Fiscal and Economic Analysis for the Proposed Amendments to

15A NCAC 02B .0200: Classifications and Water Quality Standards Applicable To Surface Waters and Wetlands of North Carolina

"The Triennial Review of Surface Water Quality Standards and Classifications"

Prepared by: DENR - Division of Water Resources

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Preface

Rule Citations:

15A NCAC 02B .0206, Flow Design Criteria for Effluent Limitations
15A NCAC 02B .0211, Fresh Surface Water Quality Standards for Class C Waters
15A NCAC 02B .0212, Fresh Surface Water Quality Standards for Class WS-I Waters
15A NCAC 02B .0214, Fresh Surface Water Quality Standards for Class WS-II Waters
15A NCAC 02B .0215, Fresh Surface Water Quality Standards for Class WS-III Waters
15A NCAC 02B .0216, Fresh Surface Water Quality Standards for Class WS-IV Waters
15A NCAC 02B .0218, Fresh Surface Water Quality Standards for Class WS-V Waters
15A NCAC 02B .0220, Tidal Salt Water Quality Standards for Class SC Waters

Rule Topic: Classifications and Water Quality Standards Applicable To Surface Waters and Wetlands of North Carolina

DENR Division/ Commission: Division of Water Resources (DWR) / Environmental Management Commission (EMC)

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Impact Summary:

State government:	Yes
Local government:	Yes
Private industry:	Yes
Substantial impact:	Yes
Federal government:	Yes

Authority: NC General Statutes 143-214.1 and 215.3(a)

Necessity: The proposed rule amendments are based upon review of the surface water quality standards and classifications in accordance with the Federal Water Pollution Control Act (Clean Water Act) Section 303(c)(1) and State of North Carolina regulations in 15A NCAC 02B. Several numerical concentrations and narrative rule changes are proposed to meet national guidance and establish allowable concentrations of pollutants that protect public health and aquatic life. The North Carolina Environmental Management Commission approved taking these proposed amendments out for public hearing on March 11, 2010.

Link to Proposed Amendments: http://portal.ncdenr.org/web/wq/ps/csu/swtrirev

Table of Contents

Table of Contents i
Glossary vi
Executive Summary ix
Section I. Purpose and Summary of Rule Changes 1
Purpose of Existing Rules and Rule Changes 1
Summary of Rule Changes 2
Section II. Basic Scientific Information 8
Proposed Metals Water Quality Standards – Basic Science 8
Proposed 2,4-Dichlorophenoxyacetic Acid Water Quality Standards - Basic Science 11
Section III. Program Overview and Impacts 12
Chapter A. State Agencies 14
A1. NC Division of Water Resources 14
A2. NC Division of Waste Management 20
A3. NC Department of Transportation 20
Chapter B. Wastewater Dischargers 21
B1. Summary of Findings 22
B2. Background: NPDES Permit and Pretreatment Programs 24
B3. Evaluation of Impacts: Metals Standards and Design Flows 28
B4. Evaluation of Impacts: 2,4-D Standards 86
Chapter C. NPDES Stormwater 87
C1. Summary of Findings 87
C2. Stormwater Program Overview: 87
C3. Assumptions and Uncertainties: 88
C4. Estimated Total Number of Impacted NPDES Stormwater Facilities by Category 91
Chapter D. NPDES Coalition Monitoring Program 96
D1. Summary of Cost Analysis 96
D2. Methodology 98
Section IV. Private Entities – Estimated Economic Impacts 100
Section V. Local Governments – Estimated Economic Impacts 103
Section VI. State Government – Estimated Economic Impacts 106
Section VII. Federal Entities – Estimated Economic Impacts 108
Section VIII. Benefits 110
Background 110
Summary of Anticipated Benefits 112

Uncertainties and General Assumptions 114
Use Benefits 115
Nonuse Benefits....130
Section IX. Policy Alternatives and Risk Analysis....132
Fiscal Impact by Proposed Standard Change 132
Uncertainty....134
Appendices....137
Appendix I.1: Link to Proposed Rule Text....138
Appendix I.2: Summary of Comments Received....139
Appendix II.1: Overview of Water Quality Standards 141
Appendix III.1: Division of Water Resources Programs....146
Appendix III.2: Wastewater Dischargers – Selection of Target Metals 151
Appendix III.3: Wastewater Dischargers – Determination of Permit Requirements for Metals 156
Appendix III.4: Wastewater Discharges – List of Permits Evaluated 164
Appendix III.5: Evaluation of Municipal Wastewater Treatment Plant Permits 170
Appendix III.6: Evaluation of Industrial Wastewater Treatment Plant Permits 179
Appendix III.7: Evaluation of Groundwater Remediation Permits....185
Appendix III.8: Evaluation of Water Treatment Plant Permits....188
Appendix III.9: Wastewater Discharges – Cost Information 193
Appendix III.10: Wastewater Dischargers – Cost Calculations....198
Appendix III.11: Projected Timeline for Implementation of Metals Standards....199
Appendix VIII.1: Impact of Metal Contamination on Endangered Species....200
Appendix VIII.2: Valuation of Water Quality Improvement - Model Summary....205
Appendix VIII.3: Alternative Method for Water Quality Valuation of Freshwater Streams.....207
Appendix VIII.4: Use Benefits – Secondary Impacts....211

List of Tables

Table 1 Total Costs and Benefits Associated with Proposed Rule Changes (in $Millions)...... xiii
Table I-1 Proposed North Carolina Aquatic Life Standards for Metals....................................... 7
Table III.A-1 Current Annual Costs for Metals Sampling Estimated by DWR Monitoring Programs...17
Table III.B-1 Summary of Estimated Economic Impacts of Proposed Rule Changes (in $Millions) Wastewater Discharges – All Permitted Facilities 23
Table III.B-2 NPDES Wastewater Permits Renewal Schedule by River Basin...........................27
Table III.B-3 Individual NPDES Wastewater Permits (7/1/2011)...29
Table III.B-4 Certificates of Coverage (COC) Under NPDES Wastewater General Permits (7/5/2011)...30
Table III.B-5 Permits and COCs with Existing Requirements for Affected & Other Metals.........33
Table III.B-6 Permits and COCs with Existing Requirements for Target Metals (Cadmium, Lead, &/or Nickel)...34
Table III.B-7 Individual Permits and COCs Evaluated 42
Table III.B-8 Estimated Impacts to Metals Requirements in Permits and COCs – by Wastewater Category..43
Table III.B-9 Number of Level II POTWs and Estimated Capital/ Initial Implementation Costs & Annual Operating Costs per POTW ($Thousands) 59
Table III.B-10 Number of Level III POTWs and Estimated Capital/ Initial Implementation Costs & Annual Operating Costs per POTW ($Thousands) 60
Table III.B-11 Summary of Estimated Economic Impacts of Proposed Metals Standards (in $Millions) – Municipal WWTPs 63
Table III.B-12 Summary of Estimated Economic Impacts of Proposed Metals Standards (in $Millions) – Industrial WWTPs..71
Table III.B-13 Potential Impacts to Groundwater Remediation Facilities..................................73
Table III.B-14 Summary of Estimated Economic Impacts of Proposed Metals Standards (in $Millions) – Groundwater Remediation Facilities 76
Table III.B-15 Metals of Concern in Water Treatment Process...78
Table III.B-16 Summary of Potential Impacts to WTPs...79
Table III.B-17 Alternative Actions - WTPs 80
Table III.B-18 Summary of Estimated Economic Impacts of Proposed Metals Standards (in $Millions) Wastewater Discharges – Water Treatment Plants......................................82
Table III.C-1 Estimated Revised NC Stormwater Benchmark Values – Freshwater 90
Table III.C-2 Estimated Number of Affected Facilities with NPDES Stormwater Permits...........91
Table III.C-3 Estimated Revised NC Stormwater Benchmark Values – Saltwater 95
Table III.D-1 Estimated costs for total recoverable metals instream sampling for one year (TOTAL) and per sample event 97
Table III.D-2 Estimated costs for dissolved metals instream sampling for one year (TOTAL) and per sample event...97

Table III.D-3 Example of How Costs Displayed in Tables III D.1 and III D.2 Are Calculated......99
Table IV-1 Overview of Estimated Economic Impacts to Private Funds 100
Table IV.2 Summary of Estimated Economic Impacts ($Million) – Private Funds....................102
Table V-1 Overview of Estimated Economic Impacts to Local Funds....................................103
Table V-2 Summary of Estimated Economic Impacts ($Million) – Local Funds 105
Table VI-1 Overview of Estimated Economic Impacts to State Government...........................106
Table VI-2 Summary of Estimated Economic Impacts ($Million) – State Government.............107
Table VII-1 Overview of Estimated Economic Impacts to Federal Funds................................108
Table VII-2 Summary of Estimated Economic Impacts ($Million) – Federal Entities 109
Table VIII-1 Summary of benefits categories considered and level of analysis conducted 111
Table VIII-2 Monetized Benefits of Proposed Rules – Annual Summary 112
Table VIII-3 Monetary Benefits Summary Table ($Mil) 113
Table VIII-4 Range of Benefit Values for Improved Water Quality 121
Table VIII-5 Range of Benefit Values from Improved Water Quality that is More Protective of Aquatic Life 122
Table VIII-6 Total Economic Impact from Commercial Fishing in NC from 2001- 2009...........123
Table VIII-7 Potential Benefits to Commercial Fisheries...126
Table VIII-9 Fishing Expenditures in North Carolina in 2011 128
Table VIII-10 Results of Recreational Use Survey of NC State Parks Visitors........................129
Table III.2-1 US EPA Translators - Freshwater 151
Table III.2-2 Worst-Case Comparison of Maximum Allowable Effluent Concentrations (MAECs) Based on Existing and Proposed Freshwater Standards for Metals............................152
Table III.2-3 Worst-Case Comparison of Maximum Allowable Effluent Concentrations (MAECs) Based on Existing and Proposed Saltwater Standards for Metals...............................154
Table III.3-1 Conditions for Setting Limits and Monitoring Requirements in NPDES Permits...160
Table III.5-1 Numbers of POTWs Evaluated, by Subcategory 170
Table III.5-2 Freshwater POTW Permits Evaluated 172
Table III.5-3 Projected Impacts Based on Subset of All Freshwater POTWs 172
Table III.5-4 Potential Permit Impacts to All Freshwater POTWs..173
Table III.5-5 Permitted Flows – Freshwater POTWs...173
Table III.5-6 Saltwater POTW Permits Evaluated 174
Table III.5-7 Potential Permit Impacts to All Saltwater POTWs...174
Table III.6-1 Potential Impacts to Metals Forming/Finishing Facilities.....................................180
Table III.6-2 Potential Impacts to Steam Electric Facilities 181
Table III.6-3 Potential Impacts to Chemicals Manufacturing Facilities 181
Table III.6-4 Potential Impacts to Textile Manufacturing Facilities 182
Table III.6-5 Potential Impacts to Other Facilities with Cadmium, Lead, and/or Nickel Requirements...182
Table III.7-1 Impacts to Groundwater Remediation Facilities – Individual Permits...................185

Table III.7-2 Extrapolation of Potential Impacts to Groundwater Remediation Facilities – General Permit NCG51 186
Table III.7-3 Potential Impacts to Groundwater Remediation Facilities 187
Table III.8-1 Projected Permit Impacts, Metals Standards Three WTPs Discharging to Freshwater 190
Table III.8-2 Extrapolation of Potential Impacts to WTPs 191
Table III.8-3 Summary of Potential Impacts to WTPs 191
Table VIII.2-1 Variable List and Explanations for Water Quality Improvement Model 205
Table VIII.2-2 Household Value for One Percent Increase in Lakes and Rivers with Good Water Quality in North Carolina 206
Table VIII.3-1 Assumptions used in alternative aquatic life benefits calculation 209

List of Figures

Figure III.B-1 Existing Metals Requirements in NPDES Wastewater Permits and COCs 34
Figure III.B-2 Permits and COCs with Existing Requirements for Target Metals (Cadmium, Lead, &/or Nickel) 35
Figure III.B-3 Existing Requirements for Metals in Permits and COCs by Permit Category 37
Figure III.B-4 Expression and Application of Proposed Metals Standards 40
Figure III.B-5 Permits, COCs, and Permitted Flow Potentially Impacted by Proposed Metals Standards 44
Figure III.B-6 Projected Metals Impacts, 30-Year NPVs 49
Figure III.B-7 Projected Permit Impacts, Metals Standards Municipal WWTPs 55
Figure III.B-8 Projected Permit Impacts, Metals Standards Industrial WWTPs 67
Figure III.B-9 Sensitivity of Freshwater Metals Limits to Hardness 84
Figure III.3-1 Expression and Application of Proposed Metals Standards 162
Figure III.5-1 Comparison of Existing and Projected MAILs with Actual Industrial Loadings Commonly Observed with Pretreatment POTWs 176
Figure III.5-2 Projected Permit Impacts, Metals Standards Municipal WWTPs 178
Figure III.6-1 Projected Permit Impacts, Metals Standards Industrial WWTPs 183
Figure III.11-1 Projected Timeline for Implementation of Metals Standards Wastewater Dischargers 199

Glossary

1Q10 flow	Lowest 1-day average stream flow expected to occur once in ten years and is used in evaluating potential to cause exceedance of acute water quality standards.
7Q10 flow	Lowest 7-day average stream flow expected to occur once in ten years and is used in evaluating potential to cause exceedance of chronic water quality standards.
Action Level Metals	Metals copper (Cu), iron (Fe), silver (Ag), and zinc (Zn), which, for permitting purposes, are subject to the action level policy in Rules 02B .0211(4) and .0220(4)
Affected metals	Metals species affected by the proposed changes in Rules 02B .0211 & .0220: • arsenic (As), • beryllium (Be), • cadmium (Cd), • chromium (Cr_{Total}, Cr-III, and Cr-VI), • copper (Cu), • iron (Fe), • lead (Pb), • nickel (Ni), • silver (Ag), and • zinc (Zn).
BIMS	Basinwide Information Management System, the Division of Water Resources' database for its water quality classifications and permitting programs.
Biosolids	Solids found in biological treatment processes such as activated sludge systems (the most common systems for municipal wastewaters), trickling filters, or lagoons. Also applies to those excess solids generated by the treatment process, and sometimes referred to as "sludge" or "residuals."
cfs	Cubic feet per second, a common unit of measure of stream flow (1 cfs ≈ 0.646 MGD).
COC	Certificate of Coverage
Coefficient of Variation	Also known as CV, is the mean value (arithmetic average) of a discharger's effluent concentrations of a pollutant divided by the standard deviation of those same values and is a statistical measure of the variability within the data set.
Combined Hardness	Flow-weighted hardness concentration calculated using the discharge's permitted flow, the receiving stream's 7Q10 flow, and the respective hardness concentrations for each.
CWA	Clean Water Act.
DENR	NC Department of Environment and Natural Resources
DWR	Division of Water Resources, within DENR.
EMC	Environmental Management Commission, DENR regulatory body.
HUC	Hydrologic Unit Code.
HWA	Headworks Analysis

IWC Instream Wastewater Concentration, a measure of the relative amount of wastewater flow in the receiving stream downstream of the discharge. It is the inverse of the available dilution in the receiving water and is used in calculating the MAEC.

IU Industrial User, an industrial facility that discharges wastewater to a municipal WWTP for treatment; also, an indirect discharger.

Local Metals Standards Applicable dissolved numeric freshwater instream standards calculated using the proposed hardness-dependent equations and the 10^{th}-percentile hardness value for the surface water's Hydrologic Unit Code (HUC).

MAEC Maximum Allowable Effluent Concentration of a metal, expressed as total recoverable metal, that will not cause an exceedance of the applicable water quality standard in the stream for a specific discharge and its receiving stream. It is derived from the Maximum Allowable Metal – Total value.

MAHL Maximum Allowable Headworks Loading

MAIL Maximum Allowable Industrial Loading

MAM-dissolved Maximum Allowable Metal – Dissolved is the dissolved metal concentration that corresponds to a metal's surface water quality standard for a specific discharge. For hardness-dependent freshwater standards, it is calculated using the combined hardness of the discharge and receiving stream. This is an interim, conceptual result in the evaluation of WQBELs and has no real application in assessing water quality.

MAM-total Maximum Allowable Metal – Total is the total recoverable metal concentration that is derived from the Maximum Allowable Metal – Dissolved for a specific discharge. This, too, is an interim, conceptual result in the evaluation of WQBELs and has no real application in assessing water quality.

mg/L Milligrams per liter, a measure of the concentration of a substance in water, equivalent to "parts per million."

MGD Million gallons per day, a standard measure of wastewater flow and of wastewater treatment plant capacity. 1 MGD ≈ 1.55 cfs.

MPEC Maximum Predicted Effluent Concentration (total recoverable) of a metal in a wastewater discharge, as determined by a statistical evaluation of actual, current monitoring data for that discharge.

MS4 Municipal separate storm sewer system

Multiplication Factor A further statistical measure of the variability of a data set, based on its Coefficient of Variation and the number of data points, n; the product of the MF and the maximum value in a data set equals the MPEC.

NCLM North Carolina League of Municipalities

NPDES National Pollution Discharge Elimination System

NRWQC National Recommended Water Quality Criterion

Permitted flow Maximum effluent flow limit in a facility's NPDES permit, including those for future plant expansions, if present.

POTW	Publicly Owned Treatment Works, a municipal WWTP.
PQL	Practical Quantitation Limit
Receiving stream	Any surface water that receives a wastewater discharge, whether the water body is a free-flowing stream or a lake, reservoir, or estuary.
Residuals	See Biosolids.
RPA	Reasonable Potential Analysis to determine if a discharger has reasonable potential to cause an exceedance of standards in its receiving stream if its MPEC is greater than its MAEC.
SIU	Significant Industrial User, an IU that discharges 25,000 gpd or more of process wastewater, contributes 5% of more of the permitted flow or organic capacity (BOD, TSS, NH3), is subject to categorical standards or in the opinion of the Control Authority has the potential to impact the pretreatment program.
Surface Water Quality Standards	As used in this document, measures of the quality of water, adopted by the Environmental Management Commission and subject to approval by the US EPA, that prescribe the physical, chemical, or biological properties essential to the contemplated best usage of waters in each surface water class. The proposed metals standards prescribe the maximum allowable concentrations of the dissolved metals and, in several cases, are expressed as both a default numeric value and as a hardness-dependent equation.
Target metals	In the context of this Fiscal Note, the metals cadmium (Cd), lead (Pb), and nickel(Ni) and the action level metals copper (Cu), silver (Ag), and zinc (Zn).
TBELs	Technology-Based Effluent Limitations, those limits that are based on treatment performance standards.
µg/L	Micrograms per liter, a measure of the concentration of a substance in water, equivalent to “parts per billion.”
Uncontrollable Loading	Difference between MAHL and MAIL.
US EPA or EPA	US Environmental Protection Agency
WQBELs	Water Quality-Based Effluent Limitations are limits that are based on surface water quality standards.
WWTP	Wastewater treatment plant or facility.

Executive Summary

Section 303(c)(1) of the Clean Water Act (CWA) mandates States to review and modify water quality standards, as needed, but at least once every three years. These proposed amendments to 15A NCAC 02B regulations comprise the state's 2008-2012 Triennial Review of Surface Water Quality Standards. DWR has identified several numerical concentrations and narrative rule changes that are warranted to maintain the objectives of the CWA goals and provide a more thorough decision making process for assessing surface water quality. The EMC has given DWR approval to proceed with rulemaking to revise the Surface Water Quality Standards in 15A NCAC 02B .0200. Revision of these standards is required by the Clean Water Act in order to ensure that they contain the appropriate protective health and toxicological information.

Revisions proposed include updates to standards for some metals, the addition of a flow design criterion, and 2,4-D standards. The following is a brief description of each revision.

Metals: Proposed revisions to various surface water quality standards for metals in 15A NCAC .0211 and .0220 reflect:

- Updates to National Recommended Water Quality Criterion (NRWQC) published by the US EPA includes: arsenic, beryllium, cadmium, chromium III, chromium VI, copper, lead, nickel, silver, and zinc;
- Change to dissolved metal concentration, where appropriate;
- Addition of acute and chronic standards;
- Incorporation of hardness-based metals standards, expressed as equations, to account for water hardness's ability to moderate metals toxicity;
- Sampling and assessment protocols for acute and chronic standards;
- Language relating to the demonstration of aquatic life use attainment to promote a fuller assessment of water's quality before identification of the water as threatened or impaired by metals concentrations; and
- A proposal has been made to remove the iron standard. Iron is a naturally occurring metal in the sediments, groundwater and surface water of the state.

Flow Design: Proposed revisions to 15A NCAC .02B .0206 includes the incorporation of a new flow design criterion to be used with the proposed acute metals water quality standards. A flow design criterion is used in the development of water quality based effluent limitations (National Pollutant Discharge Elimination System permit limits) as a simplified means of estimating the acceptable frequency and duration of deviations from the water quality standards.

2,4-D: The US EPA has published revised information with respect to the non-carcinogenic human health effects of 2,4-D, a chlorophenoxy pesticide/herbicide. North Carolina is proposing to revise the human health standard applicable to all water supplies to include this updated toxicity information.

(1) Costs

The division solicited information from potentially affected parties and received responses from wide variety of stakeholders including environmental advocates and members of the regulated community, such as private industries, local governments, state government, federal agencies and state regulatory agencies. Information provided by outside sources was used with information that the division collected to provide estimated costs and benefits (See Sections I - X of the Triennial Review Fiscal and Economic Analysis document).

The proposed change to the standard for the pesticide/herbicide 2,4-D is not expected to impact wastewater treatment facilities subject to National Pollution Discharge Elimination System (NPDES) permits, as it has not been detected in these discharges in North Carolina. The change is also not expected to impact NPDES stormwater discharges or surface water monitoring coalitions.

- **State Agencies from funding on standards changes of 2,4D and metals**

Assuming current state agency programs were maintained at existing levels, costs to DENR DWR programs could be close to $250,000 per year for changes to monitoring and permitting. However, since there is no state or federal funding to cover these potential additional costs, the division will reduce sampling frequencies, alter sampling sites, and shift personnel responsibilities to operate within the existing budget.

The DENR Division of Waste Management (DWM) and North Carolina Department of Transportation (NC DOT) were also evaluated for impacts. DWM conducts monitoring and cleanup programs on private sites containing constituents for which revised surface water standards are proposed. Based on their knowledge of the current sites under their programs, they do not project increased division costs. NC DOT identified a potential for an increased number of waterbodies to be identified and listed in “Category 5” of the state’s 303(d) list of impaired waters due to metals concentrations. No direct costs to NC DOT’s programs are expected at this time.

- **Wastewater Dischargers**

The division reviewed 2,918 individual wastewater permits and Certificates of Coverage, screening out 2,395 permits where metals were clearly not parameters of concern. The remaining 523 permits were included in the analyses. Based on these analyses, the divisions estimated that 115 treatment facilities may receive new or continued water quality based limitations for one or more metals, and another 15 facilities are projected to revert to monitoring only. As a result, a total of 2,788facilities (96% of existing permits) are not expected to be impacted by the proposed metals standards.

The division estimates that the impacts of implementing the proposed metals standards on wastewater dischargers will have a net present value (NPV) of $182 million in the first thirty years of implementation (private and local sectors). This impact will be shared between facilities pertaining to the Private, Local Government, State Government and Federal Government Sectors in the following manner: $28 million, $153 million, $220,000 and $110,000, respectively. The division also assessed the uncertainties inherent in the analysis and estimates that the NPV of the 30-year total impacts could range from as low as $94 million to as high as $285 million NPV during that period.

- **Stormwater Dischargers**

The State of North Carolina manages both a state authorized stormwater program (state stormwater program) and a separate federally delegated National Pollution Discharge Elimination System stormwater program (NPDES stormwater program). The state stormwater program will not be impacted by the proposed rules because those permits do not impose any monitoring based on any of the water quality standards regulations proposed for revision.

For those entities covered under the federally delegated NPDES stormwater program, the proposed rule changes may have positive or neutral cost impacts for local government and private stormwater permit holders as the regulations allow modifications to on-going activities such as developing and implementing appropriate best management practices and monitoring frequency.

- **NPDES Coalition Monitoring**

The NPDES Coalition Monitoring Program is a voluntary, discharger-led, ambient monitoring program that provides an effective and efficient means for assessing water quality in a watershed context. A monitoring coalition is a group of NPDES dischargers that combine resources to collectively fund and perform an instream monitoring program in lieu of performing the instream monitoring required by their individual NPDES permits. The collaboration frequently reduces monitoring costs for an individual discharger by sharing the burden across the coalition.

The current monitoring program costs approximately $75,000 per year for total recoverable metals monitoring. Under the proposed rules and current monitoring requirements, monitoring costs for dissolved metals could increase by approximately $271,000 without mitigation efforts. These costs can be mitigated numerous ways including collaboration between the coalitions and the Division of Water Resources to modify the number of stations and frequency of sampling or a discharger can withdraw from the program; therefore, no estimate of potential costs is possible at this time.

(2) Benefits

The proposed revisions to the aquatic life based standards are designed to prevent water quality degradation and improve the overall quality of the state's surface waters. The rule proposals provide for a more accurate identification of waters with high metals concentrations, as well as a more thorough decision making process for assessing waters for inclusion on the impaired waters list. The pesticide/herbicide, 2,4 - D is not commonly problematic in NC waters and therefore no benefits are attributed directly to the 2,4 -D standard revisions. Conversely, high metals concentrations are already known to compromise North Carolina's water quality. Very detailed analyses on benefits can be found on Section X of the Triennial Review Fiscal and Economic Analysis.

Regulations aimed at environmental protection provide a wide range of benefits to the public. The economic benefits identified in this fiscal note are divided into two main categories; use and non-use benefits. Use benefits include the direct and indirect use of environmental goods and services by humans (such as fish consumption, recreational fishing) and the option to use environmental goods and services at a future date or in future generations. Non-use values are associated with the public's desire to know that an environmental resource exists and is protected even if they do not expect to use the resource for their direct economic benefit.

In evaluating benefits for these rule proposals, the following uses were assessed in detail:

- Aquatic life (biodiversity);
- Commercial fishing; and
- Other uses (economic development, human health and non-use values).

Of those uses, the division was able to monetize benefits related to aquatic life and commercial fisheries estimated at $110 million and $0.1 million, respectively, over 30 years in net present value terms. Given uncertainties in the analysis, these NPV of the total quantified benefits could range between $44 and $2,193 million. Some unquantifiable benefits related to the above uses as well as benefits related to current and future economic development opportunities, reduced human exposure to pollutants, protection of resources for future generations and stewardship/preservation were qualitatively described.

This fiscal note also looked at an alternative benefit analysis to assist with verifying the primary estimate. The alternative benefit analysis estimates direct benefits that are anticipated to the health of aquatic communities through money spent by impacted parties to comply with the proposed metals standards for freshwaters. It is estimated, using the alternative analysis that the average benefit over the 30-year implementation period for the proposed rules is up to $658 million dollars in NPV.

Total Economic Impact

Costs and benefits calculated during a 30-year period using 2012 dollars which were discounted at a rate of seven percent and adjusted for inflation using a rate of two percent per annum. The final total economic costs ($182 million) are less than those estimated in some of the public estimates received by the division for use in the fiscal analysis. The difference is based on the use of more facility specific data for metals, flow, effluent and ambient hardness and the continued use of Action Level water quality standards per 15A NCAC 02B .0211 and .0220 in this fiscal analysis. Benefits were conservatively estimated to be $110.160 million NPV during the next 30 years.

