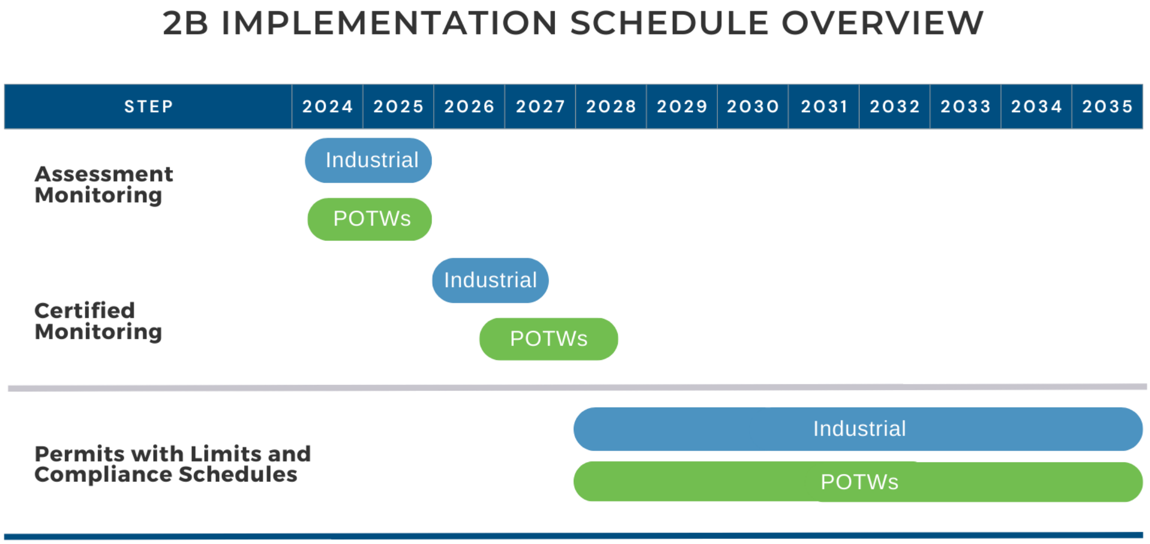

Figure 2. Overview of the 2B Implementation Timeline

Based on the data collected during the certified monitoring period, existing industrial direct dischargers, Major POTWs, and Minor POTWs with pretreatment program permits will be reviewed based on a two-tier schedule shown in Figure 3. Tier 1 permits are those having a minimum of eight effluent samples with at least two sample results showing the sum of PFOA and PFOS equal to or greater than 20 ng/L within the last 4.5 years or demonstrating a Reasonable Potential to cause or contribute to an exceedance of the HFPO-DA (GenX) water quality standards. Each of these permits will be modified to include PFAS effluent limits and compliance schedules. It is estimated that the first series of NPDES permits with PFAS limits could be issued starting in 2028. Compliance schedules will include milestones requiring PFAS reductions over time with final PFAS effluent limits to be achieved on a date that may be several years beyond that to account for treatment system analysis and implementation. Tier 1 permits are expected to cover approximately 42 permittees and about 229 SIUs, which equates to greater than 64% of the SIUs associated with having PFAS in their discharge.

Tier 2 permit reviews will be conducted after the issuance of 90% of the permits in Tier 1, or eleven years after the test Method 1633 for PFAS is promulgated in 40 CFR Part 136, whichever occurs first. Existing industrial direct dischargers, Major POTWs, and Minor POTWs with pretreatment program permits will be modified or renewed to include PFAS effluent limits and compliance schedules based on a Reasonable Potential to cause or contribute to exceedance of any PFAS water quality standards. Tier 2 permits are expected to cover approximately 106 permittees and about 235 SIUs, which represents the remaining 36% of the SIUs associated with having PFAS in their discharge.

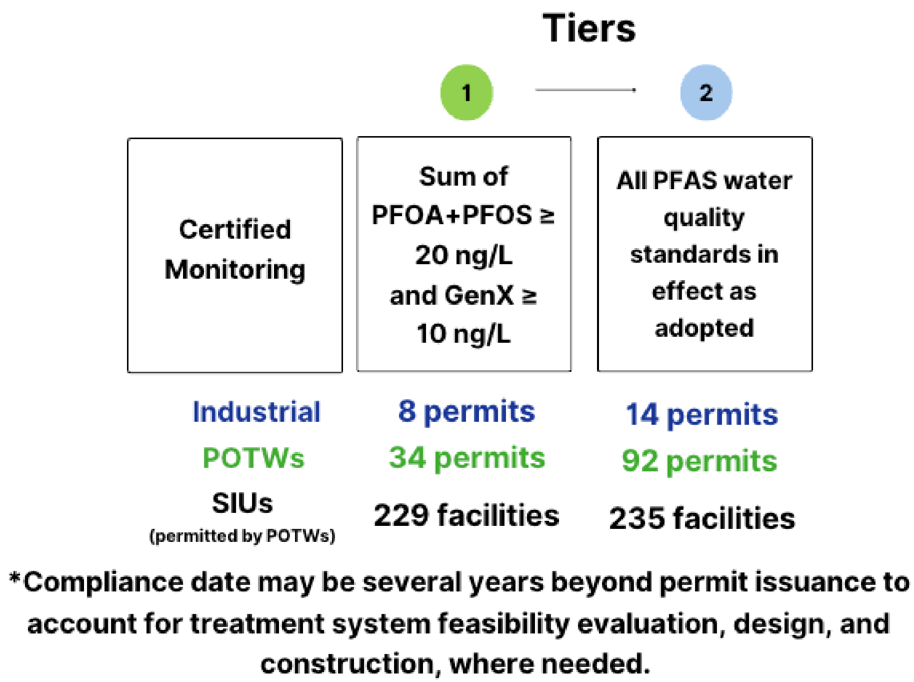

Figure 3. Tiered approach for issuing effluent limits in NPDES permits

(shows when effluent limits will be added to permits and the number/types of permits affected)

Permittees have expressed concerns about being passive receivers (i.e., receiving residential or non-industrial impacted discharges; excluding SIU dischargers) where upstream PFAS levels introduced in their raw water intake would cause their discharge concentrations to cause or contribute to an exceedance of a water quality standard. DEQ has conducted a methodical analysis of NPDES permits by evaluating the characteristics of their discharge and receiving streams and the level of PFAS needed to exceed a PFAS standard. It was determined that sites with the sum of PFOA and PFOS equal to or greater than 20 ng/L are most likely not passive receivers and are adding PFAS to the receiving stream. In the event a facility wants to demonstrate that they should not be subject to Tier 1 permit review, Rule .0404 is modified to include a procedure for a reconsideration. Specifically, facilities with a surface water intake where the raw water influent concentration is equal to or greater than 20 ng/L for the sum of PFOA and PFOS and showing a corresponding effluent concentration sum not greater than 10 percent of the influent concentration, or equivalent mass loading in pounds per day, may submit a request with supporting documentation to DWR to designate the facility a Tier Two facility. If DWR determines the facility has demonstrated it meets the criteria to be designated as a Tier 2 facility, the facility will be moved under the Tier 2 time schedule.

This tiered approach has evolved over this rule development process and incorporates a variety of feedback received through the stakeholder engagement process. The tiered approach balances many priorities and concerns raised while providing expeditious review and issuance of NPDES permits. Some of the benefits are listed below:

- Balances the protection of surface water uses by prioritizing dischargers with the greatest potential to affect water quality.
- Provides regulatory certainty over a defined schedule.
- Reduces PFAS loading to surface water, which may provide operational and/or capitalization relief to downstream public water systems required to install plant-wide treatment systems that must comply with federal drinking water regulations, directly affecting rate payers.
- Allows dischargers with influent concentrations greater than effluent concentrations to be brought into the permitting program after larger contributing sources have reduced their discharge concentrations.
- Allows lower-level dischargers to be brought into the permitting program after the effects of Tier 1 are realized and surface water concentrations have declined to reach background levels (i.e., residential contributions).
- Allows DWR to evaluate and issue NPDES permits in the time period allowed considering site-specific reviews and site-specific compliance schedules are required, along with an anticipated public comment period, a possible public hearing, EPA reviews and limited staffing resources.

The rule text associated with the tiered permitting approach is provided in Appendix B. A brief description of amendment to Rule .0404 is provided below in Table 5.

Table 5. Proposed Amendments to Add NPDES Permitting Requirements for Direct Industrial Dischargers, Major POTWs and Minor POTWs with Pretreatment Programs in Rule .0404

Rule No.	Category	Specific Requirement(s)
.0404 (f)(1)	Certified Monitoring	• When EPA test Method 1633 for PFAS is promulgated in 40 CFR Part 136, existing dischargers will be required to monitor their effluent using test Method 1633 and report concentrations for all PFAS listed in test Method 1633 as specified in their NPDES permit or pursuant to Rule .0508 of this Section.
.0404 (f)(2)(A)	Tier 1 Permit Modification/Renewal	• Facilities categorized as industrial direct dischargers, Major POTWs, and Major and Minor POTWs with pretreatment programs having a minimum of eight effluent samples with at least two sample results showing the sum of PFOA and PFOS ≥ 20 ng/L within the last 4.5 years or have the reasonable potential to cause or contribute to an exceedance of the HFPO-DA(GenX) water quality standard will be issued NPDES permits with PFAS effluent limits and compliance schedules based on PFAS water quality standards in .0200. • Facilities with a surface water intake whose raw water influent concentration of PFOA and PFOS is ≥ 20 ng/L and has a corresponding effluent concentration sum not greater than 10 percent of the influent concentration, or equivalent mass loading in pounds per day, can submit a request to move the facility to Tier 2.
.0404 (f)(2)(B)	Tier 2 Permit Modification/Renewal	• After the issuance of 90% of the permits in Tier 1, or 11 years after addition of Method 1633 in 40 CFR Part 136, whichever occurs first, facilities that have a reasonable potential to cause or contribute to exceedance of any PFAS water quality standards will be issued NPDES permits with PFAS effluent limits and compliance schedules.
.0404 (f)(3), (f)(4) and (f)(5)	Addressing Analytical Limitation for PFOA and PFOS	• For PFOA and PFOS, the Limit of Quantitation based on the national Multi-Laboratory Validation Study as reported in EPA Method 1633 is 4.0 ng/L. • Effluent limits for PFOA or PFOS when calculated to be less than the Limit of Quantitation will be given a permitted effluent limit of the Limit of Quantitation. • For PFOA or PFOS values reported less than the Limit of Quantitation, the permittee will report the actual numerical lab measurement for all samples.
.0404 (f)(6)	New Dischargers or New Sources per 40 CFR § 122.29	• New NPDES permits for new sources or new dischargers will include PFAS effluent limits and compliance schedules for facilities that have a reasonable potential to cause or contribute to exceedance of any PFAS water quality standards codified in Rules .0211, .0212, .0214, .0215, .0216, .0218, and .0220.
.0404 (f)(7)	Permit Programs Not Included	• Minor POTWs without pretreatment programs, one-hundred percent domestic wastewater treatment plants, and NPDES facilities with General Permits will not be

Rule No.	Category	Specific Requirement(s)
		evaluated for PFAS limits unless data using EPA Method 1633 shows presence of wastewaters containing PFAS listed in Rules .0211, .0212, .0214, .0215, .0216, .0218, and .0220, and their discharge impacts a downstream water use designation.
.0404 (f)(8)	Exception	• Above requirements do not apply to Technology Based Effluent Limits nor PFAS effluent guidelines promulgated by EPA.