Table 1
Total Costs and Benefits Associated with Proposed Rule Changes (in $Millions) [1,2]

		Costs					Total Benefits	Net Impact (Benefits Less Costs)
Year	**Year #**	**Private Entities**	**Local Gov't**	**State Gov't****	**Federal Gov't**	**Total Costs**		
2017	**1**	$0.03	$0.15	$0.25	$0.00	$0.43	$0.00	-$0.43
2018	**2**	$1.15	$1.29	$0.27	$0.01	$2.72	$0.00	-$2.72
2019	**3**	$1.85	$5.54	$0.27	$0.01	$7.67	$0.00	-$7.67
2020	**4**	$7.20	$55.99	$0.27	$0.01	$63.47	$0.00	-$63.47
2021	**5**	$2.30	$7.55	$0.27	$0.01	$10.13	$2.64	-$7.49
2022	**6**	$1.53	$19.01	$0.27	$0.01	$20.82	$5.39	-$15.43
2023	**7**	$4.18	$11.04	$0.27	$0.01	$15.50	$8.25	-$7.26
2024	**8**	$1.67	$17.08	$0.27	$0.01	$19.03	$11.22	-$7.82
2025	**9**	$1.67	$8.49	$0.27	$0.01	$10.44	$14.30	$3.86
2026	**10**	$1.67	$8.49	$0.27	$0.01	$10.44	$14.59	$4.14
Cost projections are inherently uncertain, those beyond 10 years even more so. Estimates for Years 11-30 are provided only for general comparison with the benefits estimates presented elsewhere in this document.								
Yr 1-10		$23.25	$134.62	$2.69	$0.08	$160.64	$56.38	-$104.26
Yr 11-20		$16.68	$84.86	$2.70	$0.08	$104.32	$163.07	$58.75
Yr 21-30		$16.68	$84.86	$2.70	$0.08	$104.32	$198.95	$94.63
Undiscounted 30-Yr Total		$56.60	$304.35	$8.08	$0.24	$369.28	$418.40	$49.12
NPV, 10-Yr		$16.20	$93.49	$1.82	$0.05	$111.56	$28.24	-$83.32
NPV, 20-Yr		$23.49	$130.57	$2.93	$0.09	$157.07	$78.53	-$78.54
NPV, 30-Yr		$28.00	$153.54	$3.61	$0.11	$185.27	$109.72	-$75.54

[1] Net Present Value (NPV) computed at 7% discount rate after estimates were adjusted for inflation using a rate of 2% per annum.
[2] Annual impacts and 10-year totals presented in this table are not adjusted for inflation.
[3] Annual estimates include both the impact on permitted state facilities affected by the proposed changes and the close to $250,000 annual opportunity cost to DENR from changes in monitoring and permitting. The latter impact is not adjusted for inflation since the estimate is driven by the labor cost of DENR staff, which is not expected to change significantly in the foreseeable future. The table does not include, however, the close to $55,000 one-time opportunity cost DENR would incur from implementing the rule in 2016.

Section I. Purpose and Summary of Rule Changes

Purpose of Existing Rules and Rule Changes

The objective of the rules established in 15A NCAC 02B is to protect the existing and designated uses of the state's surface waters. These regulations were established in accordance with Section 303(c)(2)(A) of the Federal Water Pollution Control Act, more commonly known as the "Clean Water Act" (CWA or the Act). Per directive of the Act, any revised or new water quality standards:

> "…shall consist of the designated uses of the navigable waters involved and the water quality criteria for such waters based upon such uses. Such standards shall be such as to protect the public health or welfare, enhance the quality of water and serve the purposes of this Act. Such standards shall be established taking into consideration their use and value for public water supplies, propagation of fish and wildlife, recreational purposes, and also taking into consideration their use and value for navigation."

Under Section 303(c)(1) of the Act, North Carolina has been delegated the authority to establish water quality standards to protect both human health and the aquatic environment. Under the federal delegation, the State of North Carolina is expected to adopt water quality standards to protect all uses of the waters of the state. The requirements to develop and adopt appropriate classifications and standards are delegated under the North Carolina General Statutes (NC GS §143-214.1 and 215.3(a)) to the Environmental Management Commission (EMC or the Commission). The General Statutes direct the Commission to consider the same designated uses and protections as directed by the federal government.

Per the CWA and to protect the existing and designated uses, the North Carolina Department of Environment and Natural Resources (NC DENR), Division of Water Resources (DWR) assigns primary classifications to all surface waters in North Carolina. These classifications, in accordance with the CWA, serve to protect the waterbodies for uses such as recreation, fishing, drinking water supplies, shell fishing and aquatic life propagation and survival. Numeric and narrative water quality criteria are associated with each classification. These numeric concentrations or narrative criteria are set to protect the most sensitive designated use of the water, including protection of human health (through consumption of fish or consumption of fish and water) or protection of aquatic life.

Section 303(c)(1) of the CWA mandates states and tribes to review and modify water quality standards, as needed, but at least once every three years. In accordance with the Act, these proposed amendments to 15A NCAC 02B regulations comprise the state's 2008-2012 Triennial Review of Surface Water Quality Standards. DWR has identified several numerical concentrations and narrative rule changes that are warranted to maintain the objectives of the CWA goals. In a number of instances, these proposed North Carolina revisions were published by the US Environmental Protection Agency (US EPA), publicly reviewed and revised as National Recommended Water Quality Criteria (NRWQC). Other states have adopted them into their standards programs, all as early as the late 1980s. The modifications proposed in North Carolina's Triennial Review package include updating metal standards to be in line with national guidance and with fellow states.

Where the state does not meet or exceed the level of protection provided by the recommended federal criteria, the US EPA can use their regulatory authority to promulgate federal regulations to protect human health and aquatic life in that state. Authority is delegated under Section 303(c)(3) of the CWA as follows:

> "If the Administrator, within sixty days after the date of submission of the revised or new standard, determines that such standard meets the requirements of this Act, such standard shall thereafter be the water quality standard for the applicable waters of that state. If the Administrator determines that any such revised or new standard is not consistent with the applicable requirements of this Act, he shall not later than the ninetieth day after the date of submission of such standard notify the State and specify the changes to meet such requirements. If such changes are not adopted by the state within ninety days after the date of notification, the Administrator shall promulgate such standard pursuant to paragraph (4) of this subsection."

Under the federally delegated authority, the proposed rule modifications are planned to bring North Carolina into alignment with the NRWQC as published by the US EPA[1]. Water quality criteria are numeric values that describe the ambient concentrations protective of human health and the environment. Most criteria are based on toxicity data and risk analysis (scientific judgments about the relationship between the pollutant concentrations and environmental and human health effects). As the scientific body of knowledge evolves and new toxicity data become available for inclusion into the assessment, the US EPA revises the NRWQC to reflect the most current scientifically defensible information. All changes to NRWQC are peer reviewed and go through a public review process. These criteria, published by the US EPA under the requirements of CWA Section 304(a), do not reflect consideration of economic impacts nor the technological feasibility of meeting the chemical concentrations in ambient water. The criteria define the chemical concentrations or ambient conditions that must be maintained, based on scientific data, in the water, in order to allow the water to maintain or meet its designated uses.

Summary of Rule Changes

On March 11, 2010, the Environmental Management Commission (EMC), under its delegated authority, approved DWR to proceed with rulemaking to revise the following rules[2]:

15A NCAC 02B .0206, .0211, .0212, .0214, .0215, .0216, .0218, .0220.

The text of the proposed rule changes can be viewed on the DENR website at http://portal.ncdenr.org/c/document_library/get_file?folderId=521751&name=DLFE-13938.pdf.

A summary of each rule change follows.

15A NCAC 02B .0206: Flow Design Criteria for Effluent Limitations

Water quality based effluent limitations are developed to allow appropriate frequency and duration of deviations from water quality standards while maintaining protection of the designated uses of receiving waters. A flow design criterion is used in the development of water quality based effluent limitations (National Pollutant Discharge Elimination System (NPDES) permit limits) as a simplified means of estimating the acceptable frequency and duration of deviations from the water quality standards.

Regulations to control and protect aquatic life from chronic toxicity (longer term exposure) already exist. With the consideration of an acute criterion proposed in 15A NCAC 02B .0211 and .0220, to protect aquatic life from acute metals toxicity, a 1Q10 flow design criterion is proposed. The 1Q10 flow is the lowest 1-day average flow that occurs once every 10 years.

[1] EPA-822-R-02-047; http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm.

[2] Minutes from the EMC March 11, 2010 meeting, as well as other documents from EMC's Water Quality Committee, are available at http://portal.ncdenr.org/web/emc/agendas/2010/home.

This flow design is used to assure that the one-hour average concentration of a toxic substance in the ambient water will not be exceeding the acute aquatic life criterion more than once every three years.[3]

15A NCAC 02B .0211: Fresh Surface Water Quality Standards for Class C Waters

Reorganization: The proposed revisions to 15A NCAC 02B .0211 include reorganization of some paragraphs and subparagraphs for ease of use. No associated fiscal impact is expected.

Freshwater metals standards: Revisions are proposed for 10 metals: arsenic, beryllium, cadmium, chromium, copper, iron, lead, nickel, silver, and zinc. Those revisions are:

Updates to North Carolina standards to reflect NRWQC[4] Where the federal government (US EPA) has criteria based on more current aquatic toxicity information available, that federally noticed and peer-reviewed information is being proposed for incorporation into the North Carolina water quality standards. These proposed modifications to existing North Carolina chronic standards offer protection to aquatic life from toxic effects resulting from long-term exposure to a chemical.

Addition of acute water quality standards. North Carolina currently has only chronic aquatic life water quality standards for metals. While chronic standards offer protection from toxic effects resulting from long-term exposure to a chemical, the addition of standards protective of acute (or short term) exposure are proposed. As with the proposed revisions to the existing chronic standards, updates to North Carolina standards which include the acute standard will reflect the published NRWQC.

Clarification of the sampling protocol by which compliance is judged. For the purposes of ambient monitoring, chronic water quality standards will be expressed as an average of a minimum of four samples taken on consecutive days, or as a 96 hour average concentration. For the purposes of ambient monitoring, an acute standard will be expressed as an average of two or more samples collected within one hour.

Removal of “maximum permissible level” language. As the addition of standards protective of acute (or short term) exposure and an averaging period for the chronic and acute standards are proposed (see above), removal of the "maximum permissible level" language from the aquatic life standards (currently located in 15A NCAC 02B .0211(3)(l)) will clarify the intent and purpose of North Carolina’s standards.

Revision of metals standards to reflect, where appropriate, the dissolved metal concentration. Freshwater criteria for most metals can be expressed as the total recoverable metal concentration or the dissolved metal concentration in the water column. The dissolved fraction is believed to more closely estimate the portion of the metal that is toxic to aquatic life.

Dissolved metals standards are calculated by using the applicable aquatic life criteria expressed in terms of total recoverable metal and multiplying it by a conversion factor. The conversion factor accounts for the difference in the water quality standards based on the form of the metal that was measured in the laboratory aquatic toxicity tests that were used to establish the original federal aquatic life criteria. The conversion factors for each metal can be viewed at the US EPA

[3] US EPA, “Technical Guidance Manual for Performing Wasteload Allocations”, 1986. http://water.epa.gov/scitech/datait/models/dflow/upload/wlabook6chapter1.pdf

[4] US EPA-822-R-02-047; http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.

website, see “Appendix A of the NRWQC table - Conversion Factors for Dissolved Metals”.[5]

Note: Conversion factors are a constant in the calculation of standards for dissolved metals and therefore are already incorporated into the calculated standards and hardness based equations found in the proposed revised rule language. It should be noted that this change in the expression of the water quality standards from Total Recoverable Metal, as done in the existing rules, to reflect the Dissolved Metal form does not allow for a direct numeric comparison of “existing” and “proposed” standards.

Proposed revisions include, where applicable, the use of hardness based equations as the water quality standard. Revised standards, where applicable, will be expressed as equations rather than a single numeric value, as traditionally done. For illustrative purposes, tables are located within the rule proposals which provide the water quality standards calculated at 25 mg/L. The concentrations at 25 mg/L are also the most conservative application of the formula under the proposed rules.

Various components of water quality such as naturally occurring organic matter, pH, hardness, alkalinity and sodium can affect metal toxicity to an aquatic organism. When evaluating the toxicity of metals to aquatic life, the term “hardness dependent” means that the toxicity of the metal increases as the hardness of the ambient water decreases. Additional information on these concepts can be found in the Basic Scientific Information section (Section II).

The US EPA establishes hardness dependent water quality standards for the protection of freshwater aquatic life for the following metals: copper, zinc, cadmium, nickel, chromium III, silver and lead. Hardness dependent water quality standards are expressed as equations which allow the ambient water hardness to be entered as a variable. This provides a unique standard reflective of the water chemistry at a specific place in time. The published NRWQC uses 100 mg/L hardness to calculate single numeric criteria for *illustrative* purposes only. For the purposes of establishing statewide standards for these hardness dependent metals, the State of North Carolina had previously incorporated the use of a statewide hardness of 50 mg/L. This value equaled the mean of DWR ambient hardness data collected throughout the State of North Carolina.

Because the water hardness varies throughout the numerous waterbodies within the state, North Carolina reviewed analytical hardness values for subbasins to assure protection of sensitive aquatic species as directed by national protocol. This data evaluation indicated that a significant portion of the state periodically has hardness values at or near 25 mg/L. For use with the proposed equations, a minimum hardness of 25 mg/L is proposed. The rule proposals include numeric standards calculated using the minimum hardness value of 25 mg/L for illustrative purposes. These numeric values appear on Table I.1 below.

Inclusion of information relating to the use of water hardness in the proposed standards’ equations. Rule revisions specify that application of a hardness dependent metal standard expressed as an equation in NPDES permits requires the incorporation of hardness values based on the tenth percentile of hardness data collected within the local U.S. Geological Survey (USGS) 8-digit Hydrologic Unit Code (HUC). Alternative concentrations derived in this manner must be protective of downstream uses in accordance with state regulations. The rule revisions also specify that the standards’ equations are generally applicable for instream hardness ranges from 25 mg/L to 400 mg/L, expressed as $CaCO_3$ or Ca+Mg.

[5] http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.

Allowance for more site-specific standards. The US EPA continues to examine the impact of other water quality components on metals toxicity. In February 2007, EPA published revised criterion for copper, which establishes and allows the use of the Copper Biotic Ligand Model[6] that determines copper toxicity based on a broad set of water quality parameters. The state proposes allowance for the use of this model to establish a more location specific standard for copper.

Removal of the existing surface water standard for iron. Iron is a naturally occurring metal in the sediments and groundwater of the state.

Assessment of ambient waters for compliance with water quality standards. Revised rules include language stating that with the exception of mercury and selenium, an instream exceedance of the numeric criterion for metals shall not be considered to have caused an adverse impact to the instream aquatic community if biological monitoring has demonstrated attainment of biological integrity. Biological integrity means the ability of an aquatic ecosystem to support and maintain a balanced and indigenous community of organisms having species composition, diversity, population densities and functional organization similar to that of a reference condition. Mercury and selenium are bioaccumulative, meaning that aquatic organisms accumulate these metals in their bodies. These metals can reach concentrations in the aquatic organisms that are toxic to humans before there is an impact to biological integrity.

Updating the existing "total chromium" standard with two standards that represent the speciation of total chromium as chromium III and chromium VI. Note that although the US EPA has toxicity data for chromium III in water, the US EPA has not approved (40 CFR Part 136) an analytical measure for chromium III in the laboratory. Compliance with the proposed water quality standard for chromium III will be determined using the federally approved 40 CFR Part 136 laboratory method for total chromium and subtracting the analytical results for chromium VI. Compliance with the chromium VI standard in both wastewater and ambient water will be determined using the approved analytical method for determination of dissolved chromium VI. Although the US EPA has not yet adopted the analytical measure for chromium III, the agency is proposing to update the total chromium standard in order to provide some relief to the regulated community as using a standard for total chromium is a more stringent measure.

All proposed standards are presented as dissolved metals. Current regulations are for Total Recoverable Metals. Hardness-dependent freshwater metals* shown here are calculated at 25 mg/L hardness. Per rule proposals, the use of 25 mg/L hardness provides the most stringent calculation. Scientifically based formulas may be used to derive alternative concentrations. Note that direct comparison of proposed standards to current standards requires recalculating proposed standards using 50 mg/L hardness and removing conversion factors.

15A NCAC 02B .0220: Tidal Salt Water Quality Standards for Class SC Waters

Reorganization: The proposed revisions to 15A NCAC 02B .0220 include reorganization of some paragraphs and subparagraphs for ease of use. No associated fiscal impact is expected.

Salt Water Metals Standards: Revisions are proposed for eight metals: arsenic, cadmium, chromium, copper, lead, nickel, silver, and zinc. Those revisions are:

- Updates to reflect the NRWQC. Where the federal government (US EPA) has included more current aquatic toxicity information into the NRWQC, that federally noticed and

[6] US EPA. Aquatic Life Criteria – Copper. 2007 Update. http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/copper/

peer-reviewed information is being proposed for incorporation into the North Carolina water quality standards. These proposed modifications to existing North Carolina chronic standards offer protection to aquatic life from toxic effects resulting from long-term exposure to a metal.

- Addition of acute water quality standards. North Carolina currently has only chronic aquatic life water quality standards for metals. While chronic standards offer protection from toxic effects resulting from long-term exposure to a chemical, the addition of standards protective of acute (or short term) exposure are proposed. As with the proposed revisions to the existing chronic standards, updates to North Carolina standards which include the acute standard will reflect the published NRWQC.Clarification of the sampling protocol by which compliance is judged. For the purposes of ambient monitoring, chronic water quality standards will be expressed as an average of a minimum of four samples taken on consecutive days, or as a 96-hour average concentration. For the purposes of ambient monitoring, an acute standard will be expressed as an average of two or more samples collected within one hour.

- Removal of “maximum permissible level” language. As the addition of standards protective of acute (or short term) exposure and an averaging period for the chronic and acute standards are proposed (see above), removal of the "maximum permissible level" language from the aquatic life standards (currently located in 15A NCAC 02B .0220(3)(m)) will clarify the intent and purpose of North Carolina’s standards.

- Revision of metals standards to reflect, where appropriate, the dissolved metal concentration. Saltwater criteria for most metals can be expressed as the total recoverable metal concentration or the dissolved metal concentration in the water column. The dissolved fraction is believed to more closely estimate the portion of the metal that is toxic to aquatic life.

  Dissolved metals are calculated by using the applicable aquatic life criteria expressed in terms of total recoverable metal, and multiplying it by a conversion factor. The conversion factor accounts for the difference in the water quality standards based on the form of the metal that was measured in the laboratory aquatic toxicity tests that were used to establish the original federal aquatic life criteria. The conversion factors for each metal can be viewed at the US EPA website, see “Appendix A of the NRWQC table - Conversion Factors for Dissolved Metals”.[7] Note that conversion factors are already included in the calculated standards found in the proposed revised rule language.

- Updating the existing “Total Chromium” standard with a standard that reflects the speciation of total chromium as chromium VI. There is currently no NRWQC for chromium III in saltwater; therefore no chromium III saltwater standard is proposed in these rules. Due to analytical difficulties in testing specifically for chromium VI, compliance with the proposed water quality standard for chromium VI will be determined using the federally approved 40 CFR Part 136 laboratory method for total chromium.

[7] US EPA website. National Recommended Water Quality Criteria. Appendix A – Conversion Factors for Dissolved Metals. http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#appendxa

Table 1 below provides a summary of the proposed changes to rules .0211 and .0220:

Table I-1
Proposed North Carolina Aquatic Life Standards for Metals

Metal	Proposed Freshwater Standards: Dissolved (µg/L)		Proposed Saltwater Standards: Dissolved (µg/L)	
	Aquatic Life		Aquatic Life	
	Chronic	Acute	Chronic	Acute
Arsenic	150	340	36	69
Beryllium	6.5	65	none	
*Cadmium**	0.15	0.82 / 0.51 trout	8.8	40
Chromium (total)	Proposed for removal		Proposed for removal	
*Chromium III **	24	180	none	
Chromium VI	11	16	50	1100
*Copper * †*	2.7	3.6	3.1	4.8
Iron	Proposed for removal		none	
*Lead **	0.54	14	8.1	210
*Nickel **	16	140	8.2	74
Silver	0.06	0.30 *	0.1	1.9
*Zinc **	36	36	81	90

* In freshwater, these metals are hardness dependent. In the case of silver, only the acute standard is hardness dependent.
† Or may use the Copper Biotic Ligand Model to develop more site-specific standard.

15A NCAC 02B. 0212, .0214, .0215, .0216, .0218 – Fresh Surface Water Quality Standards for Classes WS-I, II, III, IV, & V Waters

For protection of surface water supplies, an amendment is proposed to the 2,4-D, a chlorophenoxy herbicide/pesticide, standard to protect human health through consumption of water and fish tissue. The US EPA Integrated Risk Information System (IRIS) has revised information with respect to the non-carcinogenic human health effects of 2,4-D. North Carolina is proposing to revise the human health standard applicable to water supplies, to include this toxicity information. Incorporation of the new information results in a slight reduction in the water supply standard.[8]

Additional supporting documentation and scientific background information pertaining to the surface water standards triennial review can be found on the DWR web site at: http://portal.ncdenr.org/web/wq/ps/csu/swtrirev.

[8] US EPA, Integrated Risk Information System. http://cfpub.epa.gov/ncea/iris/index.cfm

Section II. Basic Scientific Information

The following section provides some background information on select scientific aspects related to the surface water quality standards rule proposals.

Water quality standards define the goals for a waterbody by designating the water's uses, setting narrative or numeric criteria to protect those uses, and establishing provisions such as antidegradation policies. The Federal Water Pollution Control Act (commonly known as the Clean Water Act) regulations require that surface water quality standards must protect for the most sensitive use that a waterbody has been designated to support. The basic uses designated for all North Carolina waters require protection for, at a minimum, human health and aquatic life. Different pollutants affect these two groups in different ways. For example, aquatic organisms are often more sensitive to metals than human beings. Toxic impacts caused by metals pollution occur at much lower concentrations for aquatic life than they do for humans.

In recognition of this, the proposed water quality standards for metals evaluated in this fiscal analysis have been calculated to protect the aquatic life in fresh and saltwater. Since humans are less sensitive to these metals, any standard that is protective of aquatic life will ultimately be protective of human health. In contrast to this, the proposed standard for 2,4-D, an herbicide, is based on human health protection.

This section is meant to provide information to aid the reader in better understanding the proposed rules and the assumptions made in this fiscal analysis. See *Appendix II.1: Overview of Water Quality Standards* for an explanation of how the water quality standards are set. The following topics will be addressed in this section:

1) Proposed Water Quality Standards for Metals - Basic Science
    a. Toxicity to Aquatic Life
    b. Metals in the Water Column: Dissolved, Particulate and Total Recoverable Metals
    c. Water Hardness
2) Proposed Water Quality Standards for 2,4-D - Basic Science

Proposed Metals Water Quality Standards – Basic Science

Metals Toxicity to Aquatic Life

Metals have been found to be both acutely and chronically toxic to aquatic life. Some metals are required by organisms to maintain their health (copper, chromium, zinc) but may become toxic at higher than biologically necessary concentrations. Other metals are not biologically essential, such as cadmium, lead and mercury. Metals that bio accumulate in the tissues of aquatic animals may cause toxic impacts to humans when these animals are consumed (e.g. mercury) or may cause toxic impacts to the animal itself and its offspring (e.g. selenium). The toxic effects of a metal can vary not only by aquatic species but also by an organism's age, size, and life stage. Additionally, many external, variable factors affect the toxicity of metals. For example, a metal's toxicity can differ based on the route of an organism's exposure to the metal (from food, water column, sediment etc.), the type of metal (e.g. chromium) and its speciation in the water column (chromium III versus chromium VI) and the form of the metal (e.g. dissolved versus particulate). The physical and chemical characteristics of the water where the exposure takes place can be influential in determining a metal's toxicity to an organism, as discussed below.

Metals in the Water Column: Dissolved, Particulate and Total Recoverable Metals

Generally speaking, the two forms of a metal in the water column that are relevant to the discussion in this fiscal note are dissolved metals and particulate metals. The US EPA operationally defines dissolved metals as the metal in a water sample which passes through a 0.45 µm or a 0.40 µm filter.[9] The free metal ion, which typically corresponds with the dissolved metal portion in the water column, is considered to be the most bioavailable form of a metal to aquatic organisms and therefore is considered the more toxic form of a metal. In basic terms, particulate metals account for metals that are bound to solids in the water column and are operationally defined by the US EPA as the total recoverable metal minus the dissolved metal.[18] The term "total recoverable metals" accounts for all measurable metals, dissolved and particulate, present in a water sample.

The different forms of a metal in the water column are not stable, and metals can cycle between the dissolved and particulate fractions. Metal form (dissolved/particulate) and speciation are dependent on water chemistry characteristics. Because water chemistry characteristics are constantly changing, the toxicity and bioavailability of metals are in a state of flux. Metals are transformed in the aquatic environment from one form and/or chemical species to another due to a variety of biological and chemical processes.

Current North Carolina water quality standards for metals reflect total recoverable metal concentrations and therefore are calculated to consider the toxic impact of all measurable forms of the specified metal present in the water column. The proposed rules would change the aquatic life water quality standards for most metals to reflect only the toxic impacts of the dissolved portion of the metals present in the ecosystem. Dissolved metals are currently understood to be the most important fraction to consider when looking at the toxic impacts of metals to aquatic organisms. According to the US EPA, the particulate fraction, while not necessarily nontoxic, appears to produce substantially less toxic impacts than does the dissolved fraction.[10] The proposed rules continue to incorporate the use of total recoverable metal measurements for mercury and selenium, as these are bioaccumulative metals.

North Carolina water quality standards for metals calculated to protect human health (ex. arsenic) are not proposed for revision and will continue to be expressed as total recoverable metals concentrations. This is appropriate as human exposure to toxicity from metals would not be specific to the dissolved metal concentration but could come from all metal forms present in a waterbody.

Water Hardness

As noted above, water chemistry is important in determining the form and speciation of a metal, thereby influencing toxicity. For example, water chemistry will dictate how much of a metal present in the water column will be in the more toxic dissolved form. Besides the potential to modify metal form and speciation, water chemistry also can have other impacts on a metal's toxicity. Many water chemistry parameters have been identified as being important influences on the toxicity of metals, such as water hardness, pH, dissolved organic carbon (DOC), and alkalinity. These parameters act in different ways to influence metal toxicity. Some parameters, such as DOC, can bind with metals thereby making them unavailable to aquatic organisms. Other parameters, such as water hardness, can provide for a competitive interaction with the metal ions. Water hardness often is expressed as the concentration of the minerals calcium and

[9] United States Environmental Protection Agency Office Of Water. 1996. The Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit from a Dissolved Criterion. EPA 823-B-96-007 (4305)
[10] United States Environmental Protection Agency Office Of Water. 1996.

magnesium present in a water source; however other minerals also contribute to water hardness. The calcium and magnesium ions that contribute to water hardness are known to lower the toxicity of some metals by competing with the dissolved metal ions for binding sites on an aquatic organism. Toxic impacts to aquatic organisms occur when the metal ions bind to these sites on the organism (such as on the gills of a fish). The higher the water hardness (indicating more hardness related ions are present) the lower the toxicity of some metals. The hardness ions are able to out-compete the metal ions for binding sites on the aquatic organisms; therefore the organisms are ultimately exposed to less metal. The opposite effect occurs in low hardness water, containing fewer hardness related ions. The competitive influence of hardness is absent or limited in these low hardness waters, increasing the likelihood that the metals will bind to sites on the organism, allowing toxicity to occur. However, the extent of this hardness effect varies by metal and by metal speciation. For example, water hardness affects the toxicity of chromium III but has no influence on the toxicity of chromium VI.

Water type (fresh or salt) also affects the impact of water hardness on metal toxicity. To date, water hardness in freshwater environments has been observed to influence the toxicity of certain metals to aquatic life, but not others. Metals included in the proposed regulations whose toxicity is not impacted by water hardness (in freshwaters) are arsenic, beryllium, chromium VI and silver. Water hardness has not been found to affect the toxicity of metals to saltwater organisms in saltwater environments.

Water hardness is a commonly studied parameter during aquatic toxicity testing for metals. Hardness can be varied in toxicity tests in order to characterize the effect, if any, on the toxicity of the metal being examined in the tests. Water hardness is also assumed by the US EPA to be a good surrogate for the influence of other water chemistry parameters on toxicity. To reflect this influence, the NRWQC are represented for some metals, referred to as hardness dependent metals in this document, as equations which allow the criteria to be modified to account for differences in ambient water hardness. The North Carolina rule proposals incorporate these equations, as the water quality standards, for the hardness dependent metals. The equations will allow the ambient hardness of a water to be added into the equation in order to determine what the standard would need to be to protect aquatic life at that specific hardness concentration. Metals whose toxicity is not influenced by water hardness are still expressed as a single numeric value in the proposed rules and do not have an associated equation provided.