V. Estimating the Fiscal Impacts

This section discusses the fiscal impacts of adopting and implementing the proposed numeric water quality standards for eight PFAS based on the tiered implementation approach shown in Figure 3 and Table 5. The fiscal impacts of this rule were estimated through a systematic approach that included the following steps:

- Review of potential impacts to DWR program from proposed rules
- Identification of potentially affected sources
- Evaluation of PFAS data for each permit to determine the potential need for treatment
- Determination of costs for monitoring, capital expenses, operation, and maintenance
- Projection of fiscal impacts for private (i.e., industries) and public entities (i.e., local and state government)

A. Potential Impacts to DWR Program from Proposed Rules

i. NPDES Discharge Individual Permits

The following programs will be directly impacted by the proposed rule and costs impacts will be calculated and discussed in subsequent sections: (1) POTWs with pretreatment programs and (2) industrial direct dischargers (majors). At this time, it is anticipated that minor POTWs without pretreatment programs and 100 percent domestic wastewater treatment plants will not be evaluated for PFAS permit limits and therefore will not be impacted by this rule. It is anticipated that minor industrial users and major POTWs without pretreatment programs could be impacted by the proposed rules. These permits were not included in the analysis since the focus was on industrial-dominated sources.

ii. NPDES General Permits

It is not anticipated that these permits would require monitoring or have limits for PFAS. Therefore, no cost is reasonably anticipated to NPDES Wastewater Discharge Facilities with coverage under a general permit.

iii. NPDES Industrial Stormwater Dischargers

Stormwater staff with the NC Division of Energy, Mineral and Land Resources (DEMLR) confirmed that the adoption of PFAS numeric criteria would not alter the way PFAS are handled. If there is a priority industry that is known to have PFAS, DEMLR can elect to require monitoring. This is already the case for a minimal number of permits. Since this type of monitoring is already being required, no additional costs are reasonably anticipated to NPDES Industrial Stormwater Dischargers.

iv. **DWR Groundwater Protection Program**

The Groundwater Protection Program in DWR primarily uses the groundwater standards for remediating sites in which hazardous waste was disposed of by injecting it into underground wells, a practice that is now prohibited. The surface water standards are used for classifying the risk level of discharges to surface water intercepts and for monitoring those surface waters during the remediation process. DWR administers about 30 groundwater protection permits, 14 of which are coal ash sites. The most common parameters monitored under these types of permits are nitrates, dissolved solids, chloride, pH, metals and occasionally volatile organics, pesticides, and semi-volatiles. DWR Groundwater Protection staff report that they do not expect any impact from the proposed codification of the PFAS numeric criteria on parties regulated under DWR's Groundwater Protection Program.

v. **DWR Non-Discharge and Animal Feeding Operations**

The DWR non-discharge program and Animal Feeding Operations program confirmed that they do not anticipate any economic impact to their permittees from the proposed changes to any of the PFAS surface water standards.

vi. **303(d) Impairment and Total Maximum Daily Loads (TMDLs)**

There are currently no waterbodies listed as impaired for PFAS as it is not included in the current assessment methodology. In the future, waterbodies will be assessed for PFAS and potential listing on the 303(d) Impaired Waters list. This will not require additional expenditure, distribution or reallocation of State funds as DWR currently samples PFAS at many locations across the state.

Following assessment, it is possible that waterbodies could be listed as impaired for PFAS. There would not be direct impacts as a result of the listing itself; however, a TMDL may trigger subsequent rulemaking. Any potential costs and/or benefits from the TMDL and associated rules would be accounted for at the time of rulemaking. Therefore, no cost is reasonably anticipated to the state under the 303(d) Impairment and TMDL program.

vii. **DWR Ambient Monitoring Program**

PFAS is currently a part of DEQ's ambient monitoring program and emerging compounds study program and has been being sampled at stations across several study areas of the state (e.g., Cape Fear, Neuse, and Yadkin River Basins) since 2021. DEQ anticipates that sampling locations for PFAS could be adapted as needed to provide data for NPDES or other programs that are seeking to identify sources or document reductions. None of these efforts are a result of the current proposal to codify PFAS water quality standards; as such, no cost is reasonably anticipated to the state under the DWR Ambient Monitoring Program.

B. Affected Sources

Although the proposed rule has the potential to affect other programs within the Division of Water Resources, the focus of this fiscal note and implementation approach is on priority permit types that are known to discharge PFAS at concentrations that have reasonable potential to impact surface water quality relative to other programs. These permit types include major and minor POTWs with pretreatment programs and major industrial direct dischargers issued through DWR's NPDES program.

The affected permits and associated sources were identified through a systematic approach that utilized available literature and data on suspected industries (i.e., DEQ's PFAS industry database) and sources of PFAS. DEQ's PFAS industry database was built through identifying information on whether PFAS is potentially associated with a given industry from the following types of resources: EPA PFAS Roadmap, EPA NPDES Guidance, EPA Preliminary Effluent Guidelines Program Plan 15, EPA Proposed Designation of PFOA and PFOS as CERCLA Hazardous Substances ANPRM Comments, National State Datasets, and peer-reviewed studies. The review of this information yielded 387 unique industries potentially associated with PFAS across 23 different sectors.

Site-specific and industry-specific PFAS data were also used to refine the screening. The initial screening on the targeted permits focused on the association of a potential PFAS industry either limited to direct dischargers or on indirect dischargers to POTWs (i.e., significant industrial users that are controllable sources). The facility's North American Industry Classification System (NAICS) or Standard Industrial Classification (SIC) code, which is reported to DEQ based on the industry type, was used to crosswalk with DEQ's PFAS industry database to determine if a specific industry matched with a potential PFAS source.

- **Industrial Direct Dischargers**
  There are approximately 56 active major industrial direct discharge permits. The crosswalk with DEQ's PFAS database identified 39 industrial permits that were potentially associated with PFAS (Figure 4).

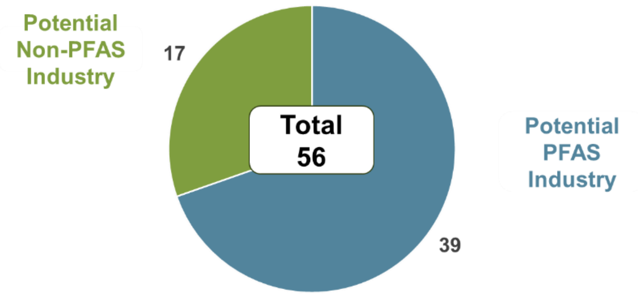

Figure 4. Breakdown of Potential PFAS and Non-PFAS Major Industrial Direct Dischargers

- **POTWs with Pretreatment Programs**
  There are approximately 126 active major/minor POTWs with pretreatment programs that receive discharges from 606 SIUs (Figures 5 and 6). SIUs are commonly referred to as indirect dischargers that are regulated by the POTWs pretreatment program. DEQ provides oversight of all pretreatment programs. The crosswalk with DEQ's PFAS database identified 113 POTWs that received flow from at least one potential PFAS SIU. Those 113 POTWs collectively receive flow from approximately 464 potential PFAS SIUs.

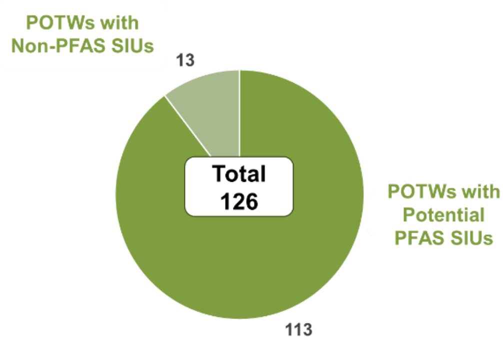

Figure 5. Breakdown of POTWs Associated with Potential PFAS SIUs

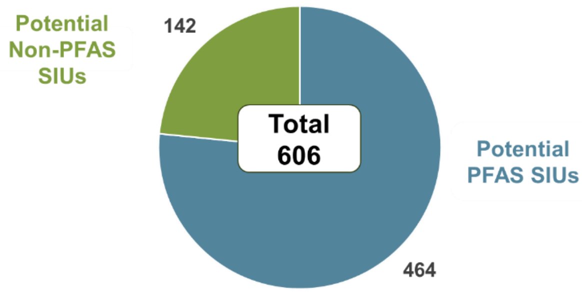

Figure 6. Breakdown of Potential PFAS and Non-PFAS Industries

The breakdown of the types of potential PFAS industries that were identified in the initial screening for industrial direct dischargers and SIUs is summarized in Figure 7. Although some major industrial direct dischargers have been identified to be potentially associated with PFAS, there are significantly more SIUs that were also captured in this analysis. There are approximately 21 times more SIUs associated with PFAS going to POTWs relative to major industrial direct dischargers. This observation highlights the vital role POTWs play in reducing PFAS discharges to surface waters by using their control authority to require source reduction.

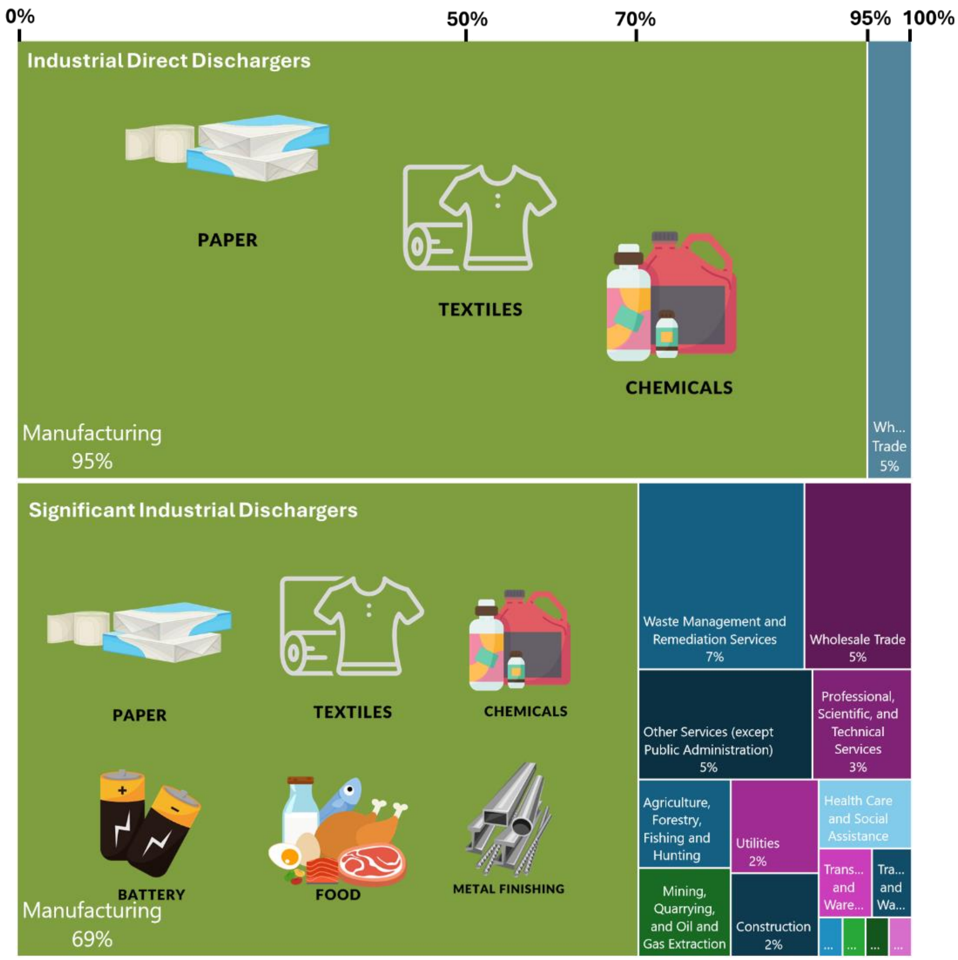

Figure 7. Breakdown of the Industry Types Potentially Associated with PFAS at Industrial Direct Dischargers and Significant Industrial Users Discharging to POTWs

Table 6 summarizes our best estimate of affected existing sources using DEQ's PFAS industry database.