Although many aspects of water chemistry are known to affect the toxicity of metals, the NRWQC currently account for the impacts of hardness alone. The US EPA has developed (and North Carolina is proposing to include in regulation) a model for copper which produces a freshwater copper standard that takes into account the cumulative impacts of many relevant water chemistry parameters. This model is known as the copper Biotic Ligand Model or copper BLM. Private researchers and the US EPA are in the process of developing additional models for other metals, as well as for saltwater environments.

The measurement of the metal reflected by the standards (dissolved or total recoverable) and the use of the water hardness variable does not change the basic scientific process as described in the beginning of this section for deriving an aquatic life water quality standard. Dissolved metals water quality standards, as well as hardness dependent standards, are derived in the traditional fashion, per the US EPA 1985 criteria derivation guidelines.

In most cases, North Carolina’s proposed numeric changes to the water quality standards for metals are based on updated toxicity test data that has been added into the previous NRWQC calculations. However, the proposed use of dissolved metals water quality standards and the incorporation of an allowance for a water hardness variable will require changes to standards implementation, both for ambient measurements and regulatory purposes. The specifics of these changes, as they are applicable to individual programs, will be discussed in detail throughout the Chapters found in Section III of this fiscal analysis.

Proposed 2,4-Dichlorophenoxyacetic Acid Water Quality Standards - Basic Science[21]

2,4-D (2, 4-Dichlorophenoxyacetic acid) is a chlorophenoxy herbicide/pesticide. It is commonly used as a broadleaf herbicide (weed killer) in commercially available products. 2,4-D is generally found in mixtures of residential, agricultural, and commercial herbicides and pesticides that are applied to broadleaf weeds, wheat, corn, pastureland, lawn, turf and roadsides. [11] There are estimated to be more than1,500 pesticide and herbicide products containing 2,4-D as the main ingredient.[12]

2,4 D is currently not considered by the US EPA to be a human carcinogen. The most important study used to derive the reference dose for the proposed water quality standard indicated that blood, liver, and kidney toxicity was observed in rats when they were exposed to 2, 4-D during feeding.[13]

Chronic or acute 2,4-D exposure reported in adults has included indications of blood, liver and kidney toxicity as well as skin and eye irritation. Specifically described health effects in adults included a reduction in hemoglobin and red blood cell numbers, decreased liver enzyme activity, and increased kidney weight.[14,15] Acute exposure to very high concentrations of 2,4-D can cause clinical symptoms: stupor; coma; coughing; burning sensations in lungs; loss of muscular coordination; nausea; vomiting; or dizziness.[16, 17]

Aquatic life toxicity test data for 2,4-D suggest that chronic toxicity may occur at around the same concentration as what has been calculated for human health protection. Therefore, the proposed standard revisions would likely provide increased protection for a variety of potential designated uses in a waterbody.

[11] US EPA website (2011): http://www.epa.gov/teach/chem_summ/24D_summary.pdf)
[12] US EPA website (2011): http://www.epa.gov/teach/chem_summ/24D_summary.pdf)
[13] Integrated Risk Information System (IRIS) website, 2011 - http://www.epa.gov/iris/
[14] US Environmental Protection Agency. 2005. "Reregistration Eligibility Decision for 2,4-D." http://www.epa.gov/oppsrrd1/REDs/24d_red.pdf.
[15] US Environmental Protection Agency. 2002. "Technical Fact Sheet on 2,4-D." http://water.epa.gov/drink/contaminants/basicinformation/historical/upload/Archived-Technical-Fact-Sheet-on-2-4-D.pdf
[16] Brahmi, N., et al. 2003. "2,4-D (chlorophenoxy) herbicide poisoning." Vet.Hum.Toxicol. 45(6):321-322.
[17] US Environmental Protection Agency. 1999. "Recognition and Management of Pesticide Poisonings." http://www.epa.gov/oppfead1/safety/healthcare/handbook/handbook.htm.

Section III. Program Overview and Impacts

The intent of the proposed rule changes to 15A NCAC 02B is to protect the designated uses (or "classifications") of the state's surface waters by establishing appropriate numeric or narrative water quality standards. These regulations serve to protect waterbodies for recreation, fishing, drinking water supplies, shell fishing, and aquatic life propagation and survival. If amended, the regulations will provide a greater level of protection for aquatic life propagation and survival and will establish allowable concentrations of pollutants established to protect public health from exposure through contact recreation, fish and shellfish consumption and water consumption. The proposed rules will also allow for a more accurate assessment of the health of the state's waters and allow for a better determination of attainment of designated uses.

Adoption of these rules will require that numerous programs within the state make changes to current protocols to assure that compliance with water quality standards instream is accomplished and that water quality is enhanced or maintained. These changes may affect operations of state programs and various types of publicly or privately held permitted facilities. Section III of this fiscal analysis outlines the various programs that have been identified as potentially impacted by these proposed rule changes. Due to the complexity of identifying and defining the various programs and entities affected, the section has been broken down into four chapters:

- *Chapter A: State Agencies* – Proposed regulations for metals modify the criteria to (1) reflect the dissolved metal concentration, (2) add acute standards and (3) use a formula based equation to establish hardness dependent metals appropriate criteria. These changes necessitate modifications to instream sampling and reporting protocols and potential modifications to compliance and assessment methodologies. This chapter covers the potential budgetary impacts to the Division of Water Resources' Water Sciences Section, the Chemistry Unit, Modeling and TMDL (Total Maximum Daily Load) Unit and other State agencies' programs.

- *Chapter B: Wastewater Dischargers* – Proposed regulations for metals and 2,4-D, as well as changes to several narrative rules, will be implemented through National Pollutant Discharge Elimination System (NPDES) permits and pretreatment permits. This chapter contains information specific to possible fiscal impacts to numerous categories of NPDES wastewater permit holders including point source discharges from:
    - Publicly owned treatment works,
    - Privately owned commercial/industrial facilities,
    - Groundwater remediation facilities, and
    - Water treatment plants.

  This chapter also covers fiscal impacts to indirect point source dischargers that participate in the Pretreatment Program.

- *Chapter C: NPDES Stormwater* – Proposed regulations for metals and 2,4-D may be implemented through NPDES Stormwater permits. This chapter contains information on impacts associated with changes to benchmark values. Benchmark values are derived from water quality standards and provide a guideline for determining the potential for stormwater discharges to cause toxic impacts to the waters of the state. Changes to standards may change the frequency of sampling and/or may create the need for a facility to adopt additional stormwater pollution prevention actions. This chapter contains information specific to fiscal impacts to numerous categories of NPDES stormwater permit holders including:

- Local governments,
- Privately owned commercial/industrial facilities, and
- State agencies.

- *Chapter D: NPDES Coalition Monitoring Program* – Proposed regulations for metals modify the criteria to (1) reflect the dissolved metal concentration, (2) add acute standards and (3) use a formula based equation to establish hardness dependent metals appropriate criteria. These changes necessitate modifications to instream sampling and reporting protocols. This chapter covers potential budgetary impacts to this voluntary, discharger-led ambient monitoring program.

Chapter A. State Agencies

After evaluation of existing data, the proposed modifications for 2,4-D are not expected to impact compliance, assessment and reporting methodologies for any state agency and therefore will not be discussed further in this chapter.

The proposed rule modifications for metals necessitate modifications to sampling and reporting protocols and potential modifications to compliance and assessment methodologies used by the state to document Clean Water Act goals. Included with the metals cost analyses are the following proposed rule changes:

Modification to reflect dissolved metal concentrations;

Addition of acute standards and design flow appropriate for use with acute standards;

Use of a formula-based equation to establish hardness dependent metals appropriate standards; and

Inclusion of a provision stipulating that an instream exceedance of a numeric metal standard will not be considered to have caused an adverse stream impact if biological monitoring indicates no negative aquatic health impacts.

Potential impacts to the Division of Water Resources' Sections, the Division of Waste Management and the NC Department of Transportation will be covered in this chapter.

A1. NC Division of Water Resources (DWR)

1. Summary

Additional costs related to the proposed rules have been identified by the Water Sciences,[18] Planning, Water Quality Permitting, and Infrastructure Finance[19] Sections of the Division of Water Resources. They estimate that changes in sampling protocols and permitting could cost close to $250,000 more per year. However, because no state or federal funding is available to cover these additional costs, the Division will take actions to operate within the existing budget.

Although no additional money will be spent, there is an opportunity cost[20] to the Division and society when staff time is used on these revised protocols and permitting requirements, and when funding and equipment that would have been used for other evaluations is used for dissolved metals sampling. The tradeoff is that waterbodies may be sampled less frequently, reducing overall knowledge of water quality in the state. This may potentially affect the Division's ability to detect water quality problems when sampling sites are more restricted and staff resources are reallocated to cover permitting related activities. The Division and state will benefit from the incorporation of standards for acute impacts because this will more clearly define the acceptable condition of the waters and will provide greater clarity to submissions of

[18] Formerly the Environmental Sciences and Laboratory Sections, now combined.
[19] Now established as the Division of Water Infrastructure.
[20] Opportunity cost is the value of the next best alternative that must be forgone in order to pursue a certain action.

water quality assessment data under Sections 305(b) and 303(d) of the Clean Water Act (CWA).[21]

For a description of affected DWR programs, see *Appendix III.1: Division of Water Resources Programs*.

2. Estimated Costs to DWR

The proposed freshwater regulations in 15A NCAC 02B .0211(11)(a) and for tidal salt waters, 15A NCAC 02B .0220(9)(a), read as follows:

"With the exception of mercury and selenium, water quality standards for metals in surface waters shall be based upon measurement of the dissolved fraction of the metal. …" and

"With the exception of mercury and selenium, tidal salt water quality standards for metals shall be based upon measurement of the dissolved fraction of the metals. …"

The change from sampling for total recoverable metals to a dissolved metal requires DWR to filter the ambient water samples in the field before shipment to the Chemistry Laboratory Section. This requires additional sampling staff time and additional sampling equipment.

The proposed regulation 15A NCAC 02B .0211 (General) (11) (b) reads as follows:

> "Hardness dependent metals standards listed in Subsection (e) of this Rule are established at 25 mg/l hardness. Alternative standards shall be derived using the equations specified in Table A- Dissolved Freshwater Standards for Hardness Dependent Metals... The equations are applicable for instream hardness ranges from 25 mg/l to 400 mg/l, expressed as CaCO3 or Ca + Mg; ..."

The change in regulation to express the freshwater standards for some metals as equations dependent on water hardness will require DWR to collect a water hardness sample with each water sample for metals. A sample specific standard will be calculated using the water hardness result to compare to the water samples for metals collected at the same time.

The proposed freshwater metals regulations in 15A NCAC 02B .0211 (General) (11) (c) and proposed tidal salt water metals in 15A NCAC 02B .0220 (9) (b) both read:

> "Acute metals standards shall be evaluated using an average of two or more samples collected within one hour. Chronic metals standards shall be evaluated using averages of a minimum of four samples taken on consecutive days, or as a 96-hour average. Samples collected within a one hour time frame shall not be used to determine compliance with the chronic standard…"

North Carolina currently has chronic aquatic life water quality standards for metals. Chronic standards offer aquatic life forms protection from toxic effects resulting from long-term exposure to chemicals. Addition of standards protective of acute (or shorter term) exposure are proposed. Incorporation of standards for "acute" impacts will allow removal of the "maximum permissible level" language from the aquatic life standards (15A NCAC 02B .0211(3)(l) and 15A NCAC 02B .0220(3)(m)). The removal of the "maximum permissible level" and the addition of the "acute" standards language more clearly define the acceptable condition of the waters and will provide greater clarity to submissions of water quality assessment data under Sections 305(b) and 303(d) of the Clean Water Act (CWA).

The proposed change to include acute standards, as well as acute sampling procedures, necessitates a change in sampling protocol for ambient samples. The proposed change to

[21] US EPA. Clean Water Act Section 303. http://water.epa.gov/lawsregs/guidance/303.cfm

sampling procedures for the measurement of chronic standards also may result in additional sampling if monitoring data or other screening suggests the necessity for determining chronic compliance with water quality standards. The state cannot specifically predict how many sites will require follow-up sampling for chronic evaluations.

The proposed regulations 15A NCAC 02B .0211(11)(d) (fresh waters) and 15A NCAC 02B .0220(9)(c) (tidal salt waters) read as follows:

> "With the exception of mercury and selenium, demonstrated attainment of the applicable aquatic life use in a waterbody will take precedence over the application of the aquatic life criteria established for metals associated with these uses. An instream exceedance of the numeric criterion for metals shall not be considered to have caused an adverse impact to the instream aquatic community if biological monitoring has demonstrated attainment of biological integrity;…" and
>
> "With the exception of mercury and selenium, demonstrated attainment of the applicable aquatic life use in a waterbody will take precedence over the application of the aquatic life criteria established for metals associated with these uses. An exceedance of the numeric criterion for metals shall not be considered to have caused an adverse impact to the in situ aquatic community if biological monitoring has demonstrated attainment of biological integrity;…"

Where collected metals data indicates an exceedance of the water quality standards, DWR staff will perform a benthic macroinvertebrate examination to determine if metals concentrations are, indeed, causing detrimental effects to the aquatic life. As noted above, until data is collected, analyzed and compared to the equation-based metals standard, the state cannot specifically predict how many sites will require this follow-up biological evaluation; however, it is estimated that the average cost per sample will be approximately $580.

Pending adoption by North Carolina and approval by the US EPA of the proposed revised metals standards, the ambient sampling of metals was suspended in 2007 for the Division's AMS program and the NPDES Coalition Monitoring Program. The estimated costs of metals sampling for the Division of Water Resources were calculated for the baseline period of record which is "prior to May 2007" time periods.

<u>(a) Monitoring Costs</u>

Funding agreements between the state and the federal government enable North Carolina to monitor state waters and report findings to the US EPA. As DWR monitoring programs rely heavily on federal funds provided through CWA Section 106 and supplemental special federal grant funds, we do not anticipate that these rules will alter the ability for DWR to maintain its ambient monitoring program, chemistry laboratory operations or biological assessment programs. With the noted potential cost increases for a sampled site, and no identified increase in state or federal funding, the DWR will make adjustments to the number of sampling sites (Monitoring Coalition, AMS, biological assessment) to accommodate both the federal fiscal year allocations and state cutbacks. Additional adjustments will be made pending finalization of revised standards and the decisions with respect to addition or deletion of sampling sites will be based on environmentally driven priority needs as assessed per US EPA guidelines.

In summary: while additional sampling, analysis and assessment costs are associated with the proposed changes to the water quality standards, the DWR will adjust by reducing or modifying sampling events, as necessary, to accommodate any change in costs; therefore, no financial impact is expected.

The following discussion estimates potential costs for full implementation of metals monitoring, including special studies to verify impairments. Table III.A-1 shows current costs to the various monitoring programs with the Division are about $236,000. Information on sampling prior to 2007 were used for calculating the AMS costs as no metals sampling has been conducted as part of the AMS sampling since then.

Table III.A-1
Current Annual Costs for Metals Sampling Estimated by DWR Monitoring Programs

	AMS	Special Studies 2010 to date	Special Studies Hardness	Biological Assessments
Number of Sites	324	10	175	71
Visits Per Site	4	4	1	1
Number of Samples	1,296	40	175	71
Man hours	108	16	175	1,118
Field Labor Cost	$3,392	$503	$0	$38,012
Field Supply & Equip. Cost	$0	$2,072	$0	$3,230
Chemistry Lab Costs	$167,832	$18,091	$2,770	$0*
TOTAL COST	**$171,224**	**$20,665**	**$2,770**	**$41,242**
Avg. Additional Cost per Sample	**$132**	**$517**	**$16**	**$581**

* Lab analysis included in Labor cost.

Methods and Assumptions

Costs to DWR programs were based upon the following assumptions:

1. AMS field sample collection:
   - Costs for regular WSS AMS sampling (personnel, travel and supplies) are not included since these costs would be incurred regardless of whether the standards change or not. Only additional requirements related to adding the metals sampling are included.
   - Number of sites sampled: 324
     - Each site is sampled quarterly.
     - All locations sampled for: Aluminum (Al), Arsenic (As), Cadmium (Cd), Total Chromium (Cr), Copper (Cu), Iron (Fe), Mercury (Hg by Method 245.1), Nickel (Ni), Lead (Pb) and Zinc (Zn).
     - 70 locations are water supplies where Manganese (Mn) will be sampled in addition to the other ten metals.
   - Field Labor Costs:
     - $31.4/hr is based on the mid-point annual salary range of an Environmental Senior Technician; Pay Grade 67- $43,904. This salary ($43,904) was adjusted upwards to $65,327 which accounts for benefits, etc., using the NC Office of State Human Resources Employee Compensation Calculator.[22]
     - AMS sampling time: 5 minutes (0.08 hour) per station, at a cost of about $2.5 (based on compensation of $31.4/hr)

[22] NC Office of State Human Resources, Compensation. Employee Total Compensation Calculator. Accessed on May 14, 2014. http://www.osp.state.nc.us/Reward/benefits/Compensation%20Calculator.htm

- Field Supply and Equipment costs: no additional materials or equipment would be required for metal and hardness sampling.
- Chemistry Lab Costs:
    - The lab will be able to handle the workload associated with AMS sampling without additional personnel or equipment. The opportunity cost of lab labor is $129.5 in 2011 dollars (this cost has not been inflated since it has remained mostly constant over the years) , which is a weighted average of costs for analyzing samples from waterbodies that are or are not water supplies:
        - For waterbodies that are not a water supply, ten metals are analyzed at a cost of $12.70/metal (this is averaged from Lab price list for 2011), or total of $127.
        - For waterbodies that are a water supply, 11 metals are analyzed at a total cost of $140 (11 x $12.7).
        - $15.83/result for hardness (if taken).
- Average additional cost per sample for AMS (without additional cost of hardness analysis) is $132 ($2.5 in labor costs + $129.5 on average in lab costs).

2. <u>Follow up monitoring for use assessment or Investigations including hardness:</u>
   DWR has performed a limited number of monitoring site investigations based on requests from the US EPA to follow-up on sites previously identified as having the potentially of not meeting the existing water quality standards.

- Number of sites sampled: 10 sites
    - Each sampled quarterly.
    - Additionally, 175 of the 324 AMS sites are generally sampled once per year for hardness only.
- Samples taken at the 10 selected sites include:
    - Dissolved metals: As, Be, Cd, Cr, Cu, Mn, Ni, Pb, Zn
        - Total recoverable metals are NOT collected
        - Two samples taken for acute toxicity assessment
        - Hardness is taken at every site
    - Quality Assurance (QA) Two samples
        - Equipment blank – Filter 1 for first sample
        - Equipment blank – Filter 2 for second sample
- Field Labor Costs:
    - 24 minutes (0.4 hours) to sample a site at a cost of $12.6, based on an hourly compensation rate of $31.4/hr (same as AMS calculation)
- Field Supplies and Equipment Costs: special studies or investigations, exclusive or hardness would additionally require two metal filter per sample, each costing $25.90, for a per sample total of $51.80.
- Chemistry Lab Costs:
    - Special Study costs: $12.6/result for 36 metals results per sample, or $452, for a total cost of $18, 091

    - Hardness sampling: $15.83 each for 175 samples per year, for a total of $2,770

  - Average additional cost per sample for Special Studies and Investigations, excluding hardness studies, is about $517 (=12.6+51.80+452)
  - Total cost of Special Studies, including Hardness, is about $23,400 per year (= 20,665 + 2,770).

3. Costs for Biological Assessment:
  - Number of sites: 71, sampled once per year.
  - Field Labor (Biological Sample Collection):
    - Costs provide for: three person crew, full-scale sample, completed lab identification, data entry, metrics, and bioclassification
    - Based on $33.85/hr, which was derived from the average annual salary range of Water Sciences Section staff and includes the fringe benefits for insurance, social security, etc. as stipulated in the NC Office of State Personnel Compensation
    - Sampling time per site: less than 5 ¼ hours per person, for a site cost of about $530, or total of $37,641
  - Field Supply and Equipment (wear and tear on equipment: waders, nets, water quality meters; lab costs: chemical supplies, mounting media for midges, slides, etc.): $ 3,230/ 71 site visits = ~$45.5/site
  - Costs for a single sampling event: $580/site

(b) Implementation Costs

The Water Permitting Section currently issues NPDES permits: NPDES staff evaluates and establishes permit requirements for metals as needed under existing operating procedures and using existing permitting tools. The proposed rules will require that different numeric standards for surface water are used when assessing the need for metals limits and monitoring requirements. NPDES and other DWR staff currently provide technical assistance regarding permit requirements to permittees. Staff time spent providing technical assistance specific to the proposed rule changes is expected to be minimal and will be integrated in to existing workload.

The Construction Grants and Loan Section, at the Division of Water Infrastructure currently reviews design documents and, upon approval, issues Authorization to Construct (ATC) permits for the construction or substantial modification of treatment plants or their component units.

The following discussion provides potential costs for full implementation of metals (including proposed design flow) in NPDES and ATC permits. The Division estimates $54,518 in opportunity costs to implement the proposed rule changes in the first year following the effective date of the rules and $7,269 per year in opportunity costs for the next five years. These estimates are based on workload experience of the Division and assume that no new staff is necessary.

Methods and Assumptions

Opportunity cost (Year 0) = [0.3 + 0.1 + 0.2] FTEs x $90,864 = $54,518 in first year

Opportunity cost (Yrs 1-5) = [0.05 + 0.03] FTEs x $90,864 = $7,269/yr

where:

- 0.3 FTE in central office and 0.1 FTE in regional offices for preparation of internal training
- 0.2 FTE for training on new standards
- 0.05 FTE/yr for rules implementation NPDES, Years 1-5
- 0.03 FTE/yr for ATC permits, Years 1-5
- Salary = $90,864/yr average (includes benefits) – Engineer at Journeyman level 1 year experience

Total opportunity costs for DWR of close to $250,000 were determined by adding the yearly costs for WSS ($236,000) to the annual costs for implementation by Water Sciences Section ($7,300). Note the agency would incur a one-time implementation cost of more than $54,500 in year 2016.

A2. NC Division of Waste Management (DWM)

NC Division of Waste Management (DWM) conducts monitoring and cleanup programs on private sites containing constituents for which revised surface water standards are proposed. The Division was contacted for information about the sites they monitor and regulate. The DWM estimates that fewer than 13 facilities will be impacted by the proposed rule changes. See the analysis of wastewater dischargers, Section III.B, for more information on facilities covered under the DWM programs.

A3. NC Department of Transportation (NC DOT)

The NC Department of Transportation (NC DOT) identified a potential for an increased number of waterbodies to be identified as impaired and listed in Category 5 of the state's 303(d) list due to potentially elevated metals concentrations. They went on to indicate that, over time, these potential listings could increase the number of TMDLs the NC DOT would need to comply with under its statewide NPDES stormwater permit. The DWR is not currently developing any TMDLs for metals, although it may in the future should the need arise. As noted in the NPDES stormwater chapter (Section III.C), no direct costs are currently expected and no costs to NC DOT are quantified at this time.

Chapter B. Wastewater Dischargers

Surface water quality standards provide objective measures of pollutant concentrations and other surface water characteristics necessary to protect aquatic life and human health.[23] NPDES wastewater permits set effluent limitations calculated to ensure that these standards are met in the receiving stream or water.

Changes in the standards can lead to corresponding changes in water quality-based limitations and other permit requirements. Changes in permit limits may, in turn, increase (or reduce) treatment costs. The Division has evaluated the potential regulatory and economic impacts of the proposed rule changes on wastewater dischargers.

This chapter presents the Division's methods and findings and is divided into the following subchapters:

- Summary of Findings: Projected economic impacts to wastewater dischargers;
- Background: Provides general information on the programs that govern wastewater discharges and briefly describes aspects of the programs that pertain to all of the proposed water quality standards;
- Impacts - Metals Standards: Examines the potential impacts of the proposed surface water standards for metals in fresh and salt waters, found in Rules 15A NCAC 02B .0211 and .0220, respectively; and the associated flow requirements in Rule 15A NCAC 02B .0206; and
- Impacts - 2,4-D Standards: Considers the potential impacts of the proposed surface water standard for the herbicide 2,4-D, found in Rules 15A NCAC 02B .0212, .0214, .0215, .0216, and .0218.

The metals and 2,4-D subchapters describe the types of dischargers affected by the proposed standards, the nature of the anticipated impacts, assumptions and methodologies used in evaluating potential impacts, estimates of costs and savings, and uncertainties inherent in the evaluations and estimates.

Appendices III.1 through III.11 provide additional information, more detailed explanations, and links to supporting calculations.

NOTE: Scope of Fiscal Analysis

On November 19, 2013, subsequent to this fiscal analysis, the Division of Water Resources held a public hearing to gather input regarding the need for future revisions to the state's surface water quality standards. As a result of comments received, the Division now proposes to delete the existing standards for manganese (Mn) as part of the subject rulemaking. Deletion of the Mn standards is expected to result in very minor savings in monitoring costs to the few facilities affected. Therefore, the fiscal analysis and this wastewater chapter have not been modified to reflect the added change or its impacts.

[23] The proposed rule changes affect only standards established for the protection of aquatic life.

B1. Summary of Findings

The Division estimates that the proposed rule changes will have a total economic impact of $182 million on wastewater dischargers in the first thirty years of the rules' implementation (Net Present Value-NPV, 2014 dollars). Of this total, 60% ($110 million NPV) would occur in the first ten years of implementation as treatment improvements and other necessary steps are taken.

The economic impacts are calculated as costs *plus* savings. However, potential savings are trivial (< $25,000 in 2014$) and so are not identified separately in the summary tables in this chapter.

Table III.B-1 below summarizes the Division's estimates for the wastewater dischargers. The table lists the real impacts (i.e., not adjusted for inflation) for the first ten years of implementation, split according to ownership of the affected facilities: private, municipal, state, and federal. The table provides 10-year totals for Years 1-10, 11-20, and 21-30 and the net present values (NPVs, in 2014 dollars) of the 10-, 20-, and 30-year estimates. The net present values are derived from the real costs assuming an average inflation rate of 2% per annum and then applying a discount rate of 7% per annum as required by North Carolina statute.[24]

The estimates indicate that local governments would be the most impacted subset of dischargers, with 84% of the estimated costs and savings. Private entities, including industrial, commercial, and privately-owned 100% domestic facilities, follow with 15% of the total estimated impacts. Impacts to state and federal dischargers together account for only 0.2% of the total estimated costs and savings.

The Division sought a conservatively high estimate of impacts. Due to the inherent uncertainties and, in some cases, a lack of sufficient information, it was not possible to identify all permit impacts nor to estimate the resulting economic impacts. Instead, the Division considered a possible range of impacts and concluded that the impacts could vary from as low as $94 million to as high as $285 million NPV over the first thirty years. Table III.B-1 and this chapter as a whole address the mid-range estimates.

These estimates consist entirely of the potential impacts of the proposed metals standards. The proposed standard for the herbicide 2,4-D is not expected to impact wastewater facilities, because the herbicide has not been found to be a pollutant of concern in wastewaters in North Carolina.

[24] NCGS § 150B-2(8c) [SL2011-398] and 150B-21.4(b1) [SL2011-13], regarding cost estimates for fiscal notes.