Table 6. Summary of permits and facilities that are identified as potential affected PFAS sources

Permit/Facility Type	# of Permits/Facilities Evaluated	# of Permits/Facilities Identified as Potential Affected PFAS Sources
Industrial Direct Dischargers (Majors)	56	39
POTWs with Pretreatment Programs	126	113
Significant Industrial Users (Indirect Dischargers)	606	464

i. Expected PFAS Levels at Affected Sources

After the initial screening step, the available influent PFAS data for these two programs were evaluated to determine the current prevalence of each of the eight PFAS with proposed numeric criteria by permit type. Table 7 summarizes the permit type and number of sites with detections by PFAS, as well as the minimum, maximum, and average concentrations for each PFAS. All eight PFAS were detected across both permit programs at varying concentrations.

Table 7. Breakdown of PFAS Detections in Influent Data Collected from Industrial Direct Dischargers (Majors) and POTWs with Pretreatment Programs

Permit Type	PFAS	# of sites with Detections	Concentrations (ng/L)	
			Min-Max	Average
Industrial (n=17)	PFOA	11	0.75-50.7	13.9
	PFOS	10	0.687-121	16.1
	PFBA	10	1.1-800	48.6
	PFBS	10	1.55-44.5	9.04
	PFHxA	10	0.991-417	61.7
	PFHxS	9	1.01-108	11.7
	PFNA	8	0.062-50	6.15
	HFPO-DA	7	0.421-188	34.5
Municipal Major/Minor POTW with Pretreatment (n=38)	PFOA	37	1.96-500	15.9
	PFOS	38	1.86-1,000	27.5
	PFBA	31	1.28-715	35.5
	PFBS	32	1.1-900	39.8
	PFHxA	38	0.8-706	36.5
	PFHxS	33	0.1-455	14.3
	PFNA	33	0.351-500	8.72
	HFPO-DA	24	0.046-125	8.31

ii. Selection of Sites Projected to get a Permit Limit and Require Treatment

Once all active major and minor POTWs with pretreatment, associated SIUs (indirect dischargers), and industrial direct dischargers were screened for their potential association with PFAS, these entities were further evaluated based on either their site-specific or industry-specific influent PFAS data. The latter was collected from various national and state databases to generate minimum, maximum, and average values for each PFAS across all available industries. POTWs that did not have site-specific data available were assigned summary values based on the data for NC POTWs with pretreatment programs that have been reported directly to DWR. Concentration data were used to evaluate all active POTWs with pretreatment programs, associated SIUs, and industrial direct dischargers to identify which facilities would be projected to need PFAS treatment. It is important to note that this association with PFAS treatment is based on currently available data and is projected for the purpose of determining the fiscal impact of the proposed rule.

PFAS treatment was deemed necessary if the influent concentration for any of the eight PFAS exceeded the estimated effluent limit for each PFAS. The effluent limit was based on the facility's surface water classification (i.e., where they discharge to) and flow data. The specific PFAS ("short" or "long" chain PFAS) that triggered treatment were captured and used to identify an appropriate treatment approach. The treatment approaches were based on known effectiveness of shelf-ready and field-validated methods and professional guidance from two national consulting firms that were hired to assist with the technical aspects of DEQ's regulatory impact analysis. The number of facilities identified needing some level of treatment is summarized in Table 8.

Table 8. Number of Facilities Anticipated to Receive at Least One PFAS Effluent Limit

Permit/Facility Type	# of Permits or Facilities	# of PFAS Affected Facilities	# of Permits or Facilities Affected by Effluent Limits
Industrial Direct Dischargers	56	39	22
POTWs with Pretreatment Programs	126	113	126*
Significant Industrial Users	606	464	464

* After further review of actual measured PFAS data, it was determined that certain POTWs that were not captured in the initial PFAS screening did have PFAS in their wastewater at levels that would result in effluent limits.

iii. Treatment of PFAS

The removal of PFAS has been demonstrated to be successful through various conventional processes. These processes include filtration (reverse osmosis) and adsorption to media (granular activated carbon or ion exchange). These treatment technologies were evaluated by Brown and Caldwell to validate the effectiveness to remove PFAS from wastewater at POTWs and industrial facilities, which includes direct (industrial facilities) and indirect (i.e., SIUs) dischargers. Granular activated carbon (GAC) and ion exchange (IX) were given priority over other treatment technologies (e.g., reverse osmosis, advanced oxidation, and chemical destruction techniques). The main rationale for this recommendation hinged on residual management options for media vs. liquid concentrates. The consultants felt that the residuals management for reverse osmosis would be more costly and was associated with more uncertainties. Table 8 breaks down the treatment drivers for POTWs and industrial direct dischargers by PFAS type. This information will be used further to project costs of treatment.

Table 9. Treatment Drivers for POTWs and Industrial Direct Dischargers

PFAS	# of Carbons	# of POTWs Needing Treatment	# of Industrial Dischargers Needing Treatment
PFOS	8	124 of 126	22 of 22
PFOA	8	123 of 126	22 of 22
HFPO-DA	6	2 of 126	None
PFBA	4	None	None
PFBS	4	None	None
PFHxA	6	None	None
PFHxS	6	14 of 126	None
PFNA	9	13 of 126	1 of 22

When modeling various scenarios to project costs the following factors should be considered:

- **Industrial direct dischargers** – PFAS can be used directly in the manufacturing process or produced indirectly. A facility with PFAS detections can evaluate whether they want to identify ways to reduce or eliminate the use of these compounds. In the event they choose not to replace these compounds (note the rule does not ban the use of PFAS), treatment may be needed. Therefore, for all scenarios, industrial users identified to be associated with PFAS and have influents above the calculated effluent limit would need to treat 100% of the flow.
- **POTWs with pretreatment programs** – modeling the treatment of PFAS at a POTW is not a straightforward process, as they are influenced by receiving flows from residential households, commercial establishments, and industrial users. When understanding the presence of PFAS in these streams, and the ability for a POTW to manage incoming PFAS, it is important to separate these flows as controllable (i.e., SIUs) versus background (i.e., residential) sources. A POTW can elect to work with their SIU to pretreat for PFAS or take on the burden of treating controllable PFAS. Source reduction has been demonstrated to be the most cost-effective method of removing PFAS. The cost analysis approach reflects POTWs only treating the background levels of PFAS from residential sources. In other words, SIUs are assumed to pretreat to the greatest extent possible before discharging to a POTW. This scenario reflects the lower end of treatment costs for the POTW. The sensitivity analysis section will show the differences in costs based on different treatment scenarios (Section VII A).

C. Cost Analysis Approach

For the purpose of this analysis, DWR considers the regulatory baseline to be the absence of PFAS standards. The cost-benefits for the proposed rules will be compared to a "zero cost" baseline for the regulated community but has a cost related to human life based on accepted value of statistical life estimates.

The cost analysis approach is based on executing the tiered approach for issuing NPDES permits with effluent limits as discussed in Section IV-B. Other programs addressed in Section V-A were anticipated to either not be impacted by the adoption of the proposed rules or PFAS monitoring was already being implemented. The proposed rules can result in costs to public and private entities for those that are affected by the need for effluent limits and implement treatment to meet numeric criteria for surface waters for POTWs with pretreatment programs and industrial direct dischargers. The anticipated costs to a regulated entity include monitoring and treatment components (capital expenditures and operational and maintenance costs). These costs were determined for permits that were identified in the affected sources section to receive an effluent limit for at least one PFAS. The specific PFAS (long or short chain) requiring treatment were used to determine if a facility was projected to install either (1) GAC or (2) GAC and IX.

Regardless of the need for treatment or adoption of water quality standards, all active POTWs with pretreatment programs and industrial direct dischargers will be required to undergo a specified period of monitoring their effluent to determine the presence and concentrations of PFAS. Monitoring costs consider the sampling that is required during the assessment and certified monitoring periods, which consists of quarterly sampling. This frequency is continued until a facility receives an effluent limit. These costs include supplies; staff time to collect samples, analyze results, and report to NCDEQ; and the lab fees to analyze and report data back to the permittee. The anticipated costs to the SIUs were based on a POTW requiring each of their pretreatment permittees to conduct quarterly monitoring. Only SIUs that were identified as a potential PFAS industry were included in these calculations.

If a facility needs to install treatment to comply with effluent limits, capital expenditures (CapEx) and operation and maintenance (O&M) costs would be required. Details on the typical components of CapEx (e.g., equipment, installation, piping, electrical work, engineering design and management) and O&M (e.g., maintenance, labor, media replacement, and residuals management) are included in Appendix C - Tables 2 and 3. These components were calculated using cost curves for various shelf-ready and field-demonstrated PFAS treatment approaches (i.e., GAC and GAC/IX) for each facility based on the specific PFAS needing to be removed. These cost curves were developed by Brown and Caldwell using an internal conceptual cost-estimating tool and supplemented by their estimating system and database, historical project data, available vendor and material cost information, and other costs obtained from published references. Additional details of how these cost curves were determined can be found in Appendix C.

The dynamic cost curves were developed specifically for NCDEQ based on the permitted flows for all relevant facilities and industry types. The relative PFAS concentrations for each industry type was determined through site-specific and industry-specific data (i.e., other state data) to tailor the cost curves to account for the impacts of concentration loadings on media (GAC and GAC/IX treatment).

Determination of costs for each permit (POTW or industrial direct discharger) or facility (SIUs) was executed by using the permitted flow for each facility as the only input value needed to calculate the associated costs in 2023 dollars. All CapEx and O&M calculations yielded low, average, and high costs (2023 dollars) that are based on an Association for the Advancement of Cost Engineering Class 5 estimate (i.e., engineering screening approach). This type of estimate is the industry standard as the first step in working towards the final design and construction of an engineered system.

These cost ranges were used to determine the anticipated expenses for each affected facility based on the year they would be realized. In addition to the industry accepted methodology for computing initial capital costs and annual O&M, several key assumptions presented in Table 10 were applied to create an annual schedule of costs over time. These values were based on current bond rates (private and public), historical and future escalation rates based on the cost types (e.g., personnel time, equipment, services, electricity), typical payback period based on equipment life, and NC Office of State Budget and Management guidance. This information was used to specifically project out and discount the CapEx and O&M costs from 2024 to 2060 for all anticipated impacted permits and facilities. This timeframe accounts for all impacted permits to receive an effluent limit (where necessary), install treatment, and complete a 20-year payback period.

CapEx was calculated over a 20-year period, which is based on the lifespan of the equipment and aligned with engineered assumptions from industry experts. The interest rate was based on whether the permittee is considered a public (POTW) or private (industrial discharger or SIU) entity. The principal amount was based on the year in which the facility would incur those costs (i.e., when they receive a permit limit and a compliance schedule), and interest was compounded annually.

O&M was also escalated to the years a facility would be required to start incurring costs annually and were assumed to start four years after CapEx payments started. CapEx payments were modeled based on a compliance schedule of three years. These costs were not financed per standard industry practice as they occur annually.

Discounting was used to compare costs and subsequent benefits accruing at different points and times. All calculated costs were discounted at a rate of 7% back to 2024 to determine an overall net present value (NPV).

Table 10. Summary of Cost Analysis Values and Assumptions

Cost Analysis Components	Values/Assumptions
CapEx and O&M Cost Curves	Appendix C – Tables 2 and 3
Discount Rate of Return	7%
Escalation Factor	CapEx – 2.42% O&M – 2%[12]
Payback Period for CapEx	20 years
Interest Rate on Capital Investment	Private – 5.68%[13] Public – 3.63%[14]

D. Estimated Costs

The estimated costs of the proposed rules are projected to impact the private sector, NC local governments, and NC state government. The respective costs for each group will be outlined separately as well as summarized at the end of this section. All costs are based on the timing associated with proposed Rule .0404 text that outlines a two-tiered approach for issuing NDPES permits with PFAS effluent limits.

The cost modeling for CapEx and O&M generated a low, average, and high estimate. The values presented in this fiscal note reflect the average values at net present value (discounted at 7%; GS 150B-21.4(b1)(5)). The low and high values are -30% and +50%, respectively, relative to the average value.

Beginning with the number of facilities screened to determine which were associated with PFAS yielded the starting point to identify the number of entities projected to be impacted by the rule. After screening for which entities were associated with PFAS, either site-specific PFAS data or average values for a similar industry or POTW was used to determine if there was a reasonable potential to exceed water quality standards for the eight PFAS. This analysis did not yield that all permits or facilities that could be impacted by the rule were projected to receive effluent limits and require treatment. Facilities that were not projected to need an effluent limit would still be impacted by the proposed rule through monitoring requirements. Table 11 summarizes this breakdown.

[12] The Budget and Economic Outlook: 2024 to 2034 | Congressional Budget Office (cbo.gov)
[13] Moody's Seasoned Baa Corporate Bond Yield (DBAA) | FRED | St. Louis Fed (stlouisfed.org)
[14] S&P Municipal Bond North Carolina Index | S&P Dow Jones Indices (spglobal.com)

Table 11. Summary of the Breakdown of Permits and Facilities Projected to be Affected by Effluent Limits

Permit/Facility Type	# of Permits/Facilities	# of Permits or Facilities Affected by Effluent Limits	Flow Range (MGD)*
Private Sector			
Industrial Direct Dischargers	56	22	0.025-15 (average 2.61)
Significant Industrial Users	606	464**	<1.0-3.0 (average 0.07)
NC Local Government			
POTWs with Pretreatment Programs	126	126	0.05-75 (average 9.4)

* MGD : million gallons per day

** Although 464 SIUs were identified to be associated with PFAS, the lack of flow data for 23 facilities did not allow these facilities to be incorporated into the cost analysis.

i. Private Sector

The private sector includes industrial direct dischargers and significant industrial users. All facilities permitted through DWR, regardless of being projected to be assigned effluent limits, would incur monitoring costs. Out of the 56 industrial permits, only 22 were included in the costs associated with treatment, but the remaining permittees also incurred quarterly monitoring costs through 2060. SIUs discharging into POTW influent were handled differently by including only the 464 SIUs potentially associated with PFAS to be projected to incur monitoring and treatment costs.

Industrial Direct Dischargers

The following cost categories were associated with industrial direct dischargers:

- ***Monitoring***
  Monitoring took place quarterly for all 56 permittees through year 2060 unless an effluent limit was assigned based on the tiered approach. The frequency associated with monitoring for the facilities requiring treatment was converted from quarterly to monthly once treatment was started (i.e., compliance schedule was assumed to be three years, which is when treatment and monthly monitoring would begin). Once treatment began, the monitoring costs were rolled into operation and maintenance projections.
- ***Treatment***
  Treatment was projected to be required for 22 permits under the industrial program. Each permittee was assumed to receive a three-year compliance schedule[15] which would allow time to design and construct the treatment

[15] Actual compliance period may be longer

necessary to meet their facility specific effluent limits. The type of treatment was determined based on the specific PFAS that were added to the facility's permit (i.e., GAC (long chain) or GAC and IX (long and short chain)). Treatment costs associated with CapEx were assumed to begin the same year the permit is issued with PFAS limits. These costs were projected over 20 years, which corresponds to the life of the equipment. O&M was projected to begin one year after treatment started (i.e., four years after limits are put into permits).

Significant Industrial Users

The following costs categories were associated with significant industrial dischargers:

- ***Monitoring***
  Monitoring took place quarterly for all 464 facilities that discharge to a POTW through a pretreatment permit through 2060 unless an effluent limit was assigned based on the tiered approach for the associated POTW. If an SIU was discharging to a POTW, under the proposed rules, they would be required to treat PFAS to the greatest extent possible. Treatment was projected to start two years prior to an effluent limit being added to the associated POTW's permit. The frequency associated with monitoring for the facilities requiring treatment was converted from quarterly to monthly once treatment was started. Once treatment began the monitoring costs were rolled into operation and maintenance projections.
- ***Treatment***
  Treatment was projected to be required for 464 SIUs, but only 441 SIUs were able to be included in the cost analysis due to the availability of flow data. The type of treatment was selected based on the associated POTW's projected approach (i.e., GAC (long chain) or GAC and IX (long and short chain)). Treatment was projected to start two years prior to an effluent limit being added to the associated POTW's permit. CapEx was assumed to begin at the same time. These costs were projected over 20 years, which corresponds to the life of the equipment. O&M was projected to begin one year after treatment started.

Summary of Impacts to the Private Sector

The total impacts to the private sector are summarized in Table 12, which include monitoring, CapEx, and O&M costs. These costs reflect expenses from 2024-2060 that have been escalated based on the year that expenses were realized and discounted at 7% following NC general statutes requirements (Table 12)[16]. A table containing annual CapEx and O&M costs between 2024 and 2060 is provided in Appendix D. Additional impacts not quantified in Table 12 are opportunity costs. The need to invest in capital equipment could cause an entity to make a decision between where financial resources

[16] NCGS 150B-21.4. Fiscal and regulatory impact analysis on rules

are allocated and what other business decisions could be delayed or forgone completely. These decisions will be specific to the affected entity at the local or corporate level and are not able to be captured in this analysis. Although this example highlights what resources would have to be diverted to these capital investments, an entity should also consider what is gained from complying with the proposed rules. For example, protecting human health and the environment, developing goodwill with the surrounding community, and being environmental leaders are invaluable benefits that should be taken into account.

Table 12. Total Direct Costs to the Private Sector (2024-2060)

Private Sector	Total Direct Costs (7% discount)
Industrial Direct Dischargers (Majors)	
Monitoring and Treatment	$ 791,981,158
Significant Industrial Users	
Monitoring and Treatment	$2,834,285,811
Total Costs	**$3,626,266,969**
Average Annual Costs	**$ 100,729,638**

ii. North Carolina Local Governments

North Carolina local governments included in this analysis were POTWs with pretreatment programs.[17] All 126 active permits, regardless of being projected to be assigned effluent limits, could incur quarterly monitoring costs until treatment was initiated. All POTWs were projected to be given at least one PFAS effluent limit and require treatment. A key design parameter is that all POTWs would require and maximize reductions from contributing controllable SIUs discharging into the POTWs. The extent of treatment was assumed to remove the background sources of PFAS (i.e., due to residential and commercial uses) since PFOA and PFOS concentrations may still exceed effluent limits derived from health-based surface water numeric criteria. Monitoring costs are included in the costs associated with treatment, but the remaining permittees also incurred quarterly monitoring costs through 2060.

- ***Monitoring***

  Monitoring took place quarterly for all 126 POTWs through 2060 unless an effluent limit was assigned based on the tiered approach. The frequency

[17] These rules do not impact public water supplies since they are regulated under the Safe Drinking Water Act and not the Clean Water Act

associated with monitoring for the facilities requiring treatment was converted from quarterly to monthly once treatment was started (i.e., compliance schedule was assumed to be three years which is when treatment and monthly monitoring would begin). Once treatment began the monitoring costs were rolled into operation and maintenance projections.

- ***Treatment***
  Treatment was projected to be required for all 126 POTW permits. Each permittee was assumed to receive a three-year compliance schedule, which would allow time to design and construct the treatment necessary to meet their facility-specific effluent limits. The type of treatment was determined based on the specific PFAS that were added to the facility's permit (i.e., GAC (long chain) or GAC and IX (long and short chain)). Treatment costs associated with CapEx were assumed to begin the same year the permit is issued with PFAS limits. These costs were projected over 20 years, which corresponds to the life of the equipment. O&M was projected to begin one year after treatment started (i.e., four years after limits are put into permits).

Summary of North Carolina Local Government Costs
The total cost to North Carolina local governments is estimated to be $7,563,667,984 for monitoring and treatment. These costs reflect expenses from 2024-2060 that have been escalated based on the year that expenses were realized and discounted at 7% following N.C. General Statutes.[18]

Additional impacts not quantified in this estimate are opportunity costs. The need to invest in capital equipment could cause a POTW or SIU to make a decision between where financial resources are allocated and what other business decisions could be delayed or forgone completely. These decisions will be specific to the affected entity at the local or county level and is not able to be captured in this analysis quantitatively. Although this example highlights what resources would have to be diverted to these capital investments, an entity should also consider what is gained from complying with the proposed rules. For example, protecting human health and the environment, reducing treatment burden on downstream drinking water and wastewater treatment systems, and being environmental leaders are invaluable benefits that should be taken into account.

iii. North Carolina State Government

The cost to North Carolina state government will only be attributed to additional staff requirements to ensure permits that require effluent limits are issued in a reasonable timeframe. In all scenarios, it is modeled that DEQ would need to utilize two of its existing allocated full-time positions to devote to processing permits with effluent limits.

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[18] NCGS § 150B-21.4. Fiscal and regulatory impact analysis on rules

The Department has already received legislative appropriations for four additional PFAS positions that can, and most likely will, be leveraged for this purpose. The total direct costs for these two positions (Engineering II and Environmental Program Consultant) are $3,957,579 from 2024-2060. Additional costs not quantified are opportunity costs. The need to invest in additional staff could divert financial resources away from other priority efforts. In this analysis, the positions that are estimated to be needed would be coming from vacant positions that are already allocated to DEQ.

iv. Summary of Costs to Private and Public Sectors

The cumulative costs to all entities associated with the proposed rules are summarized in Table 13. The total present value (7% discount) reflected in this table is approximately $11,193,892,532 from 2024-2060.

Table 13. Summary of Direct Costs to Private and Public Sectors (2024-2060)

Total Direct Costs (7% discount)	
Private Sector - Monitoring and Treatment	$ 3,626,266,969
NC Local Government - Monitoring and Treatment	$ 7,563,667,984
NC State Government - Personnel Costs	$3,957,579
Total Cost	$ 11,193,892,532
Average Annual Costs	$ 310,941,459

VI. Benefits to the State and North Carolinians

Implementation of proposed PFAS numeric water quality standards for eight PFAS will provide benefits to human health, the environment, preservation of natural resources, tourism, and property values, as well as reductions in impacts and financial burdens to drinking water treatment (public water systems and private wells). These benefits will be broken down and discussed either on a quantifiable or unquantifiable (qualitative) basis using peer-reviewed studies, technical reports, and other state rulemaking packages. The following benefits will be discussed in this section and incorporated in the comparison with costs in Section VII:

- Human health impacts
- Environmental and natural resources preservation
- Reductions in drinking water treatment burdens
    - Public water supply
    - Private wells
- Retaining residential property value
- Federal and state grant funding

An important foundational connection that is the underpinning of multiple quantified and qualified benefits is the interconnected nature of surface water with groundwater. These two resources are commonly assumed to be relatively disconnected and are treated separately. This conjecture is inaccurate, and their interconnected nature needs to be recognized when considering the full impacts of surface water quality standards and removing anthropogenic sources of contaminants[19] (e.g., PFAS). These contaminants can undoubtedly affect groundwater quality where surface water would normally seep to groundwater, in locations where groundwater withdrawals will promote seepage from surface water to groundwater, and in the case of riverine and coastal flooding. These behaviors have been demonstrated in the scientific literature and USGS reports.[20]

A. Quantifiable Benefits

When a benefit was able to be quantified based on an economic valuation, this information was leveraged to demonstrate the positive impacts of reducing PFAS in surface waters. There are two ways in which this information was used: (1) a direct value transfer or (2) a unit value transfer.