Table III.B-1
Summary of Estimated Economic Impacts of Proposed Rule Changes (in $Millions)
Wastewater Discharges – All Permitted Facilities[1,2,3,4]

	Private				Local Government				State Government				Federal Government				All
Year	**Planning**	**Capital**	**O&M**	**Total**	**Planning**	**Capital**	**O&M**	**Total**	**Planning**	**Capital**	**O&M**	**Total**	**Planning**	**Capital**	**O&M**	**Total**	**Total**
2017	$ -	$0.02	$0.02	$0.03	$ -	$0.05	$0.10	$0.15	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$0.2
2018	$0.01	$0.43	$0.71	$1.15	$0.47	$0.61	$0.21	$1.29	$ -	$0.01	$0.02	$0.02	$ -	$ -	$0.01	$0.01	$2.5
2019	$ -	$0.96	$0.89	$1.85	$0.35	$3.64	$1.56	$5.54	$ -	$ -	$0.02	$0.02	$ -	$ -	$0.01	$0.01	$7.4
2020	$0.01	$5.95	$1.24	$7.20	$0.29	$51.05	$4.65	$55.99	$ -	$ -	$0.02	$0.02	$ -	$ -	$0.01	$0.01	$63.2
2021	$ -	$0.88	$1.42	$2.30	$0.43	$1.74	$5.39	$7.55	$ -	$ -	$0.02	$0.02	$ -	$ -	$0.01	$0.01	$9.9
2022	$ -	$0.10	$1.43	$1.53	$0.36	$11.72	$6.94	$19.01	$ -	$ -	$0.02	$0.02	$ -	$ -	$0.01	$0.01	$20.6
2023	$0.01	$2.51	$1.67	$4.18	$0.02	$2.94	$8.08	$11.04	$ -	$ -	$0.02	$0.02	$ -	$ -	$0.01	$0.01	$15.3
2024	$ -	$ -	$1.67	$1.67	$0.01	$8.58	$8.49	$17.08	$ -	$ -	$0.02	$0.02	$ -	$ -	$0.01	$0.01	$18.8
2025	$ -	$ -	$1.67	$1.67	$ -	$ -	$8.49	$8.49	$ -	$ -	$0.02	$0.02	$ -	$ -	$0.01	$0.01	$10.2
2026	$ -	$ -	$1.67	$1.67	$ -	$ -	$8.49	$8.49	$ -	$ -	$0.02	$0.02	$ -	$ -	$0.01	$0.01	$10.2
Cost projections are inherently uncertain, those beyond 10 years even more so. Estimates for Years 11-30 are provided only for general comparison with the benefits estimates presented elsewhere in this document.																	
Yrs 1-10	$0.0	$10.8	$12.4	$23.3	$1.9	$80.3	$52.4	$134.6	$ -	$0.01	$0.2	$0.2	$ -	$ -	$0.1	$0.1	$158.1
Yrs 11-20	$ -	$ -	$16.7	$16.7	$ -	$ -	$84.9	$84.9	$ -	$ -	$0.2	$0.2	$ -	$ -	$0.1	$0.1	$101.8
Yrs 21-30	$ -	$ -	$16.7	$16.7	$ -	$ -	$84.9	$84.9	$ -	$ -	$0.2	$0.2	$ -	$ -	$0.1	$0.1	$101.8
Yrs 1-30	$0.0	$10.8	$45.7	$56.6	$1.9	$80.3	$222.1	$304.4	$ -	$0.01	$0.5	$0.5	$ -	$0.003	$0.2	$0.2	$361.7
NPV, 10 Yrs	$0.0	$7.9	$8.3	$16.2	$1.5	$58.2	$33.9	$93.5	$ -	$0.01	$0.10	$0.11	$ -	$ -	$0.1	$0.1	$109.9
NPV, 20 Yrs	$0.0	$7.9	$15.6	$23.5	$1.5	$58.2	$70.9	$130.6	$ -	$0.01	$0.17	$0.18	$ -	$0.003	$0.1	$0.1	$154.3
NPV, 30 Yrs	$0.0	$7.9	$20.1	$28.0	$1.5	$58.2	$93.9	$153.5	$ -	$0.01	$0.22	$0.22	$ -	$0.003	$0.1	$0.1	$181.9

Footnotes:

1 Economic impacts are the gross sum of estimated costs plus savings. Savings account for less than 0.1% of the total impacts and are not reported separately in this document.

2 Annual impacts presented in this table are not adjusted for inflation.

3 Net Present Values (NPVs) are 2014$, calculated using a discount rate of 7% after annual impacts were adjusted using an annual inflation of 2%.

4 These figures comprise the estimated impacts of the revised metals standards only. The Division does not expect that wastewater dischargers will be impacted by the proposed 2,4-D standard cannot be determined with reasonable certainty at this time.

B2. Background: NPDES Permit and Pretreatment Programs

The Clean Water Act (CWA, or "the Act") and North Carolina General Statutes (NCGS) prohibit the discharge of pollutants to surface waters of the state without a permit.[25] The 1972 Act established the National Pollutant Discharge Elimination System (NPDES) permits program to regulate such discharges. The Division of Water Resources[26] has administered the program for North Carolina permits since 1975 under formal agreement with the U.S. Environmental Protection Agency (US EPA, or EPA). The Division also issues Authorizations to Construct and Sewer Permits and administers the Tax Certification process under state statutory authorities.

The federal and state statutes also require Publicly Owned Treatment Works (POTWs) that accept wastewater from significant industrial users and discharge to surface waters to develop and administer local pretreatment programs. The aim of the local programs is to regulate significant sources of non-domestic wastewaters in order to protect the treatment works and its receiving stream; specifically, to prevent (1) interference with the POTWs' operation and performance, (2) the indirect discharge, or "pass-through," of pollutants in amounts harmful to surface waters, and (3) excessive contamination of the POTW's biosolids. The Division approves and oversees these local programs and has administered the state pretreatment program since 1982, also through formal agreement with the EPA.

Thus, the Division of Water Resources regulates 'direct dischargers' through the NPDES wastewater and ATC permits programs, and local governments regulate 'indirect dischargers' through their pretreatment programs with oversight from the Division's state pretreatment program. These programs are administered by the Wastewater Branch of the Division's Water Quality Permitting Section.[27]

1. NPDES Wastewater Permits Program

The Division of Water Resources administers two types of NPDES wastewater permits for direct dischargers to surface waters: individual permits and general permits. Both types of permit authorize the discharge of wastewater in accordance with the terms and conditions specified in the permit.

An *individual permit* governs a single facility and is tailored specifically to that facility and the particular characteristics of its discharge and its receiving stream. As of July 1, 2011, the Division administered 1,250 individual NPDES wastewater permits.[28] Permits are categorized according to the type or source of wastewater:

- <u>Municipal</u> facilities are publicly owned treatment works (POTWs) that treat domestic sewage, commercial wastes, and any process wastewaters from its industrial users.
- <u>100% Domestic</u> facilities include private and public facilities that treat less than 1.0 million gallons per day (MGD) of domestic wastes, such as residential developments, schools, churches, and similar small facilities.

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[25] 33 USC 1342 (FWPCA §402)), NCGS 143-215.1. Certain minor discharges are deemed permitted, provided that they do not cause a violation of water quality standards.

[26] Previously known as the Division of Environmental Management and, from 1996-2013, Division of Water Quality.

[27] Formerly, the Point Source Branch and the Surface Water Protection Section, respectively.

[28] Source: Basinwide Information Management System (BIMS), 7/1/2011. The Division has also issued one group permit to the Neuse River Compliance Association in accordance with the Neuse River Nutrient Management Strategy. The permit is not affected by the proposed rule changes.

- Industrial facilities include those that treat process and ancillary wastewaters from industrial and commercial establishments or greater than 1.0 MGD of domestic wastes.
- Groundwater Remediation facilities treat contaminated groundwater as part of a site cleanup project.
- Water Treatment Plants are publicly or privately owned facilities that produce waters suitable for domestic consumption or industrial use and, in doing so, generate sidestreams such as filter backwash, regeneration waters, or reject waters that often require additional treatment.

A *general permit* governs a class of facilities and includes standardized requirements and conditions that generally apply statewide. Facilities seeking coverage under a general permit must satisfy certain criteria to qualify for a Certificate of Coverage (certificate, or COC); otherwise, they must apply for and obtain an individual permit prior to discharging. As of July 1, 2011, the Division also administered five general NPDES permits governing 1,668 minor wastewater discharges.[29] The general permits establish requirements for discharges of Cooling & Ancillary Waters & Hydropower, Groundwater Remediation (Petroleum), Sand Dredging, Fish/ Seafood Packing & Rinsing & Fish Farms, and Single-Family Residences.

Individual and general permits (but not the each individual certificate of coverage issued to dischargers under those general permits) must be made available for public and agency review prior to issuance and are subject to change in response to comments received.[30]

(a) Standard Permit Requirements

NPDES wastewater permits must include any effluent limitations, monitoring requirements, and other terms and conditions necessary to satisfy state and federal requirements. Effluent limits and monitoring requirements are described below. (The Glossary at the beginning of the document defines some common permitting terms used here.)

Effluent Limitations: Federal and state NPDES regulations require that wastewater discharges (1) satisfy any applicable treatment system performance standards and (2) protect against potential instream exceedance of surface water standards. Thus, effluent limitations are generally one of two types:

i. *Technology-based effluent limitations (TBELs)* are limitations that satisfy treatment performance standards. Most TBELs are based on the US EPA's Effluent Guidelines for industrial facilities (40 CFR Parts 405-471) or secondary treatment standards for municipal facilities (40 CFR Part 133).[31] Technology-based requirements for metals are found in the Effluent Guidelines and so apply only to industrial facilities. Neither federal nor North Carolina regulations establish TBELs for metals in municipal discharges or for 2,4-D in any category of discharge.

   Wastewater characteristics vary widely from one type of facility to the next. Amenability to treatment and the cost of treatment vary widely as well. The EPA takes costs into account when setting treatment performance standards, weighing the economic impacts of greater treatment against the environmental impacts of lesser treatment.

[29] Source: Basinwide Information Management System (BIMS), 11/1/2011.
[30] Federal: 40 CFR 124.10-.12; state: 15A NCAC 02H .0109-.0111.
[31] CFR: Code of Federal Regulations. Effluent Guidelines are available online at http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?tpl=/ecfrbrowse/Title40/40tab_02.tpl

ii. *Water quality-based effluent limitations (WQBELs)* are effluent limitations calculated to satisfy surface water quality standards. Most WQBELs for metals and other toxicants are calculated specifically for the individual facility based largely on its effluent characteristics and the flow and chemical characteristics of its receiving stream. Consistent with the Clean Water Act, economic impacts are not a factor in deciding whether to set water quality-based permit limits: the purpose of the water quality standards and, in turn, any limits derived from them is to establish maximum allowable pollutant concentrations necessary to fully protect aquatic and human life. Economic impacts may, however, influence the time allowed for dischargers to comply with those limits.

    In the event that the state has adopted more than one standard for a parameter (for example, aquatic life and human health standards), the more stringent of the calculated limitations is the controlling water quality-based limit. Likewise, if the discharge is subject to both technology-based and water quality-based limits for the same parameter, the more stringent limit applies and is used in the permit.

Monitoring Requirements: Wastewater permits require discharges to monitor the quantity and quality of their discharges and to report the results to the Division on a regular basis. North Carolina's 15A NCAC 02B .0500 rules specify standard monitoring parameters and frequencies for various types of dischargers and allow the Division Director flexibility to modify these requirements.

Permits specify sampling locations, the parameters to be monitored at each location, the type of sample (grab or composite), and the sampling frequency. Sampling frequency depends on the nature, significance, and variability of the parameter and ranges from 5 samples/week (key parameter, large treatment facility) to 1 sample/year (very minor facility, minor parameter). Dischargers submit Discharge Monitoring Reports (DMRs) to the Division on a monthly basis (quarterly for very minor facilities). The Division reviews the DMRs to gauge each discharger's compliance with its effluent limitations.

(b) Statewide Permitting Schedule

Permits are issued for a maximum of five years per state and federal requirements. The Division has synchronized permit renewals by river basin in accordance with its basin-wide approach to water quality management.[32] Table III.B-2 shows the permitting schedule for the 5-year cycle beginning in 2016.

[32] For more information on the basin-wide approach to water quality management, see http://portal.ncdenr.org/web/wq/ps/bpu/about.

Table III.B-2
NPDES Wastewater Permits Renewal Schedule by River Basin

Year	River Basins	Permits
2016	Cape Fear	239
2017	Roanoke, White Oak, Savannah, Hiwassee, Watauga, Little Tennessee, Chowan, Pasquotank, Neuse	277
2018	Neuse, Broad, Yadkin	244
2019	Yadkin, Lumber, Tar-Pamlico, Catawba	245
2020	Catawba, French Broad	245
2021	*Cape Fear (2021 cycle)*	
	Total	1,250

The basin-wide approach allows for the consistent implementation of basin-wide or watershed-wide permitting strategies. In general, when a new strategy is developed, the Division begins implementing it at the next round of permit renewals in the affected river basin. All dischargers in a basin subject to the strategy then receive new permit requirements and compliance schedule at about the same time.

In similar fashion, when state-wide rules or permitting strategies are adopted or revised, including revisions to the water quality standards (upon final approval of the standards by the EPA), the Division begins implementing the changes in the next river basin on the schedule. It then takes a full five years to revise affected permits in all 17 river basins. Actions taken by the dischargers to comply with the new requirements generally follow in the same order; that is, beginning with those whose permits were modified first.

2. Pretreatment Programs

Federal and state law prohibits industrial facilities from discharging wastes to a Publicly Owned Treatment Works (POTW) if those wastes would interfere with the proper operation and performance of the POTW, pass through the POTW and impact surface waters, or contaminate the POTW’s waste residuals (also referred to as waste sludge or biosolids). POTWs that receive specific types or amounts of industrial wastewaters are required to develop and administer a pretreatment program to regulate these wastewaters, subject to Division approval and oversight.

As of July 1, 2011, the Division of Water Resources oversaw 110 pretreatment programs administered by local governments in North Carolina for their 127 POTWs. The programs regulate approximately 670 Significant Industrial Users (SIUs) and other non-domestic wastewater sources, commonly known as ‘indirect dischargers’.

Pretreatment programs generally regulate their industrial users through the adoption of sewer use ordinances and issuance of local discharge permits. In doing so, the municipalities apply:

- ‘prohibited discharge’ standards established in federal regulations (40 CFR 403.5) and in their local sewer use ordinances (subject to review and approval of the Division);
- categorical pretreatment standards, which are similar to the federal Effluent Guidelines but apply specifically to indirect dischargers; and
- local permit limits, calculated to prevent interference, pass-through, and sludge contamination.

Local permits are similar in nature to NPDES wastewater permits in that they establish effluent limitations, monitoring and reporting requirements, and other terms and conditions for the discharges. Like NPDES permits, they are issued for a period of up to five years. Categorical pretreatment standards provide a basis for technology-based limits. Local limits that are calculated to prevent pass-through of pollutants are analogous to water quality-based limits in the POTW's permit except that they are concerned with surface water standards only indirectly.

Municipalities with pretreatment programs are responsible for monitoring and enforcing their SIUs' compliance with the terms and conditions of their local permits. The Division provides technical assistance to the local programs and monitors their performance.

3. 'Authorization to Construct' Permits Program

Direct dischargers are required under state law to obtain an Authorization to Construct (ATC) permit prior to constructing or substantially modifying treatment plants or their component units. As of August 2013, ATC permits are administered by the Wastewater Branch in the Division's Water Quality Permitting Section.

In 2011, the NC General Assembly exempted industrial facilities from ATC requirements (S.L. 2011-394).

B3. Evaluation of Impacts: Metals Standards (15A NCAC 02B .0211 & .0220) and Design Flows (02B .0206)

Metals are commonly found in many wastewaters, typically in low concentrations. However, some metals can have adverse effects on aquatic life and human health even at low concentrations and are of concern when found in wastewaters. Significant sources of metals include commercial and industrial processes (raw materials, intermediate and final product, process and manufacturing equipment), potable water systems (bulk chemicals or contaminants in those chemicals, leaching of distribution lines), other distribution and collection systems (leakage, leaching), and wastewater treatment processes themselves (bulk chemicals or contaminants in those chemicals).

The proposed rule changes would revise the majority of North Carolina's surface water quality standards for metals. The affected metals are arsenic (As), beryllium (Be), cadmium (Cd), chromium (Total Chromium, Cr-III, Cr-VI), iron (Fe), copper (Cu), lead (Pb), nickel (Ni), silver (Ag), and zinc (Zn).[33] The proposed revisions affect chronic and acute standards for aquatic life in freshwater and in saltwater; existing human health standards for metals are unchanged and remain in full effect.

Preceding chapters describe the proposed standards revisions in detail. For the purposes of this subchapter, the essential changes are as follows:

1) Delete chronic surface water quality standards for iron and total chromium;
2) Revise existing metals standards to reflect changes in the underlying scientific data;
3) Adopt new chronic salt- and freshwater standards for chromium VI and chromium III;
4) Express the *freshwater* standards of the affected metals as a function of water hardness where appropriate;

[33] In a recent development, the Division modified the proposed rules package to delete existing standards for Manganese (Mn). The impacts of this change are minimal, and this chapter has not been modified to include them.

5) Express the affected metals' standards as the dissolved rather than the total recoverable metal; and
6) Adopt acute standards for most of the affected metals and codify the use of 1Q10 stream flows with those standards.[34]

Numeric surface water standards are the primary basis for setting water quality-based effluent limitations for metals in wastewater permits. Changes to the standards can have a significant, if indirect, effect on wastewater dischargers. They can lead to changes in effluent limitations and monitoring requirements that can, in turn, make it necessary for dischargers to make capital improvements, operational modifications, or other measures to stay in compliance with their permits.

The nature and extent of the impacts on a particular discharge depend on multiple factors – the type of wastewater, characteristics of the discharge, characteristics of the receiving water, and others – and must be determined on a case-by-case basis. The measures required to meet any new effluent limitations – and the economic impacts of those measures – are, in turn, specific to each affected discharger.

1. Regulated Parties – Metals

For the purposes of this subchapter, Wastewater Dischargers are those public and private facilities that receive wastewaters containing any of the affected metals, discharge directly or indirectly into the state's surface waters, and are subject to requirements of the National Pollutant Discharge Elimination System (NPDES) permit or pretreatment programs.

The tables below show a distribution by type of the 2,918 currently permitted facilities (1,250 with individual permits and 1,668 COCs). Table III.B-3 lists the numbers of individual permits and the total permitted flow in each of the five wastewater categories.

Table III.B-3
Individual NPDES Wastewater Permits (7/1/2011)

Wastewater Permit Category	Permits	Total Permitted Flow (MGD)[1,2]
Municipal WWTP[3] (POTWs)	292	1,332
100% Domestic < 1 MGD WWTP	474	30
Commercial & Industrial WWTP	225	379
Groundwater Remediation	38	3.1
Water Treatment Plants (WTP)	221	168
Total	1,250	1,913

[1] MGD = Million gallons per day
[2] Of the current permits, 233 (including 114 Industrial and 113 WTP) do not include flow limitations, because the wastewaters do not contain oxygen-consuming wastes. Difference in sum due to rounding of category totals.
[3] WWTP stands for Wastewater Treatment Plant.

Table III.B-4 shows the numbers of Certificates issued for each of the wastewater general permits.

[34] 1Q10 is defined as the lowest 1-day average flow that occurs (on average) once every 10 years

Table III.B-4
Certificates of Coverage (COC) Under NPDES Wastewater General Permits (7/5/2011)

Wastewater Permit Category	Permit	COCs
Cooling & Ancillary Waters; Hydropower	NCG50	182
Groundwater Remediation (Petroleum)	NCG51	86
Sand Dredging	NCG52	51
Fish/ Seafood Packing & Rinsing; Fish Farms	NCG53	82
Single-Family Residences	NCG55	1,267
Total		1,668

2. Baseline – Metals

The Division's NPDES permitting program must routinely evaluate whether discharge limits and other permit requirements are necessary to satisfy applicable water quality standards in the state's surface waters. Similarly, municipalities with local pretreatment programs must evaluate whether, in addition to plant improvements and other measures, it is necessary to set limits on their significant industrial users in order for the POTWs to comply with their metals (and other) limitations.

The following paragraphs briefly describe how surface water standards are used in calculating WQBELs in NPDES permits and how local pretreatment programs then use those limits to derive local requirements for industrial users. *Appendix III.3: Wastewater Dischargers – Determination of Permit Requirements for Metals* provides a more detailed description of the existing process used.

(a) Existing Regulatory Framework – NPDES Wastewater Permits

At permit issuance and at each permit renewal thereafter, the Division determines what limitations, monitoring, and other requirements are warranted for each parameter of concern. The basic steps in setting requirements, including those for metals, are to:

- Identify pollutants of concern and assemble available monitoring data for those parameters.
- Calculate technology-based effluent limitations (TBELs) based on applicable performance standards;
- Calculate water quality-based effluent limitations (WQBELs) based on a Reasonable Potential Analysis (RPA) of each metal of concern in order to ensure protection of applicable surface water standards in the receiving waters;
- Apply the more stringent limit for each metal; and
- Specify monitoring requirements for each metal of concern, whether or not limited.

1. Wastewater Individual Permits

The proposed revisions to surface water standards affect water quality-based limitations only. Thus, the focus of this chapter is on impacts to those potential limitations and related monitoring requirements.

a. Water Quality-Based Effluent Limitations (WQBELs):

Freshwater Dischargers: Water quality-based requirements in wastewater permits are, by their nature, specific to each discharge and its receiving stream. The Division performs separate Reasonable Potential Analyses (RPAs) for each permit and each parameter of concern to determine appropriate requirements.

RPAs are conducted at each permit renewal, using the then-current characteristics of the discharger's effluent and the receiving stream. The RPA calculations are repeated for each metal of concern and each applicable standard (acute and chronic aquatic life, human health-water supply, human health-fish ingestion, trout), and a separate reasonable potential determination is made in each case.

Each RPA consists of calculating the *maximum predicted effluent concentration* (MPEC)[35] for the metal of concern, based on actual effluent data from the facility, and also the *maximum allowable effluent concentration* (MAEC),[36] based on the surface water standard and the dilution available in the stream under low-flow conditions – Instream Wastewater Concentration, IWC. If the MPEC exceeds MAEC, the discharge is said to exhibit 'reasonable potential' to cause an exceedance of the standard in the stream, and an effluent limitation equal to the MAEC is included in the permit.Each RPA can indicate that a limit is warranted (in which case, limit = MAEC), that a limit is not warranted but the metal is present in significant concentrations (no limit, but monitoring is advised), or that no limit or monitoring is necessary (no metals requirements in permit). If a discharge is subject to both technology-based limitations and one or more water quality-based limitations for the same metal, the most stringent limitation is included in the facility's NPDES permit.

Effluent limitations based on chronic standards (long-term impacts) are set as monthly average limits in the permit. Those based on acute standards and criteria (short-term impacts) are generally set as weekly average limits for publicly owned facilities and as daily maximum limits for private facilities.

The NPDES program uses the same RPA methodology with all wastewater permits. The methodology has been approved by the US EPA as being consistent with its national guidance.[37]

Saltwater Discharges: Reasonable Potential Analyses are performed in the same way for discharges to freshwater and saltwater. The resulting permit limits often differ, however, because (1) metals exhibit different degrees of toxicity upon species native to the two environments and (2) IWC is determined differently in free running streams and tidal waters. By default, the Division assumes an IWC of 100% (zero dilution) in tidal

[35] The MPEC is determined from the most recent, representative effluent data for the discharge. The number of samples, the average value, and the variability of the data are used to predict the maximum effluent concentration from the facility.

[36] The MAEC is calculated using the applicable surface water standards and the facility's Instream Wastewater Concentration (IWC) The IWC is the portion of the total downstream flow that comes from the wastewater discharge and is calculated using the full permitted flow of the facility and the statistical low flow of the receiving stream. The current 15A NCAC 02B .0206 rule specifies that the 7Q10 instream low flow value shall be used in setting limits based upon chronic standards. Since 2010, the Division has calculated IWCs for acute criteria in a similar fashion but using 1Q10 flows, consistent with federal guidance. The two measures of low flow used in RPAs correspond to the exposure periods associated with the standards: 1-day low flows with acute exposure and 7-day low flows with chronic exposure.

[37] Technical Support Document for Water Quality-Based Toxics Control, EPA Document Number 505/2-90-001, March, 1991.

waters, meaning that effluent limitations for metals of concern will be set equal to the numeric standards.

Action Levels for Toxic Substances: The T15A NCAC 02B .0211 and .0220 rules establish action level standards for four metals – copper, iron, silver, and zinc – for permitting purposes. The rules specify that, if a discharge shows a reasonable potential to exceed any of these standards but has consistently passed its Whole Effluent Toxicity (WET) tests required in its permit, the facility is not subject to effluent limits for the metal. The Division does not propose to modify this portion of the rules.

b. Monitoring Requirements:

Wastewater Dischargers monitor their effluents for parameters of concern and report their results to the Division on a regular basis. NPDES permits include monitoring requirements for the most significant parameters of concern and specify sample type and location and monitoring frequency for each parameter. Monitoring frequencies are based upon requirements in the state's T15A NCAC 02H .0200 rules or upon alternative requirements established by the director according to those rules. Monitoring frequencies for metals and other toxicants are set according to the standard monitoring schedule. Monitoring frequencies for limited parameters are greater than those for the same parameters not subject to limits.

In 2010, the Division's NPDES program revised its metals monitoring schedule (for reasons not related to these proposed rule changes). The new schedule reduced the standard monitoring frequencies specified for metals and other toxicants. NPDES staff began incorporating the new monitoring frequencies with permit renewals in July 2010 and will complete the effort by July 2015 (one five-year permit cycle), prior to implementation of the proposed rule changes.

2. Wastewater General Permits

Of the five wastewater general permits administered by the Division, only the NCG51 permit for groundwater remediation facilities includes metals requirements. The permit applies to discharges from a variety of petroleum-contaminated sites and applies a water quality-based discharge limit for lead at gasoline-contaminated sites. The limit is set at the existing chronic lead standard (25 µg/L total recoverable lead for both freshwater and saltwater) to ensure that the standards are met at the point of discharge regardless of the receiving stream. Thus, no RPA or other site-specific analysis is necessary.

(b) Existing Metals Requirements – NPDES Wastewater Permits

Figure III.B-1, below, summarize the numbers of existing individual permits and NCG51 certificates of coverage (COCs) with effluent limitations or monitoring requirements for metals. Numbers in the main body of the table refer to metals affected by the proposed rule changes; numbers below the body refer to permits that either have no metals requirements or have only requirements for non-affected metals.

A total of 475 permits and 86 COCs contain requirements for the affected metals.

- 475 of the 1,250 individual NPDES wastewater permits in North Carolina (38% of the permits and 76% of permitted flow) already include effluent limitations or monitoring requirements for one or more metals affected by the proposed rules changes. Of these, 103 permits contain one or more limits for the affected metals; the remaining 372 contain monitoring only. Another ten permits have requirements for metals that are not affected by the proposed rules. The remaining 765 individual permits contain no effluent limits or monitoring requirements for any metals, either because metals have not been found in those wastewaters or because metals are presently not found in high enough concentrations to warrant permit requirements.

- All 86 of the NCG51 COCs for groundwater remediation sites apply to active gasoline-contaminated sites and include a water quality-based limit for lead. None of the other general permits contain metals requirements, and the 1,582 COCs for these permits are noted in the table but not in the figure; Figure III.B-1 includes only the NCG51 COCs.

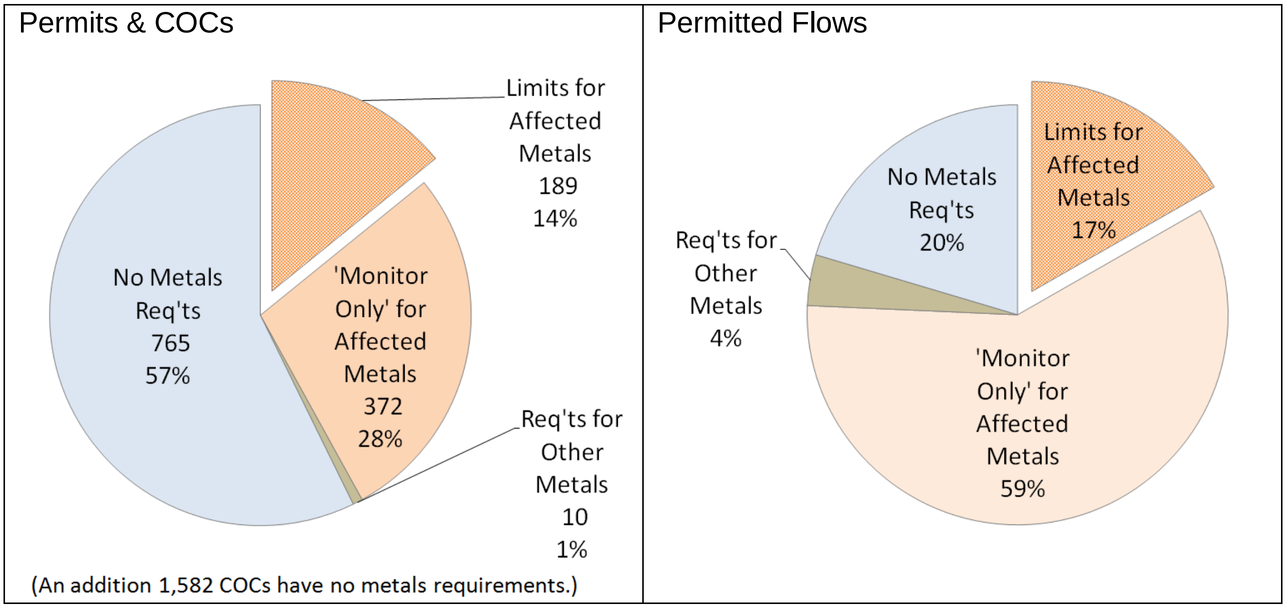
Error! Reference source not found. below shows the distribution of individual permits with requirements for the affected metals broken out for the five wastewater categories. The total permitted flows in each category indicates the relative significance of that category of discharges. Water treatment plants account for one-third of the permitted facilities but only a tenth of the permitted flow. Affected POTWs, on the other hand, account for only a quarter of the facilities bit two-thirds of the permitted flow.

These numbers include both technology-based and water quality-based metals requirements. Most metals limitations, including all for the municipal, groundwater remediation, and water treatment facilities, are water quality-based. Most of those for industrial facilities are technology-based. The 100% Domestic facilities are not subject to metals requirements. Again, the proposed revisions to the surface water standards for metals would affect only the water quality-based limitations.

Table III.B-5
Permits and COCs with Existing Requirements for Affected & Other Metals

Wastewater Permit Category	Limit(s) & Monitoring	Monitoring Only	Subtotal	Total Permitted Flow (MGD)
Municipal (POTWs)	40	119	159	1,098
100% Domestic < 1 MGD	0	0	0	-
Commercial & Industrial	47	38	85	191
Groundwater Remediation	8	7	15	0.75
Water Treatment Plants	8	208	216	158
Subtotal	103	372	**475**	1,448
Groundwater Remediation (COCs)	86	0	**86**	Not Limited
Total Permits & COCs	189	372	**561**	1,448
Requirements for Other Metals			10	
No Metals Requirements			765	
No Metals Requirements (COCs)			1,582	
Grand Total			2,918	

Figure III.B-1
Existing Metals Requirements in NPDES Wastewater Permits and COCs

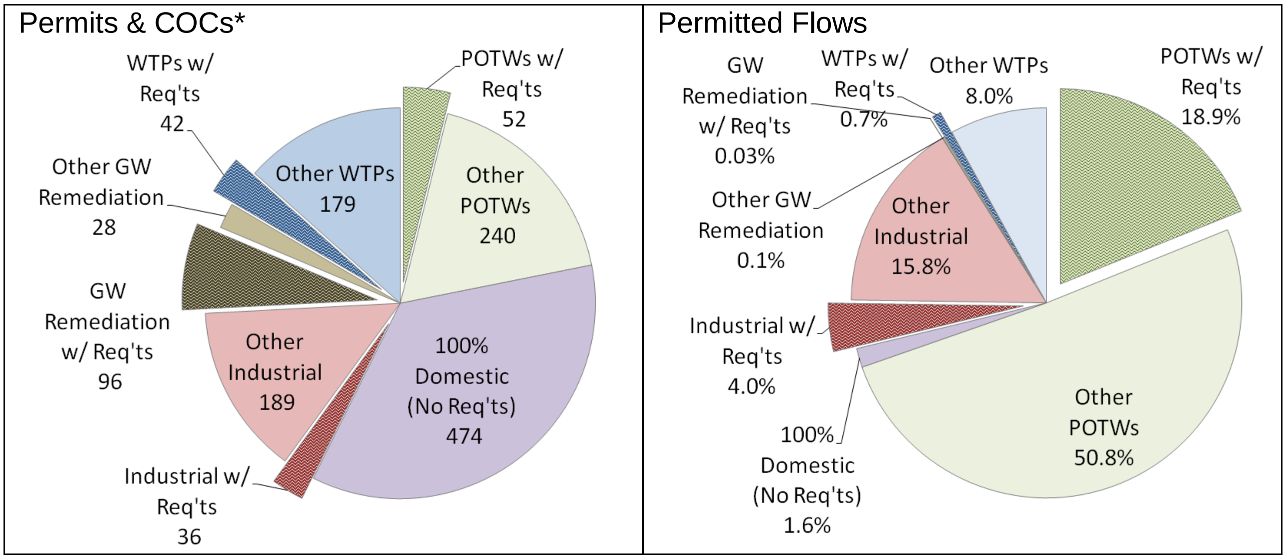


As described later in this chapter, the Division focused its technical and economic evaluations on cadmium, lead, and nickel (and, in some instances, copper, silver, and zinc), which are collectively called the 'target metals.' **Error! Reference source not found.** and Figure III.B-2, below, show the numbers of permits and the permitted flows that are currently subject to cadmium, lead, and/or nickel requirements. In this case, POTWs account for both the most permits and the most permitted flow of any category of discharger.

Table III.B-6
Permits and COCs with Existing Requirements
for Target Metals (Cadmium, Lead, &/or Nickel)

Wastewater Permit Category	Limit(s) & Monitoring	Monitoring Only	Subtotal	Total Permitted Flow (MGD)
Municipal WWTP (POTWs)	33	19	52	361
100% Domestic < 1 MGD WWTP	0	0	0	-
Commercial & Industrial WWTP	18	18	36	76.7
Groundwater Remediation	6	4	10	0.5
Water Treatment Plants	5	37	42	14.1
Subtotal	62	78	140	452
Groundwater Remediation (COCs)	86	0	86	Not Limited
Total Permits & COCs	148	78	226	452

Figure III.B-2
Permits and COCs with Existing Requirements for Target Metals (Cadmium, Lead, &/or Nickel)



*GW Remediation with requirements number includes the 86 COCs for the groundwater remediation general permit, which all have limits for lead. The remaining 1,582 COCs are not included in this representation.

The Division's evaluation of permit and economic impacts to Wastewater Dischargers is presented in subsections (h1)-(h5), below.

(c) Existing Regulatory Framework – Pretreatment Programs (Indirect Dischargers)

Publicly Owned Treatment Works (POTWs) with local pretreatment programs issue and administer local permits that are generally similar to the NPDES permits issued by the Division. Limits in local permits can be based on categorical pretreatment standards (if applicable) or Headworks Analyses calculated to prevent interference, pass-through, or sludge contamination, as described in subsection (h1), below. If a parameter is subject to more than one limit based on these objectives, the more stringent of the limits applies, just as with technology- and water quality-based limitations in NPDES permits.

Local programs perform a Headworks Analysis (HWA) at least once every five years to determine the Maximum Allowable Headworks Loading (MAHL) for each parameter of concern. The municipality must determine the contribution from its uncontrollable sources (commercial and residential sources of wastewater) and set aside a portion of the MAHL for each parameter for those sources. It can assign some or all of the remaining loadings to its significant industrial users and set limits in its local permits accordingly. The industries' portion of the MAHL is known as the Maximum Allowable Industrial Loading, or MAIL. The municipality decides how much of the total MAIL to allocate to each individual industrial user and sets local permit limits for each SIU based on these allocations.

(d) Existing Metals Requirements – Pretreatment Programs (Indirect Dischargers)

Currently, 110 local governments administer pretreatment programs for 127 out of the 292 municipal treatment facilities (POTWs). They regulate approximately 670 indirect dischargers, or Significant Industrial Users (SIUs). Many of these SIUs are subject to local permit limits for one or more of the affected metals. Most metals limits in local permits are derived from the POTWs' water quality-based metals limits and so are themselves, indirectly, water quality-based limits.

The Division's assessment of impacts to indirect dischargers is presented in subsection (h1) as part of the Municipal WWTP category.

(e) Cost Baseline

Treatment Facilities: Direct dischargers already own and operate wastewater treatment facilities and bear the costs of construction, operation, and maintenance of the facilities; disposal of biosolids and other residuals; and permitting and other regulatory activities. Indirect dischargers may also own, operate, and bear the costs of treatment facilities, depending on their permit requirements.

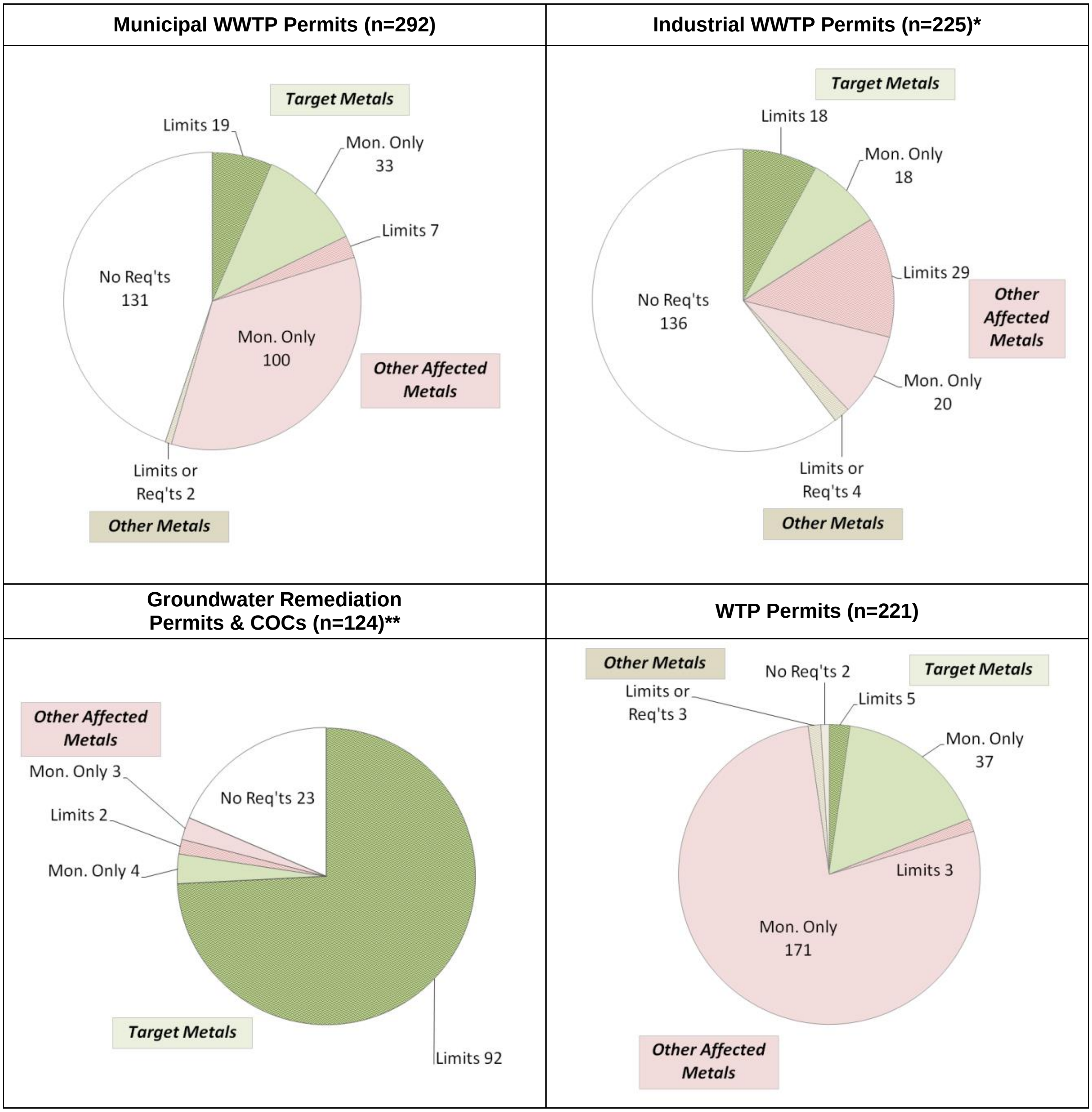
Most treatment units specifically designed to remove metals are associated with industrial facilities, due to the relatively high metals concentrations found in some industrial wastewaters. Municipal and other wastewaters typically have lower metals concentrations, and the biological treatment processes typically used rely on the coincidental adsorption of metals to the systems' biological solids and subsequent removal with the excess solids. Many large POTWs achieve additional metals removal as a result of chemical precipitation processes installed primarily to remove phosphorus.

Discharge Permits: The facilities discharge treated wastewater to surface waters of the state subject to the terms and conditions of National Pollutant Discharge Elimination System (NPDES) permits administered by the Division of Water Resources. Permits include effluent limitations for flow and for pollutants of concern, monitoring and reporting requirements, and other special and standard permit conditions. Permits are issued for a maximum of five years. Dischargers must obtain a non-discharge permit from the Division's Aquifer Protection Section for any land application of biological or chemical residuals. With the exception of industrial facilities, dischargers that propose to construct or substantially modify their treatment plants or component units must first submit design documents and receive an Authorization to Construct (ATC) permit from the Division's Infrastructure Finance Section.

Metals Requirements: Approximately 40% of individually permitted facilities and 4% of those covered by general permits are currently subject to effluent limitations or monitoring requirements for metals. These numbers include both technology-based and water quality-based requirements.

The charts in Figure III.B-3 summarize the types of metals requirements in four of the five wastewater categories. No permits in the '100% Domestic' category contains metals requirements. The charts also illustrate differences in permit requirements for metals among the four categories. The Glossary beginning on page vi defines the terms used in the figure.

Figure III.B-3
Existing Requirements for Metals in Permits and COCs by Permit Category



* Industrial permits include both technology-based and water quality-based requirements.
** An additional 1,582 COCs not shown in the chart have no metals requirements.

The numbers of permits in these charts are based on the most significant metals requirements in the chosen permits. For example, permits counted as having ‘Cd, Pb, &/or Ni’ requirements may also have requirements for other metals; but permits shown as having requirements for ‘other affected metals’ do not have requirements for cadmium, lead, or nickel.

3. Impacts – Metals

The Division first evaluated the effects of the proposed metals standards on permit requirements. It then developed estimated costs and savings for the wastewater dischargers based on the anticipated permit impacts.

The Division estimates that the impacts of the proposed metals standards on wastewater dischargers will have a net present value (NPV, 2014$) of $182 million in the first thirty years of implementation. The Division also prepared low-end and high-end estimates, in light of the uncertainties of the analysis, and estimates that the impacts could range from as low as $94 million to as high as $285 million NPV over the first thirty years. Table III.B-1 presents the estimated impacts to wastewater dischargers for the first ten years of implementation, shown by ownership, and cost totals by 10-year periods as well as the related net present values.)

Subsections (a1)-(g) describe the general impacts of the proposed metals standards and the Division's methods, assumptions, and findings. Subsections (h1)-(h5) and Appendices III.3-III.11 describe the same in more detail for each of the wastewater categories.

(a1) Potential Process Revisions – NPDES Wastewater Permits

The following paragraphs briefly describe potential changes in the permitting and pretreatment processes. *Appendix III.3: Wastewater Dischargers – Determination of Permit Requirements for Metals* provides additional information.

1. Metals Requirements in Individual Permits for Freshwater Dischargers

Effluent Limitations.

The proposed revisions to the metals standards (15A NCAC 02B .0211) will not alter the conceptual approach to setting metals limitations: water quality-based limits will continue to be based on Reasonable Potential Analyses. However, the proposed formula-based standards will require additional calculations of discharge-specific standards in evaluating water quality-based effluent limitations for the affected metals prior to the RPAs.

The Division expects that, with the proposed standards, one or both of the following new steps will be routinely required prior to conducting RPAs. Both steps would be required in the case of discharges to freshwater; only the second step is required for discharges to saltwater.

New Step #1: Calculate the Hardness-Dependent Maximum Allowable Metal (Dissolved) in Receiving Stream for Permitting Purposes

The proposed rules express freshwater standards for cadmium, chromium III, copper, lead, nickel, and zinc as hardness-dependent equations (15A NCAC 02B .0211 (11) (e), Table A). The hardness value used for permitting purposes will be the combined hardness of the effluent and receiving stream downstream of the discharge.

Whenever possible, the Division will use actual effluent to calculate combined hardness values for wastewater discharges. If sufficient effluent hardness data are not available for a facility, a default value of 25 mg/L will be used.

Actual instream hardness data are available for surface waters across the state. The proposed 02B .0211 rule specifies that, for NPDES permitting purposes, the required hardness values shall be established using the 10th percentile of hardness data collected within the 8-digit HUC and that the standards formulas apply within a hardness range of 25-

400 mg/L. Where actual hardness values fall outside the allowable ranges, the Division will calculate the standard using those boundary values.

For our purposes, the interim result from the standards formula can be called the *Maximum Allowable Metal (dissolved)* value *or MAM-dissolved*.

New Step #2: Calculate the Maximum Allowable Metal (Total) in Receiving Stream for Permitting Purposes

Most of the proposed aquatic life standards for metals are expressed as the dissolved form of the metal. However, federal regulation (40 CFR 122.45(c)) requires that NPDES permit limitations be expressed as total recoverable metals. A translator for each metal must be used to convert between the dissolved and total forms of the metal for permitting purposes.

For each metal of interest, the *MAM-dissolved* value from New Step #1 must be translated to the total recoverable form. The result is the *Maximum Allowable Metal (total)* value *or MAM-total.*

For permitting purposes, MAM-total for each metal is the discharge-specific, total recoverable expression of the proposed dissolved standard and will be used to represent the standard in the ensuing Reasonable Potential Analyses.

The Division will employ freshwater translators developed by the US EPA, which are already in wide use in other states in EPA's Region 4. The translators can be found on the US EPA website at the following link:
http://water.epa.gov/scitech/datait/models/upload/2009_03_26_models_guidance_pdf.pdf

Figure III.B-4 at the end of this section illustrates the process for determining *Maximum Allowable Metal (total)* values for permitting purposes and illustrates the differences between the use of the existing and proposed standards.

The proposed changes to the 02B .0206 rule will formally codify the current practice of using 1Q10 flow values with acute standards and will have no effect on permitting procedures.

Monitoring Requirements:

The proposed standards revisions will not require any change in how monitoring requirements for metals are set. However, specific requirements in any given permit (metals to be monitored, monitoring frequency, etc.) may change as limits are added to or removed from the permit based on the new standards. Metals monitoring is generally required more frequently for those metals with limits.

Independent of this triennial review, the Division modified its permitting guidelines in July 2010, substantially reducing the standard monitoring frequencies for metals. The Division began incorporating the new requirements in affected permits in July 2010, as part of the regularly scheduled renewals, and expects to complete the task in July 2015, at the end of one permit cycle. Thus, the net result for many dischargers in the next several years will be a net reduction (or no change) in monitoring frequencies. Even so, the Division assumes that the new guidelines will be fully implemented prior to application of the proposed metals standards and that those reduced requirements are the baseline condition for the purposes of this fiscal note.

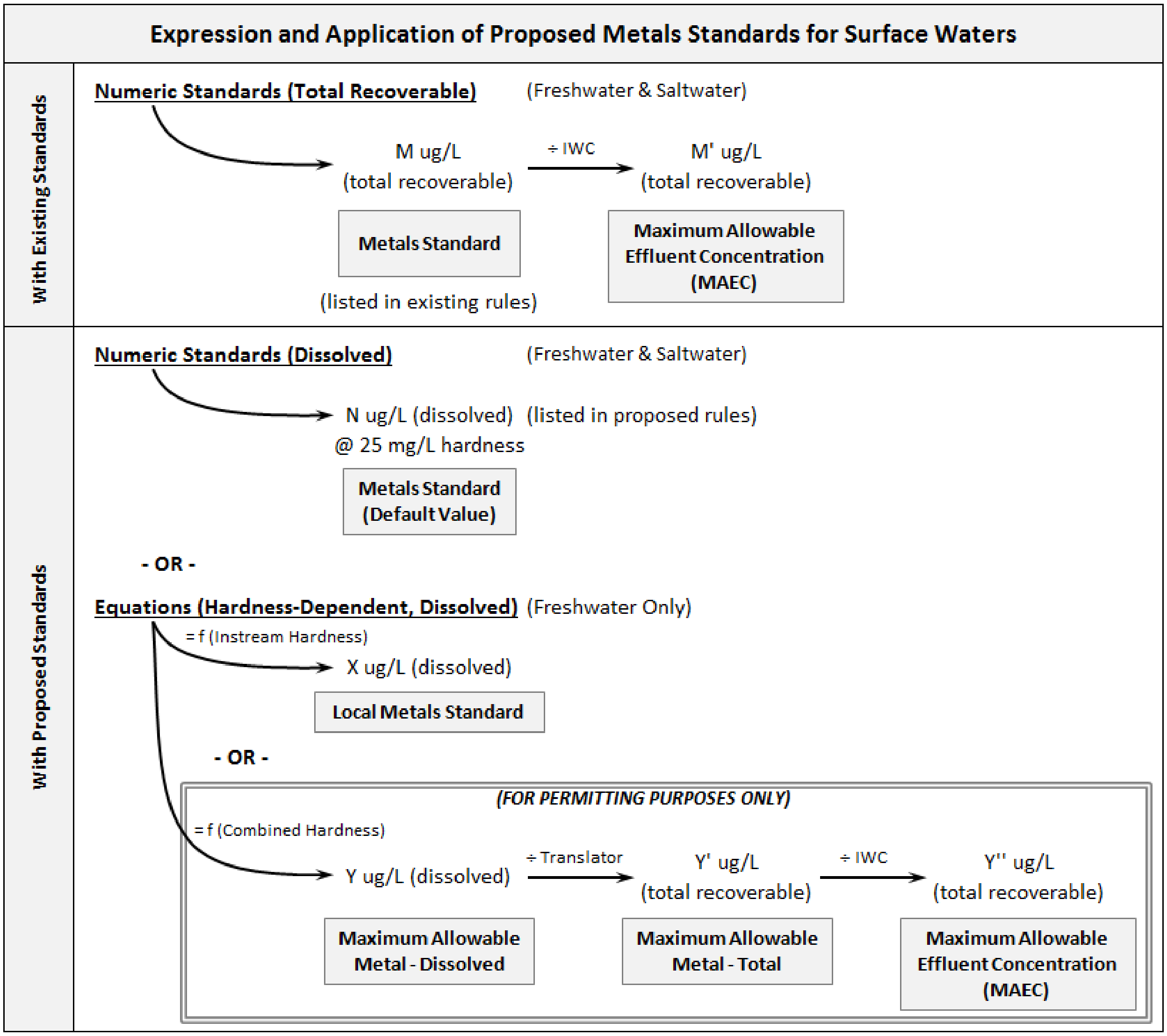
2. Metals Requirements in Individual Permits for Saltwater Discharges

Under the proposed rule changes (T15A NCAC 02B .0220), saltwater standards for metals are also expressed as dissolved metals. However, saltwater standards for metals are not hardness-dependent. Therefore, only New Step #2 applies for determining permit limits for discharges to saltwater. There is less scientific agreement on applicable saltwater translators; so, for the purposes of this fiscal note, the Division assumed a value of 100% (or 1) for all metals in these waters.

3. Metals Requirements in General Permits

The proposed standards do not require significant change in the administration of the NCG51 general permit. The Division will modify the permit's lead limit as necessary to ensure compliance with the new standards.

Figure III.B-4
Expression and Application of Proposed Metals Standards



(a2) Projected Regulatory Impacts – NPDES Wastewater Permits

In order to estimate the costs and savings of the proposed rule changes, the Division methodically evaluated the potential impacts of the proposed standards on (1) permit requirements (regulatory impacts), (2) the measures needed to respond to those requirements (compliance measures), and (3) the costs and savings likely to result from their implementation (economic impacts). This subsection provides an overview and then addresses regulatory impacts.

The Division followed a step-wise approach to estimate the economic impacts of the proposed metals standards on wastewater dischargers. The main steps were to:

- evaluate the potential impacts of the proposed standards on permit requirements for a subset of facilities;
- estimate the number of facilities likely to be impacted and the types of impacts, and extrapolate these to the remaining facilities;
- identify potential measures or series of measures that permittees might use to comply with new or more stringent metals limits;
- identify unit costs (capital and operating expenses) for each alternative measure;
- assume the numbers of facilities that would likely use each measure or series of measures;
- calculate the capital, operating, and other costs and arrange them along a timeline, taking into account the implementation sequence for NPDES permits as a whole;
- calculate the net present values of the projected costs.

The proposed revisions to the standards are several and are particularly complex in combination. Most of the standards will be formula-based and, if dependent on hardness, become more location-specific. As a result, it is difficult to determine the numeric value of the proposed standards – and any difference from existing standards – without the use of a calculator.

In addition, water quality-based metals limits are discharge-specific by their nature, and an accurate assessment of the standards' regulatory impacts would require an evaluation of every permit and metal of concern. The Division will perform that task as it implements the new standards in the coming years. However, for this assessment, it was necessary to evaluate a smaller – but still extensive – subset of permits to gauge the probable impacts.

<u>Changes in Metals Standards:</u> NPDES staff examined the proposed standards to identify potential differences from the existing standards and determine which are most likely to affect wastewater dischargers. The staff reached the following conclusions:

- Assuming worst-case conditions (combined hardness of 25 mg/L and no available dilution), the proposed chronic freshwater standards for cadmium, lead, and nickel and the chronic saltwater standards for lead and nickel are the most likely to result in more stringent water quality-based limitations and result in economic impacts to NPDES wastewater dischargers.
- The freshwater and saltwater standards for copper and zinc will result in less stringent limitations for the few facilities subject to limitations under the Action Level for Toxic Substances requirements (15A NCAC 02B .0211 and .0220).
- The proposed freshwater acute standard for silver will likely result in more stringent limits than limits based on the current criterion; however, silver is also an action level metal, and no dischargers are currently subject to silver limits, so the potential for permit impacts is minimal. (No changes are proposed to the chronic standards for silver, and the acute saltwater standard (dissolved) is the same as the criterion currently used for permitting (total recoverable).)

- Sufficient data are not available to evaluate the impacts of the proposed standards on wastewater permit requirements for chromium III and chromium VI.

Based on these preliminary findings, the Division focused its permit evaluations on proposed standards for cadmium, lead, and nickel and the 'action level' metals, copper, silver, and zinc. *Appendix III.2: Wastewater Dischargers – Selection of Target Metals* provides more information on this assessment.

Impacts to Permit Requirements: The staff next considered the potential impacts to all individual and general permits for wastewater discharges to surface waters. Representative permits from each wastewater category (and, in some instances, from subcategories) were selected for evaluation. Reasonable Potential Analyses or other evaluations were then conducted on 136 of the remaining 437 individual permits (31%) and 23 of the remaining 86 COCs (27%), focusing on the target metals. See Table III.B-7 below.

In the process, staff screened out 813 of the 1,250 individual permits and 1,582 of the 1,668 general permit Certificates of Coverage (COCs) because those lack metals requirements and, thus, are the least likely to be affected by the proposed standards. The staff evaluated several individual permits that did not contain metals requirements but for which effluent metals data were available, and the results verified this assumption.

Table III.B-7
Individual Permits and COCs Evaluated

Types of Permits/ COCs	# Permits/ COCs	# Screened as 'Non-Metal-Bearing'	# Potentially Metal-Bearing	# of Metals-Bearing Evaluated	% of Metals-Bearing Evaluated
Individual Permits	1,250	813	437*	136	31%
COCs	1,668	1,582	86	23	27%
Totals	2,918	2,395	523	159	30%

* Although 475 individual permits have requirements for the affected metals, some permits with monitoring requirements were screened out. Most of these were water treatment plants, although they have been the focus of a special data collection effort, are not expected to warrant metals requirements in the long term.