The main sources of information for the benefits discussed in this fiscal analysis included benefits valuations where total dollar amounts were based off a total population (e.g., the United States) without any specifics about the breakdown in demographics, or valuations that

[19] U.S. Geological Survey Circular 1139 - Ground Water and Surface Water A Single Resource: https://pubs.usgs.gov/circ/circ1139/pdf/circ1139.pdf

[20] Squillace, P.J., Thurman, E.M., and Furlong, E.T., 1993, Groundwater as a nonpoint source of atrazine and deethylatrazine in a river during base flow conditions: Water Resources Research, v. 29, no. 6, p. 1719-1729.)

provided information that included a breakdown of demographics and number of affected cases (e.g., number of cases per 100,000 people in a specific demographic group) that could be used to tailor those results specifically to North Carolina's demographic breakdown, population, and/or other characteristics (e.g., natural resource type).

i. Human Health Benefits

The impacts of PFAS on human health are well established in scientific peer-reviewed literature. These studies have shown that exposure through various pathways (e.g., drinking water, fish consumption, ingestion of food indirectly containing PFAS) to certain types and levels of PFAS have been linked to reproductive effects such as decreased fertility or increased high blood pressure in pregnant women; developmental effects or delays in children, including low birth weight, accelerated puberty, bone variations, or behavioral changes; increased risk of some cancers; reduced ability of the body's immune system to fight infections, including reduced vaccine response; interference with the body's natural hormones; and increased cholesterol levels and/or risk of obesity. An important aspect of the health benefits connected to reducing PFAS in surface water is that it is a benefit that will be perpetually realized for years to come.

PFAS in surface water can either be a direct or indirect route of exposure to these compounds for an individual. A direct exposure would be through the ingestion of PFAS compounds via drinking water. An indirect exposure would be through the ingestion of food containing PFAS (e.g., fish, meat) or accidental ingestion via recreational activities. The health benefits associated with the proposed rules were quantified considering both routes of exposure.

To avoid double counting, the direct exposure to PFAS from surface water influences was determined only for North Carolinians that get their drinking water from private wells, which are not subject to the federal MCLs for PFAS, and the public water systems that were projected to avoid having to install treatment to remove PFAS given reductions in PFAS discharges to surface water. It is well established that surface and ground water do impact each other[21-22]; therefore, all private wells were evaluated across the state. This analysis does not attempt to relate benefits of reducing PFAS in surface water to the lower exposure that will eventually be realized through public water systems complying with federal PFAS MCLs in the future (i.e., drinking water treatment). The number of estimated individuals that have private wells that are impacted by PFAS above the federal MCLs was approximately

[21] U.S. Geological Survey Circular 1139 - Ground Water and Surface Water A Single Resource: https://pubs.usgs.gov/circ/circ1139/pdf/circ1139.pdf
[22] USGS – The Integration of Surface Water and Groundwater – A Critical Linkage: https://www.usgs.gov/mission-areas/water-resources/science/groundwatersurface-water-interaction#:~:text=Water%20and%20the%20chemicals%20it,supplies%20the%20stream%20with%20baseflow.

210,800 (See Appendix F for additional details on this calculation). There are 48 public water systems that are projected to not need treatment with the reduction in PFAS discharged to surface water. These systems serve about 277,406 residents.

Indirect exposure from PFAS in surface water can occur from ingesting food containing PFAS or via the ingestion of water during recreational activities. Studies have shown that various foods containing PFAS can acquire these impacts through irrigation with PFAS-containing sources, washing of food prior to selling to a consumer, and growing food in soil and sediment containing PFAS. In addition, the presence of PFAS in surface water has been linked to bioaccumulation of these compounds in fish caught in NC.[23] The exposure of North Carolinians to PFAS via these food items were determined in order to project the health benefits associated with reducing PFAS in surface waters and subsequently contributing to reduction in sources of exposure.

The health benefits from reduced exposure to PFAS from the proposed rules were determined by utilizing outcomes from EPA's Economic Analysis for the Final Per- and Polyfluoroalkyl Substances National Primary Drinking Water Regulation,[24] which provided a robust overview of the human health impacts of PFAS (including six of the eight PFAS included in the proposed rule) and the associated costs (where possible). This information was used to derive unit value transfer factors that were based on the number of avoided cases/deaths per 100,000 people in a specific demographic group. In addition, the costs per avoided case/death were also calculated using the number of projected individuals affected and the associated total costs. Since this information provided the number of cases by demographic group, North Carolina's population was grouped per the EPA's methodology (Non-Hispanic Black, Hispanic, Non-Hispanic White, and other) and used to calculate the projected number of avoided cases/deaths for the health impacts.

Data pulled from this report represents the reduced exposure to PFAS (i.e., PFOA and PFOS < 4.0) in drinking water, which is 20% of an individual's exposure. This information was used to determine what fraction of the exposure in our benefits analysis for the direct and indirect exposure to PFAS in surface water could be related to the health outcomes described by EPA. The exposure to PFAS from food can be up to six times as high relative to drinking water when comparing the mass of these compounds. Taking a conservative approach, it is estimated that PFAS exposure via food ingestion containing these compounds compared to drinking water was only three times higher from food. Therefore, we adjusted the percentage

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[23] DWR Fish Tissue Monitoring Data: https://www.deq.nc.gov/about/divisions/water-resources/water-sciences/biological-assessment-branch/dwr-fish-tissue-monitoring-data

[24] Economic Analysis for the Final Per- and Polyfluoroalkyl Substances National Primary Drinking Water Regulation: https://www.epa.gov/system/files/documents/2024-04/pfas-npdwr_final-rule_ea.pdf

of quantified health benefits from the proposed rules using drinking water regulation as benchmark. Additional details on this approach are outlined in Appendix F.

In addition to the EPA evaluation, there were two additional studies that were used to derive quantitative benefits associated with the proposed rule (Malits et al. (2018)[25] and Nordic Council of Ministers, (2019)[26]). These two studies provided information to determine the associated health benefits and associated costs with avoiding the number of small-for-gestational-age (SGA) and hypertension management cases. Both evaluations have been used in other state Regulatory Impact Assessments for PFAS-related rules to describe the health benefits associated with reductions in PFAS exposure.[27] These studies were based on a total cost related to the population in the U.S. and Europe (SGA and hypertension, respectively). Therefore, the relative percentage of North Carolina's population compared to the U.S. and Europe was determined to perform a direct value transfer (e.g., if the total health benefit values for the U.S. was based on the whole population and NC accounts for 3% of that population, then only 3% of the total costs for those health benefits would be used). This information was used in the same manner to relate the health benefits associated with indirect and direct exposure reductions from controlling PFAS discharges to surface water.

The health benefits associated with reducing PFAS loadings to surface waters are summarized in Table 14. These quantified benefits reflect the impact from a gradual reduction in the eight PFAS from all dischargers receiving site-specific effluent limits that would result in avoided health impacts (Table 11). The total health benefits are approximately $7,524,784,551 from 2024-2060, or an annual average of $209,021,793.

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[25] Malits et al., (2018) - Perfluorooctanoic acid and low birth weight: Estimates of US attributable burden and economic costs from 2003 through 2014

[26] Nordic Council of Ministers – Cost of Inaction: https://norden.diva-portal.org/smash/get/diva2:1295959/FULLTEXT01.pdf

[27] NR 809, Safe Drinking Water MCL for PFOS and PFOS – Fiscal Estimate & Economic Impact Analysis: https://dnr.wisconsin.gov/sites/default/files/topic/Rules/DG2419FiscalEstimate2.pdf

Table 14. Summary of Monetized Health Benefits from Reduced Direct and Indirect Exposure to Surface Water (2024-2060)

Health Impacts	Total Costs
Cardiovascular Diseases	
Non-Fatal Heart Attack Cases Avoided	$316,712,818
Non-Fatal Blood Flow Blockage Cases Avoided	$477,236,753
Hypertension Management	$5,298,843,985
Cardiovascular Disease Deaths Avoided	$171,273,212
Renal Cell Carcinoma	
Non-Fatal Renal Cell Carcinoma Cases Avoided	$359,568,021
Fatal Renal Cell Carcinoma Cases Avoided	$106,240,267
Neonatal Impacts	
Birth Weight-Related Deaths Avoided	$307,860,800
Small for Gestation Age	$487,048,695
Total Direct Benefits	$7,524,784,551
Average Annual Total	$209,021,793

Following a similar approach as outlined above, the exposure of North Carolinians that rely on private wells impacted by PFAS for their sole source of drinking water is also captured. In addition, human health impacts from PWS that avoided treatment to meet federal PFAS MCLs were included. The population that is exposed to impacted private wells is discussed in Appendix E. The health benefits associated with reducing PFAS loadings to surface waters and subsequently reducing PFAS in groundwater is shown in Table 15. The total health benefits are approximately $89,945,706 from 2024-2060, or an annual average of $2,498,492.

Table 15. Summary of Monetized Health Benefits for Private Well Owners and Public Water Systems Avoiding Treatment from Reductions in PFAS going to Surface Water (2024-2060)

Health Impacts	Total Costs
Cardiovascular Diseases	
Non-Fatal Heart Attack Cases Avoided	$14,837,105
Non-Fatal Blood Flow Blockage Cases Avoided	$22,357,202
Hypertension Management	$7,769,376
Cardiovascular Disease Deaths Avoided	$8,023,667
Renal Cell Carcinoma	
Non-Fatal Renal Cell Carcinoma Cases Avoided	$16,844,752
Fatal Renal Cell Carcinoma Cases Avoided	$4,977,059
Neonatal Impacts	
Birth Weight-Related Deaths Avoided	$14,422,415
Small for Gestation Age	$714,131
Total	$89,945,706
Average Annual Total	$2,498,492

ii. Reductions in Drinking Water Treatment Burdens

Approximately 9,641,992 North Carolinians depend on public water systems (PWS) to get their drinking water[28], while the remaining population is receiving drinking water from private wells. These PWS rely on surface water and groundwater sources to supply this vital natural resource. The remaining residents (~797,396) utilize a private well that is supplied by groundwater. Surface water and groundwater are known to interact with each other and impacts to one source will subsequently impact the other. It is important to understand that these systems are in fact connected because managing PFAS in just one source will only go so far towards reducing the treatment burden of providing drinking water that meets PFAS MCLs. The benefit of the proposed rule will reduce PFAS loadings going into the state's surface waters, which will then contribute to reducing future groundwater impacts and vice versa.[29] The specific benefits to reductions in drinking water treatment were determined through two approaches: (1) determining the reductions in CapEx and O&M for PWS that exceed current PFAS MCLs and (2) quantifying the costs to install a treatment system at an impacted private well.

iii. Reductions in Treatment Burden at Public Water Systems

Reductions in treatment burdens were grouped by either (1) complete avoidance of treatment for PFAS and/or (2) reductions in costs from only the O&M requirements. The latter reflects a system that is impacted by PFAS in surface water that while not low enough to completely avoid CapEx, is justified to reduce the O&M of the system (e.g., reductions in change out of media filtration). This scenario is occurring in the real world, where PWS can adjust their filtration system change-out schedules depending on inlet concentrations.

A surface water PWS that is currently within 1.0 ng/L of the MCL for PFOA or PFOS (4.0-5.0 ng/L) would be within an acceptable range to project that treatment would not be needed with reduced surface water PFAS concentrations. Since these reductions in surface water will translate to groundwater quality improvements, the same approach was used for groundwater PWS that had PFOA or PFOS within 1.0 ng/L of the PFOS or PFOA MCL. If a PWS was over this range for either PFOS or PFOA then they were not identified as a facility that could completely avoid treatment.