Staff compared the projected metals requirements to existing requirements in each permit and characterized the permit impacts. In permits with metals requirements, the numbers of metals regulated in a single permit ranges from one to eight. Changes in permit requirements could include any of several actions:

- Add new limits for one or more metals;
- Delete existing limits for one or more metals;
- Modify existing limits;
- Add new limit(s) and delete other existing limits(s);
- Add new limit(s) and modify other existing limits(s);
- Delete existing limit(s) and modify other existing limits(s);
- Add, delete, and modify limit(s);
- Delete limits for all metals and continue to monitor one or more metals;
- Delete all metals limits and discontinue metals monitoring; and
- No change.

To simplify the evaluation, similar permit impacts were combined:

- new or continued WQBELs for one or more affected metals (conservatively assumed continued WQBELs to be more stringent),
- all existing WQBELs removed, permit reverts to 'Monitor Only' for metals; or
- no impact: permits with monitoring only or with no metals requirements were unchanged.

Staff then identified compliance options that dischargers could use in response to these impacts, collected cost information for each, and calculated the potential costs of compliance to the dischargers. Estimates also addressed potential increases and decreases in monitoring requirements that would result from addition or deletion of metals limits.

The Division evaluated dischargers in each of the five wastewater categories separately in order to take advantage of similarities among the dischargers. The evaluation methods varied with each category, due to the unique assortment and characteristics of facilities in each category. Within each category, it further screened the permits to identify those most likely to be affected (or not affected) by metals requirements. In most cases, it selected a representative subset of permits in each group for detailed analyses. It compared the new metals requirements to existing requirements so as to identify the incremental impacts of the proposed standards and extrapolated the results for each subset to the remaining individual permits and general permit COCs. Table III.B-8 summarizes the results.

The Division estimates that 94 individual permits and 36 COCs will be impacted by the proposed metals standards. To be conservative, the count of impacted facilities also includes those for which evaluations were inconclusive.

Table III.B-8
Estimated Impacts to Metals Requirements in Permits and COCs – by Wastewater Category

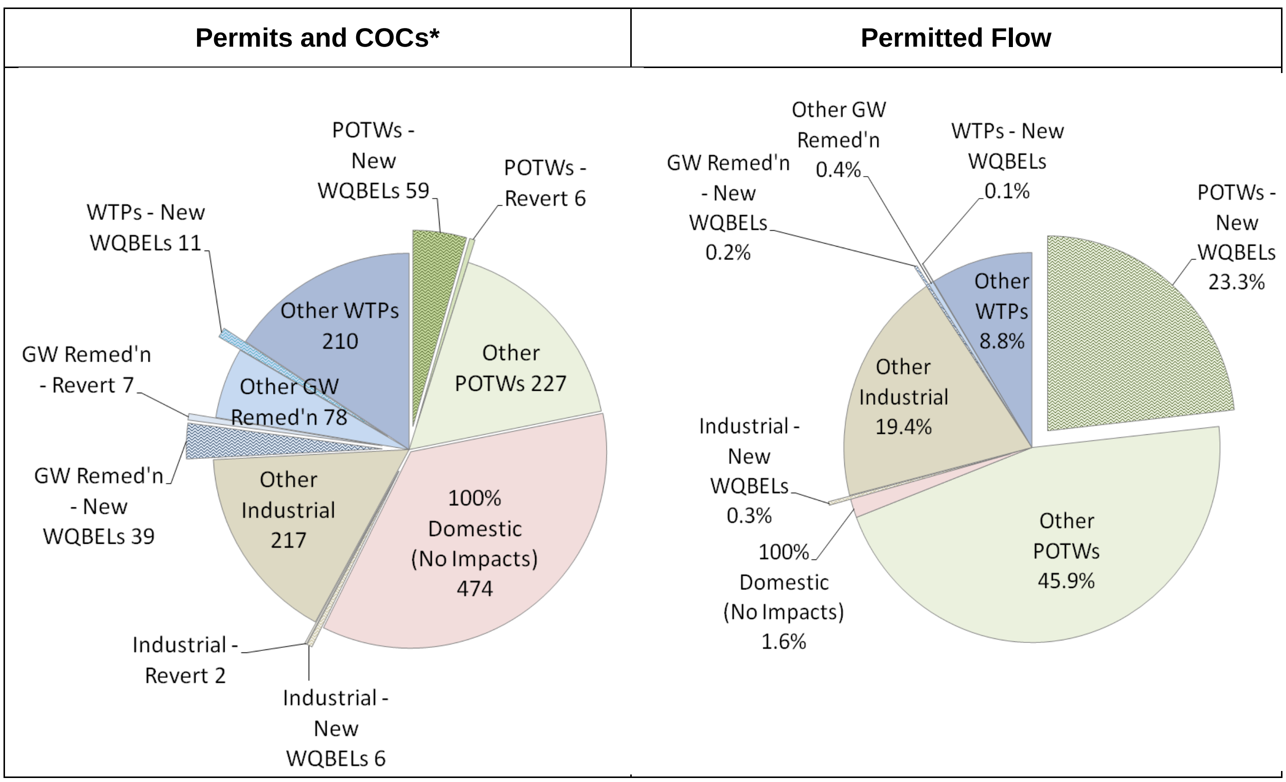
Wastewater Permit Category	New or Continued WQBELs	Revert to 'Monitor Only'	No Impact	Total
Municipal (POTWs)	59	6	227	292
100% Domestic < 1 MGD	-	-	474	474
Commercial & Industrial	6	2	217	225
Groundwater Remediation	3	7	28	38
Water Treatment Plants	11	-	210	221
Subtotal – Individual Permits	79	15	1,156	1,250
Groundwater Remediation (COCs)	36	-	50	86
Other COCs Screened as 'Non-Metal-Bearing'	-	-	1,582	1,582
Subtotal –COCs	36	-	1,632	1,668
Total – Permits & COCs	115	15	2,788	2,918

In the context of this subchapter, a permit is considered impacted or affected by the proposed rule changes if it is projected to receive either more stringent or less stringent metals requirements. The Division assumes that any continued WQBELs based on the proposed cadmium, lead, or nickel standards will be more stringent (that is, lower) than existing limits. ‘Less stringent’ requirements result when a facility is projected to either (1) drop all existing WQBELs for target metals and revert to ‘Monitoring Only’ requirements or (2) drop all monitoring for target metals and revert to ‘No Metals Requirements.’ ‘Indefinite’ requirements usually mean that sufficient data are not yet available to determine impacts to a facility (explained further in subsections (h1)-(h5) below). ‘No impact’ means that a facility whose permit currently has ‘Monitoring Only’ requirements or ‘No Requirements’ for the target metals is projected to receive similar requirements under the proposed standards.

By these estimates, 1,156 individual permits and 1,632 COCs (96% of the 2,918 permitted facilities) will not be impacted by the proposed metals standards. Most are not impacted simply because metals are not pollutants of concern in their discharges, and the rest because their discharges did not exhibit reasonable potential to exceed surface water standards in the Division’s analyses.

Figure III.B-5 again presents the numbers of permits and COCs affected, along with the associated permitted flows (minus the 1,582 unaffected COCs). As with current metals requirements (refer back to **Error! Reference source not found.** and Figure III.B-2), POTWs account for the largest portion of affected permitted flows.

Figure III.B-5
Permits, COCs, and Permitted Flow Potentially Impacted by Proposed Metals Standards



*GW Remediation with requirements number includes the 86 COCs for the groundwater remediation general permit. The remaining 1,582 COCs are not included in this representation.

<u>Implementation Timeline:</u> The Division routinely re-evaluates requirements for metals and other toxicants in each permit at issuance and at each permit renewal thereafter. With each renewal, limits and monitoring requirements are updated to reflect changes in wastewater characteristics and plant performance as well as any changes in regulations.

Upon adoption of the rule changes and EPA approval of the revised metals standards. Division staff will continue to re-evaluate metals requirements using the revised standards. Permits receiving more stringent requirements will include compliance schedules as necessary to allow time for dischargers to evaluate and implement appropriate metals controls. Compliance dates are typically set from two to five years beyond permit renewal.

For this fiscal analysis, it is assumed that the proposed rules will be adopted in early 2015 and that the standards will be approved by late 2015 and applied to permits beginning in 2016. The first affected facilities will take steps to meet new metals limits beginning in 2017. It will take five years – one permit cycle – to apply any new standards to wastewater permits across the state and up to five years more for the last of the affected dischargers to complete any measures necessary to comply with those permit requirements.

Appendix III.5: Evaluation of Municipal Wastewater Treatment Plant Permits illustrates the state-wide implementation timeline.

(b1) Potential Process Revisions – Pretreatment Programs (Indirect Dischargers)

The Division does not expect the proposed rule changes to affect the existing methods for determining MAHLs or MAILs or for setting metals limits in local permits. It does expect that more stringent limits at some POTWs will lead to reduced local limits for SIUs and that, as a result, some POTWs that will receive more stringent metals limitations will reconsider the practice of setting limits far in excess of their significant industrial users' needs.

Regulatory impacts of the proposed standards to pretreatment programs and indirect dischargers are addressed along with those to Municipal WWTPs, in subsection (h1), below.

(b2) Projected Regulatory Impacts – Pretreatment Programs (Indirect Dischargers)

In evaluating the potential impacts to local pretreatment programs and their significant industrial users, the Division chose 28 freshwater POTWs and 4 saltwater POTWs from the 61evaluated to represent POTWs with pretreatment programs across the state. The impacts of the proposed metals standards to the pretreatment programs were evaluated using the water quality-based metals limits already calculated for the POTWs' assessments. As previously noted, the evaluation focused on cadmium, lead, and nickel. The main steps in evaluating the impacts included:

- Recalculating the new Maximum Allowable Headworks Loadings (MAHLs) for cadmium, lead, and nickel at each POTW based on NPDES water quality effluent permit limits developed using the proposed water quality standards and the most recent Headworks Analysis (HWA) data available,
- Identifying potential courses of action for complying with the new MAHLs,
- Identifying impacts to Pretreatment Programs associated with the development, and implementation of the new MAHLs.

Regulatory impacts of the proposed standards to pretreatment programs and indirect dischargers are addressed along with those to Municipal WWTPs, in subsection (h1), below, and in *Appendix III.3: Wastewater Dischargers – Determination of Permit Requirements for Metals*.

(c) Description of Potential Compliance Alternatives

The Division assumed that dischargers receiving new or continued WQBELs for one or more target metals would have to take steps and incur costs to comply with those limits. The metals were assumed to be equivalent, and the control measures were assumed to be equally effective for all metals. That is, the addition of any metals limit was assumed to have the same impact as any other metals limit and result in the same fiscal impact on the discharger.

The Division conservatively assumed that the deletion of a metals limit from a permit would result in no savings to the discharger other than reduced monitoring costs, because metals removal for most dischargers is a coincidental benefit of the treatment processes, which would continue to operate regardless of the metals limits.

Potential compliance measures available to the wastewater dischargers receiving new or continued limits range from low-cost operational changes to capital-intensive treatment plant improvements. The list of effective alternatives varies among the wastewater categories and among the dischargers within each category.

Once the new standards are applied, affected dischargers will have to determine the significance of any new metals requirements for their facility, evaluate potential compliance options, and implement effective measures in order to comply with the new requirements. Those dischargers will have to take deliberate steps and, in some cases, expend capital resources for facility improvements and other measures.

The Division identified alternative actions or series of actions that dischargers in each category might use to comply with new metals requirements. Staff assembled unit costs for each measure and applied these to the numbers of potentially affected dischargers to generate cost estimates for each category.

The following are some of the compliance alternatives available to dischargers that become subject to new metals limitations. This list does not constitute a recommendation of any particular approach, nor is any one measure necessarily sufficient and appropriate to meet new limitations at any particular treatment system. The list simply presents a variety of alternative actions that represent a potential range of options and costs to wastewater dischargers. Permittees will have to develop compliance strategies that best meet their individual needs within the context of their own budgetary and other constraints.

1. Data Verification/ Improvement

Some dischargers must modify their laboratory procedures and report metals results to appropriate Practical Quantitation Limits (PQLs) so that the Division can determine what metals requirements are warranted in their permits. This is not so much an alternative as a necessity but bears mentioning here.

Other dischargers would be well served to improve the accuracy, precision, and consistency of their metals analyses. Inaccurate values may mistakenly indicate that reasonable potential exists, resulting in permit limit that are not truly warranted, or that permit limits have been exceeded, prompting formal enforcement that could have been avoided with more careful analyses. When permit limits are near or less than a metal’s PQL, even a small variability in laboratory results or reported PQLs can introduce enough variability into the effluent data to show reasonable potential to exceed standards and prompt permit limits.

These measures cost the discharger little or nothing but can provide significant relief in the facility’s permit requirements by providing a more accurate measure of its performance.

Dischargers may also elect to adopt clean sampling techniques for metals samples. Contamination of samples can increase reported metals levels, especially if metals concentrations are near the PQL. Clean sampling techniques have been found to be effective in reducing mercury contamination in effluent samples, where concentrations can be reported to a few nanograms per liter (parts per trillion).

Dischargers have the option of monitoring their effluent wastewater to determine the actual hardness. This has not been necessary in the past and is not required under the proposed rules. However, in the absence of such effluent hardness data, the Division expects to use a default value of 25 mg/L in calculating the applicable metals values for RPA calculations. If a permittee expects its effluent hardness is greater than 25 mg/L, it would be to its advantage to collect and submit actual effluent hardness to the Division with its next application for NPDES permit renewal for use in the RPA.

2. Source Identification and Controls

Dischargers subject to metals limitations can benefit from understanding the sources of those metals in their wastewaters. They may be able to control metals much more effectively at their sources. If source controls are effective, the water quality-based limits may no longer be necessary in the next permit renewal.

POTWs: Municipal dischargers can conduct sanitary sewer surveys for this purpose. They would collect a series of samples in the collection system to trace the metals back up the lines to their sources. This is most effective for discrete sources, such as commercial or industrial facilities (diffuse sources such as metals from water distribution systems are more problematic; hence, the term 'uncontrollable source' used in the pretreatment program). Once the sources are identified, the POTW or local pretreatment program can take steps to control them, such as by establishing metals limits (or revise existing limits) for the industrial user.

Industries and Industrial Users: Industrial facilities are often significant sources of metals in wastewaters. Direct and indirect dischargers commonly rely on end-of-pipe wastewater treatment to reduce metals to comply with their effluent limitations. However, other options are available that may be more cost-effective in certain situations. For example, it may be worthwhile to determine whether raw materials are a source of metals. Some facilities have found that 'minor' metals contamination of their raw materials from a manufacturing standpoint is much more significant from a water quality perspective. Process assessment is another option; in some cases, industries have modified their manufacturing processes to reduce metals loadings with little or no impact on production rates or product quality.

3. Treatment System Improvements

Dischargers have generally not had to install new treatment processes in the past to comply with their water quality-based metals limits. Most dischargers already employ biological processes, in which metals coincidentally adsorb to the biological solids in the process and are removed along with the waste solids. Some municipalities employ chemical precipitation to remove Total Phosphorus, and the process provides some metals removal as well. In industrial systems, chemical precipitation is often used specifically to remove metals, but this is rarely the case with POTWs.

Chemical precipitation involves the mixing of a flocculating chemical (alum, ferric chloride, etc.) with the wastewater to capture the metals, followed by gravity settling to remove the metal-laden floc. Filtration or micro-filtration can be used to achieve greater removal of the metals at some additional cost. Membrane filtration and reverse osmosis are other processes that could be used to remove metals but at much greater cost.

4. Diffuser Installation

A discharge's Instream Waste Concentration (IWC) is a key factor in evaluating reasonable potential to exceed standards and in setting water quality-based effluent limitations for metals. For the purposes of conducting an RPA for chronic standards, discharges to free-flowing streams are assumed to be completely mixed at the point of discharge and so get the full benefit of that dilution.

On the other hand, discharges to lakes, reservoirs, tidal waters, or other slow-moving waters are not assumed to mix. The IWC is taken to be 100% (zero dilution), and the effluent limitation is set equal to the applicable water quality standard. In these cases, any allowance for dilution can make a significant difference in the effluent limitations given the discharge. Addition of a properly designed diffuser on the outfall, with appropriate model verification, could provide a significant allowance for dilution and less stringent metals limits (if still warranted) in the permit.

5. Outfall Relocation

In rare instances, it may be cost-effective to relocate a discharge to a point that will provide greater dilution and a reduced IWC and less stringent metals limits.

6. Pretreatment Modifications for Indirect Dischargers

When a POTW with a pretreatment program receives new or modified metals limits in its permit, it must consider what impacts (if any) this will have on its significant industrial users. It must, at a minimum, update its headwork analysis and calculates new Maximum Allowable Headworks Loadings and Maximum Allowable Industrial Loadings (MAIL) for each metal. If the MAIL is significantly reduced, the POTW will potentially need to lower its Significant Industrial Users' metals limits as well.

Subsections (h1)-(h5), below, explain the alternative approaches considered within each wastewater category.

(d) Quantify Costs/ Savings

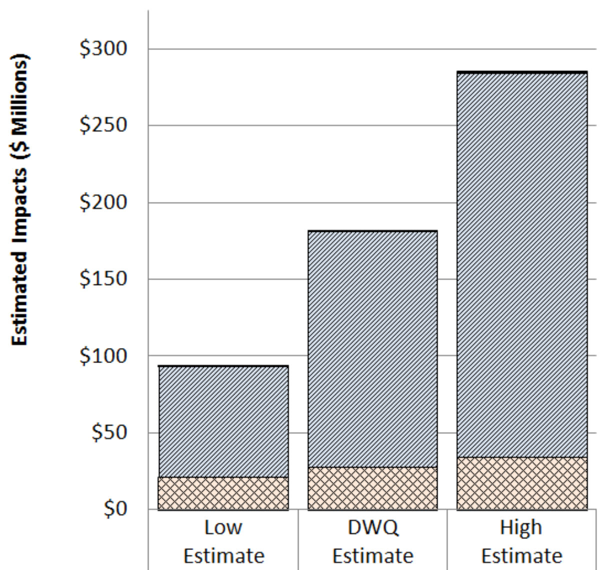
The Division of Water Resources estimates that the proposed revision of numeric surface water standards for metals in Rules .0211 and .0220 and the related change in Rule .0206 will have an economic impact of $154 million (net present value) on wastewater dischargers for the first twenty years after the standards becomes effective. Local government facilities (including both water and wastewater treatment and one municipally owned landfill included in the industrial category) account for approximately 85% of the estimated impacts, privately owned facilities account for 15%, and state and federal facilities account for 0.2%. The Division also calculated 30-year estimates for the wastewater dischargers in order to provide estimated costs for the same timeframe used to estimate the benefits described in Section VIII of this fiscal note. The Division estimates the 30-year NPV of these impacts to be $182 million.

For planning purposes, a project life of 20 years is commonly assumed for wastewater treatment improvements. For longer planning periods, it is assumed that existing facilities must then be replaced or substantially improved to continue service. The 30-year estimate does not include such replacement costs because of considerable uncertainty as to which facilities will be affected, what new controls might be available at that time, and the cost of those measures.

Figure III.B-6 shows these estimates divided according to facility ownership and permit category. There is considerable uncertainty in these estimates due to case-specific impacts of the proposed standards on metals limitations and the wide array of compliance options available to the dischargers. In light of the uncertainties, the Division also estimated potential low-end and high-end costs. It estimates that the net present value of the anticipated impacts over the first thirty years of implementation could run from as low as $94 million to as high as $285 million. The range reflects variations in unit costs, numbers of facilities affected, variations in compliance measures taken, or a combination of these factors.

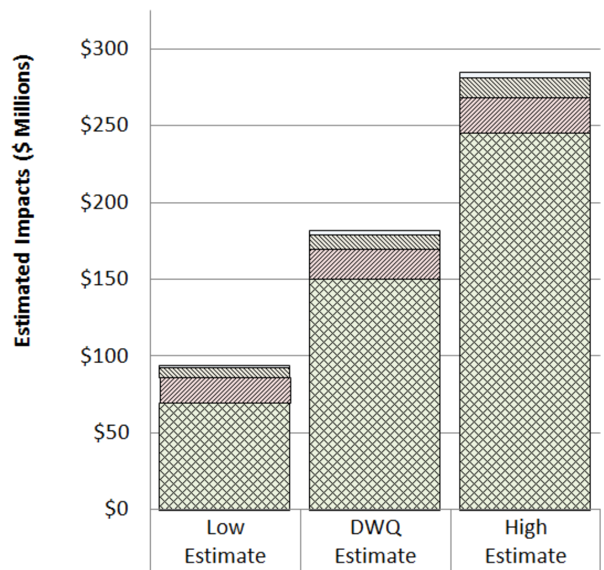
Figure III.B-6
Projected Metals Impacts, 30-Year NPVs

By Facility Ownership



	Low Estimate	DWQ Estimate	High Estimate
Total	$94	$181.6	$285
Federal Gov't	$0.08	$0.11	$0.15
State Gov't	$0.15	$0.22	$0.30
Local Gov't	$71.9	$153.3	$250.0
Private	$21.6	$28.0	$34.4

By Permit Category



	Low Estimate	DWQ Estimate	High Estimate
Total	$94	$182	$285
WTPs	$1.2	$2.3	$3.7
GW Remed'n	$6.5	$9.6	$12.8
Industrial	$16.3	$19.6	$22.9
Municipal	$69.8	$150.1	$245.5

All net present values are 2014 dollars calculated using a 7% discount rate and an inflation rate of 2% per annum.

The subsections (h1) through (h5) that follow provide more detailed cost figures for each category of wastewater dischargers.

(e) Quantification Methods and Assumptions

General methods and assumptions are described here and in subsections (f) and (g), below. Subsections (h1) through (h5) describe the Division's methods, assumptions, findings, and cost and savings estimates for each category in more detail.

The Division evaluated permits in each of the five wastewater categories to estimate the potential regulatory and economic impacts of the proposed metals standards on existing wastewater dischargers. It used different methods in each wastewater category, tailored to the characteristics of those groups of permits. Where sufficient effluent data were available, the

Division updated the Reasonable Potential Analyses for individual dischargers; in other cases, staff reviewed the available data and used best professional judgment to estimate the number of facilities impacted and the nature of those impacts. In groups of similar dischargers, staff reviewed a representative subset of permits and extrapolated the results from those permits to a larger group; in smaller or more varied groups, staff often reviewed most or all of the permits to assess impacts.

Staff then considered potential courses of action the facilities might take to comply with the new metals requirements. They identified costs for each of the alternative compliance actions and applied these, individually or in likely combinations, to the numbers of impacted dischargers in each wastewater category.

Estimates include capital and annual costs for each facility improvement, the cost of special projects or programmatic efforts (source control, etc.), costs of clean-sampling techniques, and costs/savings of changes in monitoring requirements due to the addition or deletion of metals limits in permits.

(f) General Assumptions

The Division adopted the following working assumptions in the course of its evaluations:

- The discernible impacts of the proposed metals standards on freshwater dischargers will be the result of new or continued water quality-based limitations for cadmium, lead, or nickel.
- Under worst-case conditions (IWC = 100%), the proposed chronic standards for lead and nickel are most likely to impact discharges to saltwater.
- Based on staff's experience with metals and toxicants requirements in permits, limits based on the proposed chronic standards are more stringent (numerically lower) than those based on the acute standards and will, in most cases, govern whether compliance actions are necessary.
- Permit requirements for copper, silver, and zinc will continue to be implemented according to the Action Level for Toxic Substances requirements.
- Where metals impacts are projected, the impacts are assumed to be similar regardless of the metal or metals affected.
- The deletion of metals limits from permits will result in no savings to the affected dischargers other than reduced monitoring costs.
- The existing human health standards for arsenic and nickel are more stringent than the proposed aquatic life-based standards and will continue to control permit limits for these metals *where human health standards apply*.
- Due to the lack of chromium data, the impact of transitioning from Chromium Total to Chromium III and Chromium VI cannot be addressed in this fiscal analysis.
- Because most iron requirements based on federal Effluent Guidelines, the Division assumes the requirements will remain in place despite the proposed deletion of the iron standard.
- The proposed rule changes will become effective in early 2015 and the standards approved by the US EPA by late 2015.
- Any newly adopted standards will be used to determine water quality-based metals limitations beginning in 2016.

- The number of affected facilities will be somewhat evenly distributed over the five-year period.
- The Division will re-evaluate the metals requirements in existing permits at their first renewal following approval of the standards. For the purposes of this fiscal note, the Division assumes that dischargers will, in general, begin data verification and source control measures in the first year of their renewed permits (if not sooner), evaluate treatment alternatives in the second year, and design and construct any improvements in Years 3 and 4.
- Dischargers will complete all actions necessary to comply with new metals limits within five years after those requirements are added to their permits.
- In its analysis, the Division provides a 30-year cost estimate for the wastewater dischargers in order to be consistent with the benefits estimates presented in Section X. Wastewater systems are generally designed for a 20-year life. However, due to the uncertainty of the number of permits impacted, and also considering the likely changes in metals control options in the meantime, the wastewater dischargers cost estimate does not include replacement costs, which may be underestimating the costs.
- Changes in permit requirements based on the proposed standards changes will not have a significant impact on nondischarge permits for application of residuals. Those permits' effluent limitations are not currently driven by metals considerations, and it would take a substantial increase in metals concentrations in the residuals to prompt new permit limits. In addition, the efforts of local pretreatment programs govern metals concentrations in the residuals and help to minimize those impacts.
- Effluent hardness monitoring is not required by the proposed rules and, therefore, is not considered an impact.
- The number of permits and, thus, the number facilities potentially affected by the rule changes is assumed to not change significantly, although historic data indicate a gradual decline in the numbers of permits. From July 2011 to June 2014, the number of individual permits declined from 1,250 to 1,197 and COCs for the general permits listed in Table III.B-4 rose from 1,668 to 1,763 with the addition of a new permit (NCG56) for pesticide applicators.

(g) Data Sources – Wastewater Dischargers

Information from these sources were used in some or all of the analyses for the five categories of wastewater dischargers:

- Basinwide Information Management System (BIMS), 2011.
- Electric Power Research Institute (EPRI), *Comments on the Draft Determination of Technology-Based Effluent Limits for the Flue Gas Desulfurization Wastewater at Merrimack Station in Bow, New Hampshire*, February 28, 2012, available at http://www.epa.gov/region1/npdes/merrimackstation/pdfs/comments/PC-19.pdf
- *Engineering News-Record*, Construction Cost Index History – accessed August 2011, ENR.com.
- *Engineering News-Record*, Construction Economics – accessed June 2012, ENR.com.
- Facilities data and incident site and cost information, provided by NCDENR Division of Waste Management, September 2011 and February 2012.
- McIntire, M.D., *Technical Memorandum 1: Triennial Review Impact Assessment*, prepared for North Carolina League of Municipalities, September 2, 2010.
- *Nutrient Reduction Technology Cost Estimations for Point Sources in the Chesapeake Bay Watershed*, Chesapeake Bay Program, Nutrient Reduction Technology (NRT) Task

Force, 2002. Available for download at http://archive.chesapeakebay.net/pubs/NRT_REPORT_FINAL.pdf.

- US EPA. Development Document for Proposed Effluent limitations Guidelines and Standards for the Centralized Waste Treatment Industry (Volume I), Washington, DC, EPA 821-R-98-020, 1998, available at http://water.epa.gov/scitech/wastetech/guide/cwt/proposal_develop_index.cfm.

(h1) Wastewater Dischargers – Municipal WWTPs

1. Description and General Baseline – Municipal WWTPs

For the purposes of the NPDES permit and pretreatment programs, municipal wastewater treatment plants are those publicly owned treatment works (POTWs) that treat wastewaters from domestic, commercial, and industrial sources and discharge treated effluent to surface waters of the state. Municipal wastewaters commonly contain metals at reportable levels. Sources of metals include both commercial/ industrial users (any or all metals, depending on the users) and domestic connections (primarily copper and zinc).