Any PWS that did not fall within the above range would see only a benefit in reductions in O&M annually from reduced surface water PFAS concentrations in their source water. A mass balance was used where data was available to determine the range in mass loadings for

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[28] Safe Drinking Water Information System (SDWIS) Federal Reporting Services: https://www.epa.gov/ground-water-and-drinking-water/safe-drinking-water-information-system-sdwis-federal-reporting

[29] USGS – The Integration of Surface Water and Groundwater – A Critical Linkage: https://www.usgs.gov/mission-areas/water-resources/science/groundwatersurface-water-interaction#:~:text=Water%20and%20the%20chemicals%20it,supplies%20the%20stream%20with%20baseflow.

PFAS from POTWs and their projected contribution to the drinking water intake PFAS concentrations. This concentration was determined by taking the mass loadings in the POTW effluent and using the extent of dilution expected within the water supply boundary of the impacted PWS. On average, the reductions in PFAS treatment burden were approximately 10%, which would translate to lower projected O&M costs.

Costs associated with drinking water treatment were obtained from a nationwide study completed by Black and Veatch for the American Water Works Association.[30] This study estimated CapEx and O&M costs for treatment systems grouped by population served. These costs were reflected as average costs for each range. This information was used to translate the reductions in treatment costs for the NC systems that either (1) avoided treatment completely (CapEx and O&M eliminated) or (2) avoided a fraction of the O&M costs with reductions in PFAS going to surface water. Cost data in the report was already annualized and discounted at 7% and therefore were directly used “as is” to calculate the benefits. CapEx savings were realized at one time in 2027 and the O&M avoided and reduced were quantified annually from 2028-2060. The total reductions in drinking water treatment burdens for NC systems are approximately $436,840,143 (Table 16).

Table 16. Breakdown of Projected Reductions in NC PWS Treatment Costs (2024-2060)

NC Public Water Supply Source Water	# of Systems Avoiding CapEx and O&M	# of Systems only avoiding O&M	Total Avoided CapEx	Total Avoided O&M
Surface Water	5	36	$194,910,000	$54,829,101
Groundwater	43	176	$130,660,000	$56,441,041
		Total	**$436,840,143**	
		Average Annual Total	**$12,134,448**	

iv. Reductions in Treatment Burden for North Carolinians with a Private Well

Reductions in PFAS in surface water has the potential to benefit North Carolinians that use a private well for their source of drinking water by avoiding the need to install treatment. Private well PFAS data for the proposed compounds were analyzed from NCDEQ efforts to determine what fraction of samples were found to exceed the EPA MCLs. PWS that used groundwater as their source were also evaluated to identify the extent of impacts more broadly across NC. Approximately 1 in 4 wells were found to exceed at least one PFAS MCL. This value was used to project what the PFAS impact on private wells would be across NC. The total estimated number of private wells across NC was determined by using the

[30] WITAF 56 Technical Memorandum – PFAS National Cost Model Report: https://www.awwa.org/Portals/0/AWWA/Government/2023030756BVFinalTechnicalMemoradum.pdf?ver=2023-03-14-102450-257

current population of NC and removing the population that gets drinking water through PWS. Once this population was determined, an average number of residents per household of 2.48 was used to determine the number of households using a private well (~321,531). This information was then used to determine the projected number of private wells impacted by PFAS. It is estimated that approximately 85,000 households are either projected to or have a confirmed impact from PFAS, which also captures wells that were tested through other DEQ efforts (Table 17). The installation of filtration at a residence that has a PFAS-impacted well is approximately $4,500 per household. The total value of costs associated with installed filtration at impacted private wells is $382,500,000. This cost is a one-time realized benefit. There are additional costs for O&M (i.e., media or filter replacement) and the eventual need to replace the whole unit at the end of its useful life.

Table 17. Summary of Private Wells Impacted by PFAS

Private Wells Tested Through DEQ Efforts	Private Wells that Exceeded EPA MCLs
20,415	9,678*
Remaining Wells not Tested	**Projected # of Wells Exceeding EPA MCLs**
301,289	75,322**
Total # of Impacted Wells	85,000
Total Costs to Install Filtration* **	$382,500,000

* Determined through sampling efforts

** Estimated values

*** Costs reflect a one-time value

v. Preservation of Residential Property Value

PFAS contamination experienced at a private well has been demonstrated across the country to negatively impact property values (e.g., Minnesota[31], Michigan[32-33], and Pennsylvania[34]). This impact continues with the property even after treatment has been installed. The benefits of the proposed rule would be the eventual reductions in the need for filtration at a property. In addition, reducing PFAS in surface water has the potential to avoid additional private well owners experiencing reduced property value. Using the number of projected impacted wells from the previous section, a projected decrease in property value was determined. Using the median sale price of a home in NC in 2023 of $359,191 (NC Fiscal Research Division, 2024), it was calculated that the total property value would be $30,531,235,000. An average

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[31] PFAS and Public Health – Clean Wisconsin: https://dnr.wisconsin.gov/sites/default/files/topic/DrinkingWater/NR809/CleanWisPresentation.pdf
[32] The Effects of PFAS Contamination on the Michigan Housing Market: https://tinyurl.com/ypaxfcea
[33] Estimating the impacts of pfas contamination on the housing market: a case study in Pennsylvania:
[34] The True Cost of PFAS and the Benefits of Acting Now: https://tinyurl.com/53m5ykcd
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8296683/pdf/es1c03565.pdf

decrease in property value of 5% (based on the studies cited above) was used to calculate the total benefit of avoiding PFAS impacts to private wells through the rule. The estimated total decrease in property value is approximately $1,526,561,750. This estimated decrease is conservative, as other studies have reported property value impacts of upwards of over 40%.

vi. Division of Water Infrastructure Loans and Grants

DEQ's Division of Water Infrastructure (DWI) administers existing programs to provide loans and grants to local government units for wastewater infrastructure projects. These grants are funded by the state and federal government. There are various grants programs that are anticipated and projected to have funding available for PFAS related efforts (e.g., monitoring, engineering design, construction of treatment systems). Currently, it is estimated that there is approximately $1,714,616,536 available between 2024-2060 that is projected to go towards wastewater-specific projects. DWI expects to see an increase in applications from wastewater systems linked to PFAS with the adoption of this rule. The estimate of participation is conservative. The value is a fraction of the total funding that is available. These funds provide an economic benefit to the public sector by offsetting costs.

vii. Environmental and Natural Resources Preservation

North Carolina has vast natural resources that provide value to the public and visitors as well as significant economic value to the state's economy. PFAS levels in the environment can impact these resources and cause a decrease in either the value of that resource to the public or the direct economic value to the state. NC currently ranks 5th in domestic visitations[35], which contributes to spending, as well as 11th for outdoor recreation's value-added economic impact.[36]

There are currently no reports on the total valuation of NC's natural and environmental resources as a whole. A study on the Economic Valuation of the Albemarle-Pamlico Watershed's Natural Resources Natural resources in the Albemarle-Pamlico Watershed was completed by RTI (2016).[37] Unit value transfer factors were derived for environmental and natural resources within NC from this report. This information can be used to then approximate the value of the same resource across all of NC (e.g., farmland, outdoor recreation). Data from the Bureau of Economic Analysis of the U.S. Department of

[35] Research commissioned by Visit North Carolina: https://www.visitnc.com/

[36] U.S. Bureau of Economic Analysis – Outdoor Recreation: https://www.bea.gov/data/special-topics/outdoor-recreation

[37] Economic Valuation of the Albemarle-Pamlico Watershed's Natural Resources: https://www.albemarlercd.org/uploads/2/1/7/6/21765280/apnep_econ_assess_final_web.pdf

Commerce[38], NC Beach and Inlet Management Plan[39], and Clean Wisconsin[40] report on PFAS and Public Health included additional data on the value of environmental and natural resources for outdoor recreational activities. These categories reflect resources that have an annual economic value to the state. If a resource is impacted by PFAS, it is possible that there could be a loss in its use (i.e., no longer able to realize the economic benefit of the resource) or a partial loss over time. In reviewing existing court issued settlements related to PFAS that addressed natural resource impacts in other states (e.g., 3M, Solvay, Dupont/Chemours), awarded monetary settlements demonstrate an obvious and clear devaluation of affected natural and environmental resources from these compounds. At this time, we are not including any data related to any changes in valuation of natural and environmental resources of the state as it is anticipated to be released later. Its monetized benefit is expected to be significant and will further increase the total benefit estimate contained in the current fiscal note. The absence of this information does not alter the conclusions associated with the rules' fiscal impacts, but further supports it.

viii. Summary of Quantifiable Benefits to NC and North Carolinians

The cumulative benefits of the proposed rules and preferred approach are summarized in Table 18. The total net present value (7% discount) is approximately $11,675,248,686 from 2024-2060.

Table 18. Cumulative Benefits Associated with the Proposed Rule (2024-2060)

	Total Costs
Human Health (Exposure from Ingestion)	$ 7,524,784,551
Human Health (Exposure from Drinking Water from Impacted Private Wells)	$ 89,945,706
Savings to Downstream Drinking Water Utilities	$ 436,840,143
Private Well Avoided Treatment	$ 382,500,000
Division of Water Infrastructure Grants	$ 1,714,616,536
Preservation of Property Value	$ 1,526,561,750
Total Benefits*	$ 11,675,248,686
Average Annual Total	$ 324,312,464

*Natural and environmental resource benefits do not include benefits associated with preservation as it is anticipated to be released later. This monetized benefit will further increase the total benefits reported here.

[38] Bureau of Economic Analysis of the U.S. Department of Commerce: https://www.bea.gov/data/gdp/gdp-state

[39] Socio-Economic Value of North Carolina Beaches and Inlets - https://www.deq.nc.gov/documents/pdf/bimp/bimp-section-iv-socio-economic-value-nc-beaches-and-inlets/download

[40] PFAS and Public Health – Clean Wisconsin: https://dnr.wisconsin.gov/sites/default/files/topic/DrinkingWater/NR809/CleanWisPresentation.pdf

B. Qualitative Benefits

In addition to the quantified benefits discussed above, there are more unquantifiable benefits that are related to reducing exposure of PFAS to human health and the environment. The lack of quantifiable information for the information discussed below does not diminish the value of the importance of these impacts but simply reflects the need for experts to quantify these benefits. These benefit categories represent a small subset of benefits that could be realized through academic research, economics studies (treatment costs declining due to competition and new technologies being introduced), and societal impact evaluation (e.g., health care costs, loss of income from being ill), but are beyond the scope of DEQ resources.

i. Human Health Benefits

The impacts of PFAS on human health are well established in scientific peer-reviewed literature. These studies have shown that exposure through various pathways (e.g., drinking water, fish consumption, ingestion of food indirectly containing PFAS) to certain types and levels of PFAS have been linked to reproductive effects such as decreased fertility or increased high blood pressure in pregnant women; developmental effects or delays in children, including low birth weight, accelerated puberty, bone variations, or behavioral changes; increased risk of some cancers; reduced ability of the body's immune system to fight infections, including reduced vaccine response; interference with the body's natural hormones; and increased cholesterol levels and/or risk of obesity. The following list provides a high-level summary of the increased risk of the health impacts occurring related to the 8 PFAS with proposed water quality standards[41,42,43,44]:

- <u>Cancer</u>
  - Testicular Cancer
  - Kidney Cancer in adults
  - Pancreatic Cancer
  - Liver Cancer
  - Breast cancer
- <u>Cardiovascular Effects</u>
  - Pregnancy induced hypertension and preeclampsia
  - Increased serum cholesterol
  - Abnormal levels of lipids in the bloodstream in adults and children

[41] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7906952/
[42] https://www.atsdr.cdc.gov/pfas/health-effects/index.html
[43] https://pfas-1.itrcweb.org/7-human-and-ecological-health-effects-of-select-pfas/
[44] NASEM - Guidance on PFAS Exposure, Testing, and Clinical Follow-Up: https://nap.nationalacademies.org/resource/26156/interactive/

- Developmental Effects
  - Accelerated puberty
  - Bone variations
  - Behavioral changes
- Endocrine Effects
  - Thyroid disease and dysfunction in adults
- Gastrointestinal Diseases
  - Ulcerative Colitis in adults
- Immune Effects
  - Decreased response to vaccines
  - Decrease antibody response in children and adults
- Liver Effects
  - Increased serum enzymes (nonalcoholic fatty liver disease)
- Neonatal Effects
  - Increased risk for fetuses to develop tetanus and diphtheria
- Reproductive Effects
  - Decreased fertility
  - Lower sperm count and impairment

ii. Co-Pollutant Removal via PFAS Treatment

The treatment that was discussed for the removal of the 8 PFAS included GAC and IX. These approaches use their available surface areas to allow pollutants to adhere to their surface and be removed from affected sources of water (e.g., drinking water or wastewater). This removal mechanism is non-selective which means any pollutant that is present that can stick to the surface of these media can be removed. Considering this behavior, this is why pretreatment is necessary prior to using GAC or IX to remove PFAS. A benefit of using GAC and/or IX for the removal of PFAS is that other PFAS can be removed in the process in addition to other pollutants. In general, studies on the removal of PFAS using GAC identify that longer-chain PFAS are successfully removed. Therefore, any PFAS that are larger around six carbons could presumably be removed. Similar observation have been made for IX at the opposite end of the chain length scale. Anything that is smaller than approximately four to five carbons could be removed. Other pollutants that could be removed via GAC or IX (if present) are outlined in Table 19.

Table 19. Summary of Other Contaminants Removed by GAC or IX Media

Removed by GAC	Removed by IX
Trichloroethylene (TCE)	Calcium
Tetrachloroethylene (PCE)	Magnesium
Radon	Nitrate
Benzene	Uranium
Toluene	Arsenic
Nitrobenzene	TOC
PCBs	Perchlorate
Chlorobenzene	Hardness
Chloronaphthalene	Barium
Phenol	Sulfate
Chlorophenols	Dissolved ions
Acenaphthene	
Benzopyrenes	
DDT	
Aldrin	
Chlordane	
Heptachlor	
Carbon tetrachloride	
Choloroalkyl ethers	
Dyes	
Gasolines	
Amines	
Humic substances	

iii. Shifting Burden to Polluters Pay

In the absence of regulations or regulatory actions towards an entity discharging PFAS from their facility, this discharge will continue and is rarely proactively disclosed to the regulatory agency. To date, there are limited examples of industry being responsible and voluntarily treating PFAS at the source and preventing the discharge of PFAS to the environment or disclosing their presence of these compounds. Due to decades of PFAS dischargers continuing to release these compounds to the environment, we are seeing the treatment burden being shifted to rate payers (on public water supply), private residences (private well owners), and public utilities that did not receive financial benefits from these manmade compounds. The proposed rules would help shift these financial burdens away from North Carolinians and to the polluters.

VII. Cost and Benefit Summary

Table 20 summarizes the costs and benefits discussed in the previous section. The total costs and benefits were $11,193,892,532 and $11,675,248,686, respectively.

The extent of costs associated with the proposed rule are aligned with the expected outcomes given PFOA and PFOS are driving treatment needs due to their widespread detection in wastewaters and low water quality standard (and as such the calculated effluent limit). The costs for POTWs account for only the removal of PFOA and PFOS from background residential sources (meaning that controllable sources consisting of SIUs are required to reduce PFAS discharges to the greatest extent possible). The benefits analysis demonstrates that the rule will provide a positive benefit in terms of savings related to human health and the associated fatal and non-fatal diseases.

This analysis shows that the PFAS rulemaking will have a significant impact to the regulated sources. However, the monetized benefits to the state as a whole and over 10 million residents have the potential to outweigh the costs through improvements in long-term health, quality of life, and preservation of property value. The qualitative benefits from reduced PFAS levels will add additional value to the state and its residents that are not quantifiable. Although this estimate can be uncertain within reason due to the nature of estimating statewide costs for efforts projected in the future.

Additionally, in the absence of water quality standards for the proposed eight PFAS, NPDES dischargers will continue to discharge these PFAS into the environment above the health-based standards. It is estimated that in the absence of these standards, 10,279 mortality cases could occur[45]. Using the value of statistical life, the total costs of these deaths would equate to $128.1 Billion.[46] This value represents the cost to the public under the baseline of no PFAS standards.

The magnitude of costs and benefits summarized in this section should be examined as a directional means for assessing the overall fiscal impacts as they can vary due to the method for estimating costs and the uncertainties described in Subsection VII.C (below). The data presented in this fiscal analysis quantified to the “greatest extent possible” as required under G.S. 150B-19.1. Uncertainties and limitations are described in the next section.

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[45] Cases include deaths related to cardiovascular disease, renal cell carcinoma, and low birth-weight.

[46] Based on the value of statistical life used by EPA of $12,765,504. The Federal Highway Administration uses a higher value of $13.2 million.

Table 20. Summary of Estimated Costs and Benefits for the Proposed Rule (2024-2060)

Total Costs (7% Discount)		Total Quantitative Benefits (7% Discount)		Qualitative Benefits
Private Sector				
Industrial Direct Discharger – Monitoring and Treatment	$ 791,981,158	Human Health (Ingestion beyond DW)	$7,524,784,551	Avoided Health impacts including**: • Cancer • Cardiovascular Effects • Developmental Effects • Endocrine Effects • Gastrointestinal Diseases • Immune Effects • Liver Effects • Neonatal Effects • Reproductive Effects
SIUs – Monitoring and Treatment	$ 2,834,285,811	Human Health (Impacted Private Wells and PWS avoiding treatment)	$ 89,945,706	
NC Local Government		Downstream Drinking Water Utilities Savings	$ 436,840,143	
POTW – Monitoring and Treatment	$ 7,563,667,984	Private Well Avoided Treatment*	$ 382,500,000	Removal of other co-pollutants
NC State Government		Retaining Property Value*	$ 1,526,561,750	Shifting treatment burden from rate payers to polluters
Personnel Costs	$ 3,957,579	Division of Water Infrastructure Grants	$ 1,714,616,536	
Total Costs	**$ 11,193,892,532**	**Total Benefits*** **	**$11,675,248,686**	
Total Average Annual Costs	**$ 310,941,459**	**Total Average Annual Benefits**	**$324,312,464**	

* Private well avoided treatment and retaining property values which were both one-time estimates.

** Qualitative benefits discussed in more detail in previous section.

***Natural and environmental resource benefits associated with preservation are not yet included as it is expected to be released later. Addition of this benefit category will further increase the Total Benefits value shown in the table.

A. Uncertainties and Limitations

Uncertainties and limitations, within reason, are expected due to the nature of estimating statewide costs for efforts or impacts projected in the future. The data presented in this fiscal analysis are quantified to the "greatest extent possible". These uncertainties and limitations were minimized as much as possible using sound engineering and scientific judgement and leveraging external technical expertise (i.e., national engineering firms and associated experts). This section provides a summary of the primary uncertainties/limitations associated with this analysis.

i. Affected Sources

- PFAS Industries
  In order to estimate the anticipated costs and impacts to affected entities, understanding the universe of where PFAS could be found in dischargers for industrial direct dischargers, POTWs with pretreatment programs, and SIUs is important. This analysis relied on a database of PFAS industries that have been identified as potential sources of these compounds and goes beyond the recommended targeted industries covered by EPA NPDES permitting guidance for PFAS. This extended list allows the department to ensure that the estimated number of affected entities was more inclusive to avoid underestimations. It is possible that some additional SIUs or industrial direct dischargers could be pulled in as being affected by the proposed rules but since we believe the current estimate is the most comprehensive the uncertainty is minimal compared to using a limited list of PFAS sources.

ii. Treatment

- Division of Water Infrastructure Loans and Grants
  One of the estimated benefit categories projects the availability of DWI grants that are available for public wastewater treatment plants to reduce the costs associated with the proposed PFAS rules. The estimate provided includes only a fraction of what is available overall for eligible entities and serves as a conservative estimate of the minimum amount of funding that could support these rules. Once PFAS rules are adopted there will be greater interest and motivation to apply for these funds.
- Selection of PFAS Treatment Approach
  Treatment decisions are always a site-specific decision that not only rely on the wastewater stream and PFAS present but will also be dictated by the owners or operators of that facility. There are multiple treatment options available for PFAS treatment and each have their operational considerations. GAC and IX are the two approaches that provides the least amount of uncertainty around disposal of treatment residuals. Another treatment option is reverse osmosis but would be more costly and have limited disposal options. Table 21 summarize the cost associated with GAC, IX,

and Reverse Osmosis for a POTW with a capacity of 10 MGD. These values are kept in 2023 dollars for illustrative purposes only.

Table 21. Comparison of Costs for Different Treatment Approaches for a 10 MGD POTW

	CapEx	O&M
GAC	$ 88,140,000	$ 9,280,000
IX	$ 69,920,000	$ 5,280,000
Reverse Osmosis	$ 110,530,000	$ 5,280,000

- <u>Source Reductions at SIUs</u>
  The costs represented for POTWs with pretreatment programs for their projected required treatment relied on 100% of the SIUs identified as potentially associated with PFAS to comply with requirements to treat to the greatest extent possible. These source reductions would translate to residential background levels. This level was based on the currently available data in NC and across the U.S. to determine what the 100% domestic makeup of PFAS is. Additional surveillance data is needed to determine the background levels now and while reductions from this rule are realized. Compliance also hinges on the POTWs requiring their SIUs to pretreat for PFAS. If there is some percentage of SIUs that do not comply with pretreatment or the POTWs decides to take on more of the PFAS treatment burden, then then the costs to the POTWs would increase and costs for the SIUs would decrease. Table 22 demonstrates the differences in POTW costs if there is no pretreatment upstream vs. maximum source reduction at the SIUs.

Table 22. Total Direct Treatment Costs for CapEx and O&M Relative to the Extent of Pretreatment (2024-2060)

	No Pretreatment	Maximum Pretreatment
POTW Costs	$15,423,145,503	$7,544,381,814

- <u>Controllable Sources</u>
  POTWs with pretreatment programs are the control authority that permits SIUs. When looking at the sources of PFAS coming into POTWs beyond households, the priority would be to first evaluate the SIUs for their potential to contain PFAS in their discharge and sample for PFAS. There is potential for PFAS to be discharged from other sources beyond SIUs which makes it a challenge for POTWs to be able to eliminate all sources of PFAS which would put additional burden on the POTWs to treat.