Highlights – Municipal WWTPs

# Permits:			292
Permitted Flow (MGD)	- Total:		1,332
	- Average:		4.56
	- Median:		1.20
- Freshwater Discharges:		275	94%
- Saltwater Discharges:		17	6%
Permits with:		No.	%
- Affected Metals Requirements		159	54%
Affected Metals Limits		40	14%
- Cd, Pb, Ni Requirements		52	18%
Cd, Pb, Ni Limits		33	11%
- No Affected Metals Requirements		133	46%
Subject to Pretreatment Programs:		127	43%

Municipal wastewater dischargers hold 292 (23%) of the 1,250 individual NPDES wastewater permits in North Carolina. They account for 1,332 MGD (70%) of all permitted flows statewide. Of the 292 permits, 275 govern discharges to freshwater streams, and the remaining 17 apply to discharges to saltwater.

Of these discharges, 159 are subject to permit requirements for one or more of the affected metals, including 40 with one or more limits. Of the 159, 52 permits include cadmium, lead, and/or nickel requirements, of which 33 include limits. The remaining 133 (46% of all municipal permits) do not warrant or include any limits or monitoring requirements for the affected metals at this time. (See also **Error! Reference source not found.** and **Error! Reference source not found.** on pages **Error! Bookmark not defined.** and **Error! Bookmark not defined.**.)

Federal and state regulations (40 CFR Part 133, 15A NCAC 02B .0406) set forth secondary treatment standards for municipal and similar wastewater facilities. These technology-based standards for conventional parameters do not include standards for metals. Thus, all metals limitations for municipal treatment facilities are water quality-based requirements.

Currently, 110 local governments administer pretreatment programs for 127 out of the 292 municipal treatment facilities (POTWs). They regulate approximately 670 indirect dischargers, or Significant Industrial Users (SIUs). Many of these SIUs are subject to local permit limits for one or more of the affected metals. Most metals limits in local permits are derived from the POTWs' water quality-based metals limits and so are themselves, indirectly, water quality-based limits.

2. Regulatory Impacts – Municipal WWTPs

The Division evaluated the potential impacts of the proposed metals standards on municipal facilities. The evaluation focused on cadmium, lead, nickel, copper, silver, and zinc, which are collectively called the 'target metals.'

The Division adopted three working assumptions in an attempt to identify the POTWs most likely to be impacted. These assumptions are similar to those used by the NC League of Municipalities in a separate analysis of the proposed rule changes; the methods and findings in that analysis are discussed later in this subsection. The three working assumptions were that:

- POTWs with local pretreatment programs have the greatest contributions of industrial wastewater and so are most likely to have significant levels of metals in their wastewater;
- Larger POTWs, with at least 1 MGD capacity, are more likely to have metals than smaller POTWs, due to greater contributions from commercial and minor industrial facilities; and
- POTWs discharging to smaller streams, which offer less dilution (higher IWC), are more likely to receive metals limits. To be consistent with the League's study methodology, the Division (initially) chose facilities with an IWC threshold of greater than 15%.

Staff evaluated a subset of 61 POTW permits (57 freshwater and 4 saltwater) from the 292 permits. Initial results from 26 POTWs indicated that, while the three working assumptions held true in general, a facility's capacity (permitted flow), pretreatment status, and IWC are not consistently useful in predicting impacts from the proposed metals standards. Instead, the most reliable indicator was simply the presence of metals limitations or monitoring requirements in the facility's current permit. Based on these findings, subsequent efforts focused on those dischargers with existing permit requirements for cadmium, lead, and nickel and with limits for the action level metals copper, silver, or zinc. See *Appendix III.4: Wastewater Discharges – List of Permits Evaluated*.

The Division collected the most recent RPAs for each POTW as well as effluent hardness data, where available, and re-ran the RPAs for target metals using the proposed standards. The RPA results were compared to existing metals requirements, and potential impacts were categorized as follows:

- No impact – continued 'no requirements' or 'Monitor Only'
- Minor impact – marginal 'reasonable potential'
- Significant impact – new or different limits, clear 'reasonable potential'
- Less stringent – revert to 'Monitor Only'
- Indefinite impact –additional data needed

The results from the 61 POTWs evaluated were extrapolated to estimate impacts to the full set of municipal permits. Figure III.B-7 summarizes the projected regulatory (permit) impacts of the proposed metals standards to the state's POTWs.

Fifty facilities are expected to receive WQBELs for metals under the proposed standards. All continued as well as new limits were assumed to be more stringent than existing requirements. In addition, indefinite results nine facilities were conservatively assumed to result in new or continued limits at the facilities. Six POTWs will revert to monitoring only, and the remaining 210 plants are not expected to be impacted.

Appendix III.5: Evaluation of Municipal Wastewater Treatment Plant Permits describes these evaluations in greater detail.

Figure III.B-7
Projected Permit Impacts, Metals Standards Municipal WWTPs

Subcategory	Permits	Evaluated
Freshwater	275	57
Saltwater	17	4
Totals	*292*	*61*

Count	Projected Impacts	Projected # Permits		
		More Stringent	Less Stringent	No Impact
23 of 57	New or Cont'd WQBELs *	50		
4 of 57	Revert to 'Mon. Only'		6	
26 of 57	Cont'd 'Mon. Only' or 'No Req'ts'			210
4 of 57	Indefinite - need added data	9		
4 of 4	Cont'd 'Mon. Only' or 'No Req'ts'			17
61 of 61	*Subtotals*	*59*	*6*	*227*
			Total	*292*

3. Regulatory Impacts – Pretreatment Programs and Industrial Users

Following adoption of the new standards, affected POTWs with pretreatment programs will have to re-evaluate their Allowable Headworks Loadings (AHLs) and their Maximum Allowable Headworks Loadings (MAHLs). Thus, new metals requirements for the POTWs may, in turn, result in new requirements for their significant industrial users (SIUs).

In evaluating the potential impacts to local pretreatment programs and their significant industrial users, the Division chose 28 freshwater POTWs and 4 saltwater POTWs from the 61 evaluated to represent POTWs with pretreatment programs across the state. The impacts of the proposed metals standards to the pretreatment programs were evaluated using the water quality-based metals limits already calculated for the POTWs' assessments. Again, the evaluation focused on cadmium, lead, and nickel. The main steps in evaluating the impacts included:

- Recalculating the new Maximum Allowable Headworks Loadings (MAHLs) for cadmium, lead, and nickel at each POTW based on NPDES water quality effluent permit limits developed using the proposed water quality standards and the most recent Headworks Analysis (HWA) data available,
- Identifying potential courses of action for complying with the new MAHLs,
- Identifying impacts to Pretreatment Programs associated with the development, and implementation of the new MAHLs.

The analyses of the 28 freshwater POTWs with pretreatment programs indicated that a facility's size and Instream Wastewater Concentration (IWC) are not reliable predictors of permit impacts. The analyses showed that essentially all MAHLs and, hence, the Maximum Allowable Industrial Loadings (MAILs) for cadmium and lead would decrease in response to more stringent limits for these metals in the POTW's permit. However, MAHLs and MAILs for nickel decreased in only 40% of the POTWs due to the fact that headworks loadings for this metal are often controlled by considerations of residuals disposal, process inhibition or, in the case of Water Supply-classified waters, protection of human health.

The Division determined that the SIU permit reductions that would result from the POTWs' new metals limits would not require metals loadings reductions by the SIUs. A recalculation of the new MAHLs (and MAILs) for all 28 freshwater POTWs showed that 20 (71%) would not have to reduce current SIU permitted allocations for metals to comply with the revised MAIL. The remaining POTWs would have to reduce one or more SIU permitted allocations, but the reduced allocations could be at least 3 to 5 times greater than the individual SIU's actual current loads and the POTW would still comply with its revised MAIL.

4. Cost Baseline – Municipal WWTPs

The facilities with individual NPDES permits and effluent limitations for one or more target metals already own and operate treatment systems or use other means to comply with those metals limits. They already conduct effluent monitoring and reporting as required in their permits and are subject to the associated permit fees and costs.

Municipal facilities are designed primarily to remove organic materials and other oxygen-consuming wastes from wastewaters, and they use biological treatment processes for that purpose. Microorganisms in the system use the organic matter as a food source and, with adequate aeration, continue to grow steadily. A portion of this biomass is drawn off regularly to maintain optimum operating conditions in the treatment units. Biological processes achieve some metals removal as well. Metals adsorb to the biosolids to varying degrees and are removed with the excess solids. A significant number of facilities are also subject to total phosphorus limitations and add chemicals to capture and remove phosphorus. These systems coincidentally capture some portion of the metals in the process.

The amount of metals removed varies for each metal and from one POTW to the next. Removal rates for metals typically range from 30% to 90%. Physical/ chemical processes commonly associated with metals removal in other treatment systems are generally not as cost-effective at POTWs due to the relatively low metals concentrations found in municipal wastewaters.

5. Estimated Economic Impacts– Municipal WWTPs

Affected dischargers will have to determine the significance of any new or more stringent permit requirements for metals, evaluate alternative actions in response, and implement appropriate measures in order to comply with the requirements. Those dischargers identified as potentially impacted will have to take deliberate steps and, in some cases, expend capital resources for facility improvements or other compliance measures.

The potential impacts to POTW permits fall into five general levels. Each level in turn leads to a general sequence of steps, which provides a basis for estimating compliance costs for POTWs. The levels used to gauge the type and degrees of impact are:

- <u>'No Action' Level</u>: The facility is clearly expected to not receive one or more limits for cadmium, lead, and/or nickel based on existing metals control efforts. The Division estimates 210 facilities fall in this category (see Figure III.B-7).
- <u>'Monitoring' Level</u>: The facility no longer warrants metals limits based on RPAs and reverts to 'monitoring only' status. Six facilities are projected in this category.
- <u>Level I</u>: The facility's effluent data are not sufficiently sensitive to determine if limits will be required. For instance, an RPA might indicate that the allowable effluent concentration for a metal is 5 µg/L, but the facility currently has a limit of 25 µg/L and all effluent test results have been reported as '<20 µg/L.' The Division conservatively assumes that the nine facilities with indefinite impact mentioned will fall in this category and incur costs related to Level I actions in addition to monitoring.
- <u>Level II</u>: The facility shows marginal 'reasonable potential' to cause an exceedance of surface water standards for metals. RPAs indicate that the maximum predicted effluent value is greater than the maximum allowable concentration for one or more metals but no effluent data exceeded the projected effluent limits. Such facilities are expected to make some improvements to comply with any new metals limits; for example, source

controls, public education, basic chemical addition with secondary clarification. Based on the extrapolation of evaluated permits to the entire permit population, nine of the 50 facilities with more stringent or new WQBELs fall in this category and incur Level II costs in addition to monitoring costs. Additionally, some of the nine facilities with indefinite impact will also perform Level II steps based on the outcome of steps taken in Level I.

- Level III: The facility clearly shows 'reasonable potential' and is expected to receive one or more limits for one or more target metals. The Division estimates that 41 facilities of the 50 with more stringent or new WQBELs fall in this category. In addition, other facilities may need to perform Level III steps based on outcomes from Level II. Level III control measures include source identification & controls, PAX chemical flocculation with existing secondary or new tertiary clarification, and membrane filtration, in addition to Level II measures.

The six facilities with the 'Monitoring' Level impacts are expected to realize savings from reduced monitoring costs. All 59 of the facilities with Level I-III impacts are conservatively assumed to incur new monitoring costs.

The Division estimates that the economic impacts of the proposed rule changes on municipal wastewater dischargers will be approximately $127 million for the first twenty years of implementation and $150 million for the first thirty years (NPV, 2014 dollars, 7% discount 2% inflation). Table III.B-11 at the end of this subsection summarizes these costs by year and by ownership. For more detailed computations of the impact from the proposed rule change, see *Appendix III.9: Wastewater Discharges – Cost Information* and *Appendix III.10: Wastewater Dischargers – Cost Calculations*.

The Division assumes that municipal dischargers will use existing means to obtain funding for these costs. Commonly available means include application for grants and loans from state and federal agencies, sale of municipal bonds, and increases in sewer use rates. Note that in the case of loans or bonds, the municipals dischargers would incur an interest expense that is not included as a cost in this analysis.

6. Methods and Assumptions – Municipal WWTPs

General compliance options are described earlier in this chapter. Permittees may elect to pursue any or all of these, or they may choose other options that better suite their situation.

The Division's assessment of POTWs treated target metal requirements in each permit as if they were equivalent metals; that is, as if the available compliance options are the same when the permit includes limits for any or all of the target metals. For example, RPA results were treated as 'no change' if the RPA showed a permit with multiple existing limits would gain or lose a limit for one of the metals.

In most of the permits evaluated, new limits for cadmium or lead (and sometimes nickel) are estimated to be significantly more stringent than existing limits, often 25-50% of existing limits. These POTWs have some options to address the new limits. They can verify their effluent measurements using clean techniques; locate and control sources of the metals of concern in their wastewater; evaluate, design, and install treatment process improvements to remove the metals at the POTW; or pursue some combination of these approaches.

For the purposes of this fiscal note, the Division assumed that impacted POTWs would follow one of three general courses of action, Levels I-III, in response to more stringent metals requirements in their permits. Each is a combination of compliance steps that would generally be implemented in a tiered fashion until the desired results are achieved. These steps are not required or recommended approaches but represent, in the Division's view, reasonable approaches to complying with the new metals requirements.

The treatment of sidestreams (e.g., return flows from solids handling operations), which can carry elevated concentrations of metals, has been shown to be an effective and cost-effective method of controlling metals in some POTWs. The Division did not evaluate this alternative because sidestreams have different chemical characteristics that are facility-specific, but recognizes it may be a potential part of an effective control strategy and may drive down the estimated costs presented in this analysis.

The Division identified unit costs or savings for each action, linked them to each step in the three courses of action, and applied the costs to the estimated numbers of impacted dischargers to calculate the economic impacts for each. Although the Division initially evaluated individual municipal dischargers, the compliance measures and resulting costs were developed without consideration of individual facilities. Assumptions, unit costs and equations used to estimate impacts to municipal dischargers are summarized in *Appendix III.9: Wastewater Discharges – Cost Information*.

<u>'Monitoring' Level:</u> The Division assumed that the six POTWs falling under the Monitoring Level would realize monitoring savings of $120 per year (one metal, reduced from monthly to quarterly monitoring, $15 per sample).

Additionally, it is assumed the other 59 facilities (9 with indefinite impacts and 50 with new or continued WQBELs) would invest in clean sampling techniques, and as a result would each incur capital costs of $3,870 and annual costs of $7,580 (based on 2010 estimates inflated to 2014 dollars).

<u>Level I:</u> The potential first step for the 9 facilities classified under Level I would be for the dischargers to work with their certified laboratories to report metals analyses at the practical quantitation limit (PQL) so that subsequent RPAs can clearly indicate whether limits are warranted. This is referred to as Step 1. Based on best professional judgment, the Division assumed that:

- Analytical results reported to the metal's PQL would cost no more than those currently reported;
- 50% (4) of the ensuing RPAs would call for metals limits in the facilities' permits; and
- For the purposes of sensitivity analysis, a low of 20% and a high of 80% of these permits would receive limits instead of the 50% mentioned in the bullet above.

The Level I facilities expected to receive limits (4 facilities under the 50% assumption) were added to those already assigned to Level II and were included as part of those calculations.

As mentioned above, all Level I facilities are assumed to adopt clean sampling techniques.

<u>Level II:</u> The Division expects that 9 POTWs directly assigned to Level II and the four carried over from Level I will adopt clean sampling techniques in order to minimize potential contamination of effluent samples (as mentioned above). This same general approach has already been used by several POTWs to successfully demonstrate that they do not show reasonable potential to exceed the mercury standard.

The Division assumed that 50% of the ensuing RPAs (20% low, 80% high range) will call for metals limits and require Level II actions.

The Division assumed that eight POTWs would undertake source controls by identifying the sources of the limited metals and implementing measures to control those sources. POTWs with pretreatment programs already have considerable information from past industrial user surveys and may be able to revise local permit limits to achieve necessary reductions. Some might first have to conduct special studies designed to locate sources in their service areas. POTWs with no pretreatment program might conduct similar studies for the same purpose. Public education that targets commercial and medical sources of metals can also be effective in some situations.

The Division assumed that those eight facilities would also evaluate alternate means to improve or supplement its treatment processes to actively remove metals. Because the facilities in Level II show only marginal reasonable potential, the Division assumes that a chemical precipitation process added at the existing secondary clarifiers will capture sufficient amounts of metals to comply with permit limits. This approach requires either the addition of new chemical storage and feed systems or a nominal increase in chemical dose for those with existing feed systems. To be conservative, it is assumed that affected POTWs would install new feed and storage systems.

Initial implementation/capital costs and annual operating costs are shown in Table III.B-9 below. Costs for installation of these systems, operations and maintenance, and residuals disposal are based on those developed by the Chesapeake Bay nutrient program for the use of alum for phosphorus removal. Chemical addition is assumed to be equivalent to removing 0.5 mg/L phosphorus, and all costs are adjusted to 2014 dollars. The Division assumed that 25% of POTWs evaluating treatment alternatives (10% low end, 30% high) will choose more advanced systems and proceed to Level III.

Table III.B-9
Number of Level II POTWs and Estimated Capital/ Initial Implementation Costs & Annual Operating Costs per POTW ($Thousands)

Steps	# POTWs			Costs	
	Low Est.	DWR Est.	High Est.	Implementation/ Capital	Annual Operations
1. Report results to PQL	-	-	-	-	-
2. Improved Sampling & Analysis*	9	9	9	-	-
3. Source Identification	4	8	14	-	-
A. Public Education	1	2	4	$25-50	-
B. Pretreatment Controls	3	6	10	$25-50	-
4. Evaluate Treatment Options	1	4	7	$25-50	-
A. Chemical Precipitation with Secondary Clarification	1	4	7	$391	$107

* Note, Step 1, working with certified labs to report at PQL, is a Level I action and is not included in this table.

Level III: The Division expects that 29 Level III POTWs (70%; 50% low estimate, 85% high) will require additional measures beyond Level I or II to comply with limits. Measures again include source identification and control and, if necessary, evaluation of treatment options. Treatment options include simple chemical precipitation (same as in Level II), polyaluminum chloride (PAX) precipitation with existing secondary clarifiers, PAX precipitation with tertiary clarifiers, and membrane filtration.

Initial implementation/capital costs and annual operating costs are shown in Table III.B-10 below. Capital and annual operating costs for the PAX and membrane filtration options are based on the unit costs used in the League of Municipalities estimates, adjusted to 2014 dollars.

Facility costs are based on an average daily capacity of 6.82 MGD, the average of all POTWs potentially subject to metals requirements.

Table III.B-10
Number of Level III POTWs and Estimated Capital/ Initial Implementation Costs & Annual Operating Costs per POTW ($Thousands)

Steps	# POTWs			Costs	
	Low Est.	DWR Est.	High Est.	Implementation/ Capital	Annual Operations
1. Report results to PQL	-	-	-	-	-
2. Improved Sampling & Analysis	41	41	41	-	-
3. Source Identification	20	29	35	-	-
A. Public Education	5	7	9	$25	-
B. Pretreatment Controls	15	22	26	$25	-
4. Evaluate Treatment Options	18	24	26	$35	-
A. Chemical Precipitation with Secondary Clarification	11	11	9	$391	$107
B. PAX & Existing Secondary Clarification	5	9	10	$784	$405
C. PAX & New Tertiary Clarification	2	3	4	$8,579	$405
D. Membrane Filtration	0	1	3	$39,219	$1,440

The Division's projections assume that any given measure is either fully effective or not effective. The projections do not account for the possibility that some measures might be effective if only partially implemented.

The resulting cost estimates are the sums of costs and savings for treatment system improvements, operations & maintenance, special studies, changes in monitoring requirements, and other measures. For the purposes of this fiscal analysis, economic impacts equal costs *plus* savings.

7. Methods and Assumptions – Indirect Dischargers

The Division considered actions that the pretreatment POTWs might pursue in order to develop and implement new MAHLs in response to their new water quality-based metals limitations:

Improve Metals Monitoring: Approximately half of the pretreatment POTWs evaluated will need to generate additional effluent metals data using lower reporting limits that are consistent with established PQLs in order to determine the need for, and compliance with, metals limits based on the proposed metals standards.

Review the HWA calculations: Some POTWs may benefit from reconsidering their uncontrollable loading to determine if a different method is more appropriate or if more recent data support a more favorable removal rate. The decision sometimes depends on whether the POTW wishes to provide additional protection or the data was reported as below the PQL. Employing clean sampling techniques and reporting metals data at levels consistent with laboratory PQL concentrations may enable Pretreatment POTWs to more accurately measure their metals removal rates, uncontrollable metals loadings, and SIU metals loadings, which may in turn result in increased values for their MAHL and MAIL metals loadings.

Reduce local metals limits for SIUs as necessary to eliminate any over-allocations: Eighteen percent of the pretreatment POTWs evaluated will receive lower water quality-based AHL for cadmium that is less than the expected Practical Quantitation Limit of 1 µg/L. The sums of uncontrollable loading and SIU loadings for these POTWs were less than their projected MAHLs, but compliance cannot be confirmed based on the existing sampling results. The apparent over-allocation will be allowed and is acceptable to the US EPA compliance programs, as long as the effluent results remain less than the PQL.

Having to perform an “extra” HWA is not out of the ordinary and is considered a negligible manpower cost. SIU permits are routinely modified as necessary at almost all POTWs. Since these actions are expected as part of a municipality’s pretreatment program, they were not considered as added costs in this fiscal note. Costs associated with source controls, additional monitoring, using appropriate PQLs, clean sampling techniques, and supplemental or improved treatment to remove metals at the POTWs were all assessed as impacts to the POTWs in the previous section.

Some POTWs will have to reduce SIU permit limits to resolve over-allocations. Other POTWs may choose to reduce permit limits to a number closer to what the SIU actually discharges in order to have more available capacity. In either case the POTW will need to work closely with industrial users and communicate the reasons for program changes and the effect on those users. These educational efforts by the pretreatment coordinators will most likely represent the greatest investment of manpower. Typically, a HWA is revised every five years. In some cases, the permit renewal does not coincide with the HWA requirement. Therefore, some POTWs may have to revise their HWAs prior to their full five-year term, although every effort will be made to avoid that circumstance. Some SIU permits may have to be modified prior to their expiration date.

Thus, based on its analyses of the 32 pretreatment POTWs, the Division does not anticipate that the proposed metals standards will result in additional costs to municipal WWTPs and their pretreatment programs beyond those already identified; nor does it anticipate impacts to their SIUs.

8. Comparison to NC League of Municipalities Assessment

In 2010, the North Carolina League of Municipalities (NCLM) sponsored a study to (1) assess the likely impacts of the then-newly-proposed revisions to the metals standards on POTWs’ permits and (2) estimate the cost to local governments of complying with any new requirements. The League reported the results of its initial review in September of that year.

Given the large number of facilities and the complexity of conducting individual assessments, the League’s analysis focused on a representative set of 26 POTWs. Reasonable Potential Analyses were conducted for each facility for cadmium, copper, lead, nickel, silver, and zinc (the Division’s ‘target metals’) to determine what limits would be likely at each facility under the proposed standards. HWAs were recalculated for a number of the facilities in order to estimate potential impacts on local limits for SIUs. Several potential compliance options available to the POTWs were identified, and the cost of implementing those options was estimated, providing a range of possible impacts.

The analysis assumed that the requirements in 15A NCAC 02B .0211 and .0220 regarding “Action Levels for Toxic Substances” would be eliminated and, as a result, found that most of the POTWs would receive copper, silver, and/or zinc limits for the first time. Lacking hardness data for the facilities’ discharges and receiving streams, a worst-case value of 25 mg/L hardness for effluent and instream flows was used in the RPA calculations.

The League's report concluded that:

- essentially all POTWs with an IWC greater than 15% will receive one or more metals limits under the proposed standards;
- the metals limits will be sufficiently stringent that POTWs must make significant treatment system improvements in order to comply;
- in most cases, uncontrollable sources, not industrial users, are the most significant source of metals at the POTW, and the local government must bear the cost of any improvements; and
- the cost to local governments statewide could range from roughly $600 million to more than $6 billion over a 20-year period.

The Division's assessment is similar to the League's in many respects, and the Division agrees with the League's conclusions that the proposed standards could have significant impacts on some POTWs.

However, the Division's assumptions and methods differed from the League's in certain key respects. The Division used the fact that the rules regarding "Action Levels for Toxic Substances" will remain in effect. Staff used available facility-specific effluent and instream hardness data to calculate discharge-specific metals values for use in the RPAs. And they evaluated a larger set of POTWs from across the state so as to determine the proposed standards' impacts for a wider range of circumstances.

These differences account for most of the differences in the Division's and the League's findings as to the degree and potential costs of those impacts.

9. References & Data Sources – Municipal

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Table III.B-11
Summary of Estimated Economic Impacts of Proposed Metals Standards (in $Millions)
Wastewater Discharges – Municipal WWTPs [1,2,3]

	Private				Local Government				State Government				Federal Government				All
Year	**Planning**	**Capital**	**O&M**	**Total**	**Planning**	**Capital**	**O&M**	**Total**	**Planning**	**Capital**	**O&M**	**Total**	**Planning**	**Capital**	**O&M**	**Total**	**Total**
2017	$-	$-	$-	$-	$-	$0.05	$0.09	$0.14	$-	$-	$-	$-	$-	$-	$-	$-	$0.14
2018	$-	$-	$-	$-	$0.45	$0.05	$0.19	$0.68	$-	$-	$-	$-	$-	$-	$-	$-	$0.68
2019	$-	$-	$-	$-	$0.35	$3.17	$1.51	$5.03	$-	$-	$-	$-	$-	$-	$-	$-	$5.03
2020	$-	$-	$-	$-	$0.29	$50.59	$4.57	$55.45	$-	$-	$-	$-	$-	$-	$-	$-	$55.45
2021	$-	$-	$-	$-	$0.42	$1.61	$5.29	$7.32	$-	$-	$-	$-	$-	$-	$-	$-	$7.32
2022	$-	$-	$-	$-	$0.36	$11.32	$6.82	$18.50	$-	$-	$-	$-	$-	$-	$-	$-	$18.50
2023	$-	$-	$-	$-	$0.02	$2.74	$7.95	$10.71	$-	$-	$-	$-	$-	$-	$-	$-	$10.71
2024	$-	$-	$-	$-	$0.01	$8.58	$8.36	$16.95	$-	$-	$-	$-	$-	$-	$-	$-	$16.95
2025	$-	$-	$-	$-	$-	$-	$8.36	$8.36	$-	$-	$-	$-	$-	$-	$-	$-	$8.36
2026	$-	$-	$-	$-	$-	$-	$8.36	$8.36	$-	$-	$-	$-	$-	$-	$-	$-	$8.36
Cost projections are inherently uncertain, those beyond 10 years even more so. Estimates for Years 11-30 are provided only for general comparison with the benefits estimates presented elsewhere in this document.																	
Yrs 1-10	$-	$-	$-	$-	$1.9	$78.1	$51.5	$131.5	$-	$-	$-	$-	$-	$-	$-	$-	$131.5
Yrs 11-20	$-	$-	$-	$-	$-	$-	$83.6	$83.6	$-	$-	$-	$-	$-	$-	$-	$-	$83.6
Yrs 21-30	$-	$-	$-	$-	$-	$-	$83.6	$83.6	$-	$-	$-	$-	$-	$-	$-	$-	$83.6
Yrs 1-30	$-	$-	$-	$-	$1.9	$78.1	$218.6	$298.6	$-	$-	$-	$-	$-	$-	$-	$-	$298.6
NPV, 10 Yrs	$-	$-	$-	$-	$1.4	$56.5	$33.3	$91.2	$-	$-	$-	$-	$-	$-	$-	$-	$91.2
NPV, 20 Yrs	$-	$-	$-	$-	$1.4	$56.5	$69.8	$127.7	$-	$-	$-	$-	$-	$-	$-	$-	$127.7
NPV, 30 Yrs	$-	$-	$-	$-	$1.4	$56.5	$92.4	$150.3	$-	$-	$-	$-	$-	$-	$-	$-	$150.3

Footnotes:
[1] Economic impacts are the gross sum of estimated costs plus savings.
[2] Annual impacts presented in the table are not adjusted for inflation.
[3] Net Present Values (NPVs) are 2014$, calculated using a discount rate of 7% after annual impacts were adjusted using an annual inflation of 2%.