- Co-Pollutant Reductions
  The co-benefits of employing a treatment approach that can remove other pollutants can occur but to what extent was not able to be predicted and is only discussed qualitatively in this analysis.
- Treatment Media Management (Disposal and Regeneration)
  The analysis used the most conservative approach for managing media that can be regenerated and reused. Typically, if a facility is using GAC and their spent media pass the tests required to accept media back for regeneration, they can send their media back for regeneration. A regenerated media would be sent back to the facility. Since this decision will be facility specific, the analysis assumes that regenerated media is used but after it is spent the media will be sent for incineration. This is the more costly conservative approach.

iii. Cost Analysis

- Class 5 Cost Analysis
  A Class 5 cost analysis is a starting point to determine an estimated order of magnitude of an engineering design or concept screening. The expected accuracy range is -50% to +100%. In this analysis, -30% and +50% of the anticipated costs were used to compute a low and high range for each scenario. This approach is industry standards and has been utilized by other stakeholders during discussions around cost estimates for PFAS treatment. This level of estimation would be used to inform further decisions around treatment and then refine the estimates. Given this is a statewide estimate of treatment costs, this approach was appropriate given recommendations from industry experts that also provide a great depth of review in certain respects (e.g., identification of facilities projected to need treatment).
- Capital Investment Payment
  A typical 20-year payback period was used to calculate the CapEx for each facility. It is possible that an entity could elect to have a shorter or longer payback period. This decision would either reduce additional costs associated with interest or increase costs, respectively. The direct an entity goes is going to be a site-specific business decision depending on their financial portfolio and how they plan to handle treatment costs.
- Discount Rate
  The discount rate used for both direct costs and benefits from 7% as required by NCGS 150B-21.4 (Fiscal and regulatory impact analysis on rules), which has been a standard value used for regulator impact analysis. This percentage captures the return paid by private capital or effects of investment and business. It has been recommended to also look at a 2% discount rate that better reflects the return receive by consumers as opposed to private entities at 7%. The main difference between using a discount rate of 7% and 2% is the value of benefits is less at 7% vs. 2%

because the valuation is pushed so far out into the future. For example, if a benefit occurs in 40 years it is only values at 6.7% of the undiscounted price at a discount of 7%. This difference can have significant effects on the evaluation of the cost and benefit analysis of an environmental policy.

- Rate Payer Impacts
  The cost of PFAS treatment is not an expense that might be planned for in advance when considering financial forecasting. It is unclear how a private or public entity might take on the costs of treatment and determine how that expenses will be managed. There is concern that the costs of PFAS treatment is going to be passed along to rate payers which would be an indirect impact. A public entity could use DWI grants to reduce the burden on rate payers but to what extent this will be leveraged and considered in their decision to increase rates it unknown. There is no way to predict this impact and will vary widely across utilities.

iv. Benefits Analysis

- Human Health Impacts
  The human health impacts were calculated using the best available scientific information that related the exposure of PFAS in drinking water to a specific outcome that was either at the national level om the U.S. or international in Europe. Since this information was extrapolated down from a national level to a state level there can be some extent of uncertainty. In addition, the extent of exposure between the mass of PFAS in drinking water has been documented to be lower than the scenario we used to estimate the human health impacts of the proposed surface water quality standards which accounted for PFAS in food that is ingested. Therefore, although there is some degree of uncertainty in the calculations, conservative estimates were used to ensure that the valuation of these benefits were not overestimated relative to what could be realized in the future. In addition, the public would expect to realize these health benefits perpetuality into the future especially since there are multiple generations that have been exposed to PFAS at different points in their lifespan. Reducing PFAS exposure now is necessary to reduce future health impacts.
- Surface Water Impacts on Groundwater Quality
  Surface water commonly is hydraulically connected to ground water, but the exact interactions are difficult to observe and measure when it comes to the transport of pollutants. Studies have been done to demonstrate how surface water will influence groundwater. To the exact extent this rule impacts groundwater and private wells was calculated under the theory that if PFAS were present in private wells the mechanisms for these compounds to be present would be related to the influence of industrial discharges to surface water on groundwater through natural interactions or flooding. It is possible that some of the contributions of PFAS at these locations could be attributed to non-point sources.

- Private Well Impacts and Property Value
  The estimated impacts to property values have been demonstrated in various studies but at different extents (1.5% to over 50%). The value used in this analysis was conservatively chosen at 5% to avoid over estimation and illustrate the potential magnitude of property value loses if this value is indeed higher in NC.

VIII. Rules Alternatives

In accordance with N.C.G.S. 150B-21.4(b2)(5), the fiscal note for a proposed rulemaking with a substantial economic impact is required to contain a description of at least two alternatives to the proposed rules. As defined in N.C.G.S. 150B-21.4(b1), "substantial economic impact" means an aggregate financial impact on all persons affected of at least one million dollars ($1,000,000) in a 12-month period. As shown in Section IV of this fiscal note, the proposed rules are expected to have a substantial economic impact. Therefore, two alternatives have been evaluated in this section.

Three alternatives evaluated account for differences in timing associated with when effluent limits are put into permits when necessary (i.e., rollout to all permits at their renewal or limited rule implementation focus on a subset of permittees) relative to the proposed approach for setting water quality standards (Table 23). It is important to note that the proposed PFAS numeric water quality standards do not change for each of these alternatives because the underlying human health analytical method is the same. This information would still be used in the same manner to determine effluent limits.

Table 23. Summary of Alternatives to the Proposed Rules that were Considered

	Proposed Rules (Tiers)	**Alternative 1 (Numeric Standards)**	**Alternative 2 (Narrative Standards)**	**Alternative 3 (Numeric Standards - Reduced Tiers)**
Water Quality Standards (all values are the same)	Codified Numeric Criteria	Codified Numeric Criteria	Derived Numeric Criteria (Narrative Standard)	Codified Numeric Criteria
Permit Issuance Process	Tiered Approach (1 & 2)	As Permits Renew	As Permits Renew	Tiered Approach (Tier 1 only)

A. Alternative 1: Non-Tiered Implementation Approach with Codified Numeric Criteria

The first alternative evaluated was adding effluent limits to permits using the codified numeric criteria and based on the current NPDES permit process which would be applied during the regularly scheduled permit renewal cycles. This alternative does not consider the relative PFAS concentrations or loadings at a facility. The main differences in this approach relative to the proposed approach in Rule .0404 is the same number of permits (i.e., 148) would get a permit limit but the timing of that change would be earlier. For example, under the proposed approach 100% of the permits would receive at least one effluent limit by 2044 as opposed to 2035 under Alternative 1. Treatment requirements would not necessarily change but the timing when those cost would begin would be earlier. It is anticipated that the overall benefits would not change significantly as the same number of facilities would be meeting effluent limits that aim to protect water quality. Therefore, this alternative does comply with the CWA and NC law and regulations which require that water quality standards must, among other things, "protect human health and welfare" (CWA 303(c)(2)(A), NCGS 143-211(c), and 15A NCAC 02B .0208(a)(2)). The total costs and benefits as well as the associated net benefits of this alternative is summarized in Table 18.

B. Alternative 2: Non-Tiered Implementation Approach with Derived Numeric Criteria through the Narrative Standard Translation Process

The second alternative evaluated was adding effluent limits to permits using the derived numeric criteria (narrative standards) based on the current NPDES permit process which could be applied during the regularly scheduled permit renewal cycles. This alternative does not consider the relative PFAS concentrations or loadings at a facility. Standards would be derived for each permit using the narrative standard translator mechanism and then used to determine permit effluent limits. The main differences in this approach relative to the proposed approach in Rule .0404 is the same number of permits (i.e., 148) would get a permit limit but the timing of that change would be earlier and codified numeric criteria are not used. For example, under the proposed approach 100% of the permits would receive at least one effluent limit by 2044 as opposed to 2035 under Alternative 1. Treatment requirements would not necessarily change but the timing when those cost would begin would be earlier. It is anticipated that the overall benefits would not change significantly as the same number of facilities would be meeting effluent limits that aim to protect water quality. Therefore, this alternative does comply with the CWA and NC law and regulations which require that water quality standards must, among other things, "protect human health and welfare" (CWA 303(c)(2)(A) and NCGS 143-211(c). The total costs and benefits this alternative are summarized in Table 24.

C. Alternative 3: Abbreviated Tiered Implementation

Alternative 3 is an abbreviated version of the proposed approach where only facilities that fall within Tier 1 would receive an effluent limit (where applicable). An abbreviated roll out could alleviate cost burdens for facilities that fall into Tier 2 and could be treating a higher percentage of "background PFAS" (i.e., residential contributions). The goal of focusing on the first tier would be to allow time to observe how controlling SIUs and industrial users will contribute to reducing influent PFAS concentrations. The costs of this alternative are understandably less than the preferred approach and Alternatives 1 and 2 since only 42 permits would receive an effluent limit (i.e., only 28% of the permits receiving limits in the proposed approach). The human health and natural resources benefits associated with Alternative 3 would be significantly reduced relative to the preferred approach and Alternatives 1 and 2. Therefore, this alternative would not comply with the CWA and NC law and regulations require that water quality standards must, among other things, "protect human health and welfare" (CWA 303(c)(2)(A) and NCGS 143-211(c)) unless the EMC revisits the rulemaking process after reviewing the effects of Tier 1 facilities implementing treatment and revises the rules that bring the remaining sources (i.e., Tier 2) into the program. The total costs and benefits this alternative are summarized in Table 24.

D. Summary of Comparisons

The costs between the proposed approach and Alternatives 1 and 2 were within approximately $1.4 billion dollars which is mainly attributed to moving up the timeline for adding permit limits to applicable permits (Table 24). Comparing the total benefits as a result of the rule both approaches have substantial positive benefits to human health, North Carolina's economy, and reduced financial burdens on North Carolinians. Alternative 3 had the lowest overall cost to permittees but that is due to only a fraction of the permits receiving effluent limits. The most significant difference in Alternative 3 is the reduced benefits.

Table 24. Comparison of Costs and Benefits Under the Proposed Approach and Alternatives (2024-2060)

Total Costs	**Proposed Approach (All Tiers)**	**Alternative 1 (Numeric Standards)**	**Alternative 2 (Narrative Standards)**	**Alternative 3 (Numeric Standards – Tier 1 only)**
Private Sector				
Industrial Direct Discharger – Monitoring and Treatment	$791,981,158	$902,595,858	$902,595,858	$629,285,793
SIUs – Monitoring and Treatment	$2,834,285,811	$3,296,609,134	$3,296,609,134	$2,834,285,811
NC Local Government				
POTW – Monitoring and Treatment	$7,563,667,985	$8,425,924,935	$8,425,924,935	$4,765,912,466
NC State Government				
Personnel Costs	$3,957,579	$3,957,579	$3,957,579	$3,957,579
Total Costs	**$11,193,892,532**	**$12,629,087,506**	**$12,629,087,506**	**$8,233,441,649**
Total Benefits	**Proposed Approach (Tiers)**	**Alternative 1 (Numeric Standards)**	**Alternative 1 (Narrative Standards)**	**Alternative 2 (Numeric Standards - Reduced Tiers)**
Human Health (Ingestion)	$7,524,784,551	$7,524,784,551	$7,524,784,551	$2,106,939,674
Human Health (Private Wells)	$ 89,945,706	$ 89,945,706	$ 89,945,706	$25,184,798
Savings to Downstream Drinking Water Utilities	$436,840,143	$436,840,143	$436,840,143	$122,315,240
Private Well Avoided Treatment	$382,500,000	$382,500,000	$382,500,000	$107,100,000
Division of Water Infrastructure Grants	$ 1,714,616,536	$ 1,714,616,536	$ 1,714,616,536	$ 1,714,616,536
Preservation of Property Value	$1,526,561,750	$1,526,561,750	$1,526,561,750	$427,437,290
Total Benefits	**$11,675,248,686**	**$11,675,248,686**	**$11,675,248,686**	**$4,503,593,538**

For the reasons cited above, the proposed amendments to rule in .0200 and .0400 achieves the greatest overall savings to the state while balancing health benefits, environmental and natural resources preservation, and savings to rate payers and property owners. Compared to the alternatives, it is recommended as the preferred approach for rulemaking. The cost to the regulated sources is substantial and must be carefully examined by policy makers and the public to ensure the long term economic and societal impacts are minimized from PFAS related toxic effects.