(h2) Wastewater Dischargers – 100% Domestic WWTPs

1. Description and General Baseline – 100% Domestic

The '100% Domestic' WWTPs are those private and public wastewater facilities that treat less than 1.0 MGD of domestic wastes. This group of dischargers includes schools, residential developments, churches, and other small facilities.

Domestic WWTPs hold 474 (38%) of the 1,250 individual NPDES wastewater permits in North Carolina and account for 30.2 MGD (1.6%) of all permitted flows statewide. Of these, 456 permits apply to discharges to freshwater, and the remaining 18 are for discharges to saltwater.

Domestic WWTPs, like POTWs, are designed to remove oxygen-consuming materials from wastewaters and employ biological treatment processes. The dischargers already own and operate treatment facilities necessary to comply with permit requirements.

Highlights – 100% Domestic WWTPs

Total Permits:			474
Permitted Flow (MGD)	- Total:		30.2
	- Average:		0.064
	- Median:		0.018
Freshwater Discharges:		456	96%
Saltwater Discharges:		18	4%
Permits with:		No.	% of Total
- Affected Metals Requirements:		0	0%
Affected Metals Limits:		0	0%
Cd, Pb, Ni Limits:		0	0%

2. Description of Regulatory Impacts – 100% Domestic

Due to their domestic nature, these wastewaters have historically not been a significant source of metals. As a result, none of the 474 permits contains requirements for any of the metals affected by the proposed rules.

3. Cost Baseline – 100% Domestic

None of the facilities provides treatment for metals removal.

4. Estimated Economic Impacts – 100% Domestic

The Division projects that that these facilities will incur no costs and realize no savings as a result of the proposed changes to Rules 15A NCAC 02B .0211 and .0220.

5. References & Data Sources – 100% Domestic

- The proposed rules.
- Basinwide Information Management System (BIMS), 2011.

(h3) Wastewater Dischargers – Industrial WWTPs

1. Description and General Baseline – Industrial

Industrial WWTPs include those private and public wastewater facilities that are associated with commercial or industrial operations. For the purposes of this fiscal note, the category also includes institutional and similar facilities that treat domestic and commercial wastewaters (e.g., laundries, food services) or that treat more than 1 MGD of domestic waste and so do not fit into the municipal or “100% domestic <1 MGD” categories. Industrial facilities as a whole are a significant source of metals in surface waters; the types and amounts of metals depend on the nature and size of the industrial facilities and their processes.

Industrial WWTPs hold 225 (18%) of the 1,250 individual NPDES wastewater permits in North Carolina. The 111 industrial permits that specify flow limits total 379 MGD, or 20% of all permitted flows statewide. Of the 225 industrial permits, 194 are issued to facilities that discharge to freshwater, and the remaining 31 are for discharges to saltwater.

Highlights – Industrial WWTPs

Total Permits:		225
Permitted Flow (MGD)	- Total:	379.1*
	- Average:	3.42*
	- Median:	0.45*
Freshwater Discharges:	194	86%
Saltwater Discharges:	31	14%
Permits with:	No.	% of Total
- Affected Metals Requirements:	85	38%
Cd, Pb, Ni Requirements:	36	16%
Affected Metals Limits:	47	21%
Cd, Pb, Ni Limits:	18	8%
- No Affected Metals Require’ts:	140	62%

* 111 industrial permits have flow limits.

The 225 industrial facilities with NPDES wastewater permits consist of the following:

- 35 power generation facilities, including wood-, coal-, and natural gas-fired (25), nuclear (3), and hydropower (7) facilities;
- 20 chemicals manufacturing facilities;
- 16 textiles manufacturing facilities;
- 25 primarily domestic WWTPs associated with industrial operations or with hospitals and other institutions, including three state facilities and three military bases;
- 29 food and seafood processing and similar facilities;
- 11 mining and processing operations;
- 47 oil terminals and other petroleum facilities;
- 7 pulp and paper mills;
- 10 wood products facilities; and
- 25 miscellaneous operations or facilities.

Of these dischargers, 85 include requirements for the affected metals, of which 47 include limits for one or more of those metals. Thirty-six permits with metals requirements include cadmium, lead, and/or nickel requirements, of which 18 include limits. The remaining 140 (62% of the 225 industrial permits) do not warrant or include limits or monitoring requirements for metals at this time.

Of the 85 facilities subject to requirements for affected metals, 78 discharge to freshwater, the rest to saltwater. Of these 85 facilities, 79 are privately owned, two others (a public landfill and a former industrial WWTP) are owned by municipal agencies, two (a vehicle maintenance facility and a cogeneration facility) are state-owned, and two are federal military bases.

The US EPA has established treatment performance standards, like Effluent Guidelines, for many industrial categories. These treatment performance standards provide the basis for technology-based effluent limits for these categories of dischargers.

Water quality-based limits are included in permits only when the discharge shows reasonable potential to cause a water quality standards exceedance in the receiving stream and the resulting water quality-based limitations are more stringent than applicable technology-based limitations, such as from Effluent Guidelines. Approximately ten industrial permits currently include water quality-based limits for one or more of the affected metals. Other metals limits in these ten permits or in the 37 other industrial permits with metals limits are technology-based limits and are, therefore, not impacted by the proposed rules.

The characteristics of industrial wastewaters vary among individual facilities much more than do those of domestic and municipal wastewaters, and industrial treatment processes vary to accommodate those differences. Industrial treatment systems can include biological treatment processes similar to those used in municipal systems, but many employ physical/ chemical processes, alone or in combination with biological processes. The existing industrial dischargers already own and operate such treatment facilities as are necessary to comply with permit requirements.

2. Description of Regulatory Impacts – Industrial

2.1 Methodology and Assumptions

The Division focused its evaluation of industrial dischargers on the 85 permits that currently contain limitations or monitoring requirements for one or more of the affected metals. It assumed that, as with the municipal dischargers, industrial facilities that are already subject to water quality-based requirements for metals are the most likely to be affected by the proposed standards revisions. The Division further assumed that proposed changes to water quality standards for cadmium, lead, and nickel are the most likely to impact the dischargers. It identified 36 industrial permits with cadmium, lead, and/or nickel requirements (out of the 85 permits with limits or monitoring for affected metals). A complete list of all facilities evaluated is included in *Appendix III.4: Wastewater Discharges – List of Permits Evaluated*.

Twenty-three of these 36 permits fall into one of four industrial groups (which in turn account for 53 of the 85 industrial permits with requirements for the affected metals). The Division chose 17 of the 36 facilities from the four groups and added six other facilities of various types that have requirements for cadmium, lead, or nickel, for a total of 23 facilities for further evaluation:

- Metals forming or finishing: 4 of 5 with cadmium, lead, and/or nickel requirements,
- Steam electric power generation (excluding hydropower and nuclear power): 6 of 24,
- Chemicals manufacturing: 4 of 13,
- Textiles manufacturing: 3 of 11, and
- Other facilities with Cd, Ni, Pb requirements: 6 of 12.

Not all permits in each group include requirements for cadmium, lead, or nickel.

Only one industrial facility with water quality-based limits (for lead) discharges to saltwater; therefore, no distinction was made between discharges to saltwater and freshwater in these evaluations.

The Division assembled the most recent Reasonable Potential Analyses for each facility and re-ran them using the proposed metals standards. It then compared projected and existing requirements in each case to determine the probable impacts on the facilities' permit requirements. Any permit with new or continued WQBELs for target metals was considered 'more stringent.' In this case, the Division estimated the economic impacts to the facility assuming that compliance action would be required to meet the limit(s) and that monitoring costs would rise with the increased frequency per the current schedule. Any permit expected to lose all WQBELs and revert to monitoring only was considered 'less stringent' and reduced monitoring costs were calculated. Facilities losing one or more – but not their last – WQBEL and still subject to TBELs were counted as 'no impact' since they would still have to control other metals. Permits expected to continue with monitoring requirements only or with no metals requirements were also considered as 'no impact' permits.

The Division estimated the compliance costs for each of the four industrial groups listed above. Projected impacts vary significantly from one group to the next. The estimated regulatory impacts and compliance costs are summarized below.

2.2 Regulatory Impacts

The Division evaluated permits in the categories described above. *Appendix III.6: Evaluation of Industrial Wastewater Treatment Plant Permits* describes the methods used and the results for each subcategory.

The combined results of the evaluations (see Figure III.B-8) indicate that six of the 85 industrial facilities of interest will likely receive new or continued WQBELS as a result of the proposed metals standards. Two of the 85 are expected to revert to 'Monitoring Only' requirements, which would result in savings, and the remaining 57 facilities are not expected to be impacted. Together with the 140 facilities without affected metals requirement and 20 facilities with affected metal requirements that were screened, 217 facilities are estimated not impacted by the proposed rule change.

Figure III.B-8
Projected Permit Impacts, Metals Standards Industrial WWTPs

Subcategory	Permits	Evaluated
Metals Forming/Finishing	5	4
Steam Electric	24	6
Chemicals Mfg.	13	4
Textiles Mfg.	11	3
Others w/ Cd, Pb, Ni Req'ts	12	6
Others w/ No Cd, Pb, Ni Req'ts	20	(screened)
Others w/ No Aff. Metals Req'ts	140	(screened)
Totals	*225*	*23*

Subsets of Evaluated	Projected Impacts	Projected # Permits: More Stringent	Projected # Permits: Less Stringent	Projected # Permits: No Impact
3 of 4	New or continued WQBELs	3		
1 of 4	Continued TBELs			2
1 of 6	Continue WQBELs	1		
5 of 6	Cont. 'Mon. Only' or 'No Req'ts'			23
1 of 4	Revert to 'Mon. Only'		1	
3 of 4	No more stringent			12
1 of 3	Revert to 'Mon. Only'		1	
2 of 3	Cont. 'Mon. Only' or 'No Req'ts'			10
1 of 6	New or Cont'd WQBELs	2		
5 of 6	Continued 'Mon. Only'			10
(screened)	Continued 'No Req'ts'			20
(screened)	Continued 'No Req'ts'			140
23 of 23	***Subtotals***	*6*	*2*	*217*
			Total	***225***

No industrial facilities have WQBELs for action level metals; therefore, no impacts were assumed based on those metals.

3. Cost Baseline – Industrial

The facilities with individual NPDES permits and effluent limitations for one or more target metals already own and operate treatment systems or use other means to comply with those metals limits. They already conduct effluent monitoring for metals as required in their permits.

4. Estimated Economic Impacts - Industrial

The Division estimates that the economic impacts of the proposed rule changes on industrial wastewater dischargers will be approximately $16.8 million for the first twenty years of implementation and $19.6 million for the first thirty years (NPV, 2014 dollars, 7% discount 2% inflation). Table III.B-12 at the end of the subsection summarizes these costs by year and by ownership.

5. Description of Economic Impacts - Industrial

Affected dischargers will have to determine the significance of any new or more stringent permit requirements for metals, evaluate alternative actions in response, and implement appropriate measures in order to comply with the requirements. Those dischargers identified as potentially impacted will have to take deliberate steps and, in some cases, expend capital resources for facility improvements or other compliance measures.

Seven industrial facilities are projected to receive new or more stringent water quality-based limits for one or more target metals, and four are projected to revert to ‘Monitoring Only’ status. Compliance options and the resulting cost estimates for the different industrial subgroups are described below.

The nine impacted facilities will see changes in monitoring costs as a result. Implementation of clean-sampling techniques was not identified as a need; however, the estimates include an allowance for seven facilities with more stringent limits to implement them, in case those needs develop.

5.1 Methodology and Assumptions

The Division developed cost estimates for the seven industrial facilities projected to be impacted by the proposed revisions to the metals standards. The estimates were prepared for the same subcategories of industrial facilities.

The Division assumed that implementation of the proposed standards in each subcategory will be evenly distributed through the first permit renewal cycle. For example, if three facilities in a subcategory are affected, they would receive new limits and begin incurring costs in Years 1, 3, and 5 of implementation, respectively. Thus, the 10-year estimates do not represent ten years of costs for all three facilities (likewise for the 20- and 30-year estimates).

Affected facilities will receive new metals requirements at their next permit renewal after state adoption and EPA approval of the standards. The calculations of annual cost assume that each affected facility begins implementation in the first year of its new permit, designs its treatment system in the second and third years, and constructs any necessary improvements in the fourth year, leaving a full year for system start-up and optimization before any new metals limitations become effective.

The Division assumed facilities with more stringent requirements as a result of this rule change would incur monitoring costs of $120 per year. Additionally, it is assumed in the analysis that these facilities would invest in clean sampling techniques, and as a result would each incur capital costs of $3,870 and annual costs of $7,580 (based on 2010 estimates inflated to 2014 dollars).

5.2 Metals Forming/ Finishing – 3 facilities

The three facilities projected to receive more stringent metals limitations include two electroplaters and one metals forming facility. All have existing treatment systems. The type of system varies, but each is designed to comply with its particular effluent limitations.

For the purposes of this analysis, the Division assumes that each facility will employ secondary chemical precipitation units with clarification and multimedia filtration to meet new WQBELs that result from the proposed metals standards. The new treatment units would supplement existing treatment with a chemical feed system, reactor tank, and pumps, mixers, and other appurtenances; followed by a clarifier and multimedia filter. This is not a recommendation for this approach over other alternatives; nor is this approach necessarily sufficient to meet new limitations or compatible with existing treatment systems. However, it is meant to provide a reasonable measure of the potential costs of complying with more stringent limitations, and cost curves are available for similar systems.

Capital and operations & maintenance (O&M) costs are based on cost equations developed by the US EPA for metals treatment in the Centralized Wastewater Treatment category of industrial dischargers and are estimated at about $912,000 and $176,000, respectively, in 2014 dollars and assuming a quantity of design of 0.1 MGD (see *Appendix III.9: Wastewater Discharges – Cost Information*). The equations were developed in 1989, and costs were converted to 2014 dollars using the Engineering News-Record Construction Cost Indices for those years.

5.3 Steam Electric – 1 facility

The steam electric power generating facility that is projected to receive lower metals limitations routes its metals-bearing wastestreams to an ash settling basin to provide a degree of treatment prior to discharge. Several other facilities in North Carolina have installed chemical precipitation and clarification units to treat waters from their flue gas desulfurization (FGD) scrubbers (used to meet air emission limitations) and have demonstrated that this treatment is an effective means of reducing effluent metals concentrations. The affected facility does not yet employ such treatment.

The Division based its cost estimates for the affected facility upon recent efforts by the US EPA and by the Electric Power Research Institute (EPRI). Each estimated the costs of installing and operating a treatment system, similar to those in North Carolina, for FGD scrubber wastewaters at the Public Service of New Hampshire (PSNH) Merrimack Station.

The two organizations arrived at widely differing estimates. The US EPA estimated that a treatment system using chemical precipitation and clarification would cost $4.9 million to construct and $430,000 per year to operate and maintain. The EPRI estimated capital costs at $18 million and annual costs at $1,000,000.

The Merrimack Station has a generating capacity of 520 MW, approximately eight times that of the facility of interest here. Unit costs for a smaller treatment system are greater due to a reverse economy of scale. Lacking cost information for other facilities of different capacities, the Division assumed, based on best professional judgment, that the unit costs in the case of the North Carolina plant would be 40% of the Merrimack estimates rather than 13% (the relative generating capacity of the North Carolina plant). Therefore, for this analysis, the Division used the EPA figures to arrive at a low-range estimate of capital and annual costs of $1.96 million (40% x $4.9 million) and $172,000/year (40% x $430,000), respectively; and the EPRI figures were used for the high-range estimate of $7.2 million capital costs (40% x $18 million) and $400,000 annual costs (40% of $1,000,000).The Division computed the average value for capital and annual costs for a mid-range estimate.

5.4 Others Industrial Facilities – 3 facilities

The Division assumed that three facilities will install chemical precipitation (PAX option) and tertiary clarification units to comply with new metals limitations. It used the unit costs from the League of Municipalities report to estimate capital ($875,000/MGD capacity plus $10,000 in initial implementation cost for sludge disposal and some land related costs in 2010 dollars) and annual operating costs ($5,000/year/MGD capacity, plus $39,400/year/MGD in chemical costs, $1,000/year/MGD in electricity costs, and in 2010 dollars). These values were sufficiently general in nature to apply to the variety of facilities being evaluated. Dischargers in this group that are already subject to cadmium, lead, and/or nickel have an average permitted flow of 1.4 MGD.

The estimates for this subcategory include some local government costs. The Division considered one facility treating leachate from a municipal landfill to be more similar in nature to industrial facilities, and the Division included it in the industrial category to simplify its analysis.

6. References & Data Sources – Industrial

- The proposed rules.
- Basinwide Information Management System (BIMS), 2011.
- Electric Power Research Institute (EPRI), *Comments on the Draft Determination of Technology-Based Effluent Limits for the Flue Gas Desulfurization Wastewater at Merrimack Station in Bow, New Hampshire*, February 28, 2012, available at http://www.epa.gov/region1/npdes/merrimackstation/pdfs/comments/PC-19.pdf
- *Engineering News-Record*, Construction Cost Index History – accessed August 2011, ENR.com.
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- USEPA. Development Document for Proposed Effluent limitations Guidelines and Standards for the Centralized Waste Treatment Industry (Volume I), Washington, DC, EPA 821-R-98-020, 1998. Available online at http://water.epa.gov/scitech/wastetech/guide/cwt/proposal_develop_index.cfm.

Table III.B-12
Summary of Estimated Economic Impacts of Proposed Metals Standards (in $Millions) – Industrial WWTPs [1,2,3]

	Private				Local Government				State Government				Federal Government				All
Year	**Planning**	**Capital**	**O&M**	**Total**	**Planning**	**Capital**	**O&M**	**Total**	**Planning**	**Capital**	**O&M**	**Total**	**Planning**	**Capital**	**O&M**	**Total**	**Total**
2017	$-	$0.01	$0.01	$0.02	$-	$0.00	$0.001	$0.002	$-	$-	$-	$-	$-	$-	$-	$-	$0.02
2018	$-	$0.004	$0.02	$0.03	$-	$-	$0.002	$0.002	$-	$-	$-	$-	$-	$-	$-	$-	$0.03
2019	$-	$0.86	$0.20	$1.06	$-	$0.06	$0.02	$0.08	$-	$-	$-	$-	$-	$-	$-	$-	$1.13
2020	$0.01	$5.94	$0.55	$6.50	$0.001	$0.45	$0.04	$0.49	$-	$-	$-	$-	$-	$-	$-	$-	$6.99
2021	$-	$0.86	$0.73	$1.59	$-	$0.06	$0.06	$0.12	$-	$-	$-	$-	$-	$-	$-	$-	$1.70
2022	$-	$-	$0.73	$0.73	$-	$-	$0.06	$0.06	$-	$-	$-	$-	$-	$-	$-	$-	$0.79
2023	$0.01	$2.50	$0.97	$3.48	$0.00	$0.19	$0.07	$0.26	$-	$-	$-	$-	$-	$-	$-	$-	$3.75
2024	$-	$-	$0.97	$0.97	$-	$-	$0.07	$0.07	$-	$-	$-	$-	$-	$-	$-	$-	$1.04
2025	$-	$-	$0.97	$0.97	$-	$-	$0.07	$0.07	$-	$-	$-	$-	$-	$-	$-	$-	$1.04
2026	$-	$-	$0.97	$0.97	$-	$-	$0.07	$0.07	$-	$-	$-	$-	$-	$-	$-	$-	$1.04
Cost projections are inherently uncertain, those beyond 10 years even more so. Estimates for Years 11-30 are provided only for general comparison with the benefits estimates presented elsewhere in this document.																	
Yrs 1-10	$0.0	$10.2	$6.1	$16.3	$0.002	$0.8	$0.5	$1.2	$-	$-	$-	$-	$-	$-	$-	$-	$17.5
Yrs 11-20	$-	$-	$9.7	$9.7	$-	$-	$0.7	$0.7	$-	$-	$-	$-	$-	$-	$-	$-	$10.4
Yrs 21-30	$-	$-	$9.7	$9.7	$-	$-	$0.7	$0.7	$-	$-	$-	$-	$-	$-	$-	$-	$10.4
Yrs 1-30	$0.0	$10.2	$25.5	$35.7	$0.002	$0.8	$1.9	$2.7	$-	$-	$-	$-	$-	$-	$-	$-	$38.4
NPV, 10 Yrs	$0.0	$7.4	$4.0	$11.4	$0.001	$0.6	$0.3	$0.9	$-	$-	$-	$-	$-	$-	$-	$-	$12.2
NPV, 20 Yrs	$0.0	$7.4	$8.2	$15.6	$0.001	$0.6	$0.6	$1.2	$-	$-	$-	$-	$-	$-	$-	$-	$16.8
NPV, 30 Yrs	$0.0	$7.4	$10.8	$18.2	$0.001	$0.6	$0.8	$1.4	$-	$-	$-	$-	$-	$-	$-	$-	$19.6

Footnotes:
[1] Economic impacts are the gross sum of estimated costs plus savings.
[2] Annual impacts presented in the table are not adjusted for inflation.
[3] Net Present Values (NPVs) are 2014$, calculated using a discount rate of 7% after annual impacts were adjusted using an annual inflation of 2%.

(h4) Wastewater Dischargers – Groundwater Remediation Facilities

1. Description and General Baseline – Groundwater Remediation

The groundwater remediation facilities that are of interest in this fiscal note are those that pump and treat contaminated groundwater as part of a site cleanup. These sites and the underlying groundwater are most often associated with operations of an industrial nature, whether public or private. Metals can be pollutants of concern at these sites, depending on type of contamination.

Individual Permits. Groundwater remediation facilities hold 38 (3%) of the 1,250 individual NPDES wastewater permits in North Carolina. They account for 3.1MGD (<0.2%) of all permitted flows statewide. The majority of groundwater remediation facilities discharge to freshwater, and two discharge to saltwater.

Of the 38 groundwater remediation permits, 15 contain requirements for one or more of the affected metals, indicating that the metals are pollutants of concern at those facilities and have been reported in the effluent. Of the 15 permits, ten have requirements for cadmium, lead, and/or nickel: six with effluent limitations for lead and/or nickel and four with monitoring requirements only for cadmium, lead, and/or nickel.

All existing metals limitations for groundwater remediation facilities are water quality-based.

Highlights – GW Remediation Facilities

Total Permits (Individual):		38
Permitted Flow (MGD) - Total:		3.1*
- Average:		0.09*
- Median:		0.07*
- Freshwater Discharges:	36	95%
- Saltwater Discharges:	2	5%
Permits with:	No.	% of Total
- Affected Metals Requirements:	15	39%
Cd, Pb, Ni Requirements:	10	26%
Affected Metals Limits:	8	21%
Cd, Pb, Ni Limits:	6	16%
- No Affected Metals Requirements:	23	61%

General Permits with Metals Req'ts:	1 (NCG51)	
Certificates of Coverage (General Permits):		86
- Freshwater Discharges:		85
- Saltwater Discharges:		1

General Permit NCG51: The NCG51 general permit, the only general permit affected by metal standards, applies to petroleum-contaminated sites, including those with gasoline contamination. As of 2011, groundwater remediation sites subject to the NCG51 general permit accounted for 117 (0.7%) of all Certificates of Coverage (COCs) issued for NPDES wastewater general permits in North Carolina. When the NCG51 permit was renewed in September 2011 and permittees were required to apply for continued coverage under the permit, only 86 of the 117 groundwater facilities applied for renewal of their Certificates of Coverage. The other 31 COCs expired and were not included in this fiscal analysis.

All 86 facilities with current COCs are required to clean up contaminated groundwater resulting primarily from leaking petroleum Underground Storage Tanks (USTs). They are primarily regulated by the Division of Waste Management (DWM) but are also required to obtain NPDES permit coverage from the Division of Water Resources for any discharge to surface waters.

Eighty-five of the 86 facilities discharge to freshwater. Eighty-three are privately owned, two are state facilities operated by the North Carolina Department of Transportation, and one is a North Carolina National Guard facility funded by both the state and federal governments.

Under the current NCG51 general permit, dischargers are subject to a lead discharge limit. They are required to monitor for lead, other pollutants of concern, and discharge flow. Unlike facilities subject to individual NPDES permits, sites subject to COCs are required to maintain records of their discharges but do not submit discharge monitoring reports to the Division of Water Resources. In addition, the general permit provides that, if initial effluent testing does not indicate the presence of lead, the facilities can discontinue lead monitoring. Thus, effluent data for these facilities is extremely limited and was not readily available for this analysis.

2. Description of Regulatory Impacts – Groundwater Remediation

The Division will begin applying the revised metals standards in RPAs upon adoption of the proposed rule changes and subsequent US EPA approval of the standards. Metals requirements in the affected individual permits will be modified as necessary over a five-year period as part of the regular permit renewal process. Permits will include compliance schedules of up to five years if the changes result in more stringent limitations. Affected dischargers are expected to install and begin operation of all necessary treatment improvements – or implement other compliance measures – prior to the end of their compliance schedules and continue those efforts thereafter.

The Division will modify the lead limitation in the NCG51 permit at the next scheduled renewal of the permit in 2016 in order to reflect the new standards. Dischargers unable to meet the new standard can apply for an individual NPDES permit and, depending on their individual circumstances, might receive a less stringent lead limitation. If an individually permitted discharger cannot meet its limit initially, the Division will consider including a compliance schedule in the facility's permit.

Table III.B-13 summarizes the projected impacts to all groundwater remediation facilities. More detailed results of the evaluation are available in *Appendix III.7: Evaluation of Groundwater Remediation Permits*.

Table III.B-13
Potential Impacts to Groundwater Remediation Facilities

Permits/ COCs			Potential Impacts
Individual	NCG51	Total	
3	36	39	New or Revised WQBELs
7	0	7	Revert to Monitoring Only
28	50	78	No Impact
38	86	124	**Total**

The Division estimates that ten facilities with individual permits and 36 facilities subject to the NCG51 general permit will be impacted by new permit requirements for metals. Of these, it is estimated that 39 facilities would be subject to more stringent requirements and seven would receive less stringent permit requirements. The remaining 78 facilities are not expected to be impacted.

3. Cost Baseline – Groundwater Remediation

The facilities with individual NPDES permits and effluent limitations for one or more target metals already own and operate treatment systems or use other means to comply with those metals limits. They already conduct effluent monitoring and reporting as required in their permits and are subject to the associated permit fees and costs.

The same is true for facilities subject to the NCG51 general permit except that they are not required to submit reports.

4. Estimated Economic Impacts – Groundwater Remediation

Affected dischargers will have to determine the significance of any new permit requirements for metals, evaluate alternative actions in response, and implement appropriate measures in order to comply with the requirements. Those dischargers identified as potentially impacted will have to take deliberate steps and, in some cases, expend capital resources for facility improvements or other compliance measures. See also subsection (c) Description of Economic Impacts on section III.B.

The Division estimates that achieving compliance with the anticipated water quality-based metals requirements at groundwater remediation facilities will cost \$7.7 million for the first twenty years of implementation and \$9.6 million for the first thirty years (NPV, 2014 dollars, 7% discount, after adjusting annual impacts for 2% inflation). Table III.B-14 summarizes these costs by year and by ownership.

5. Methodology and Assumptions

The Division assumed very conservatively that all 39 groundwater remediation facilities projected to be impacted will install additional treatment for lead removal and that capital and operating costs would be similar for each remediation regardless of permit type or receiving water (fresh or salt). Cost estimates are based on unit cost information provided by the Division of Waste Management (DWM).

DWM provided cost estimates for thirteen of the facilities to upgrade their treatment systems to meet the projected lead limit in the permit. It estimates that the cost of installing additional treatment will be from \$5,000 to \$10,000 per site based on the use of a zeolite-based HS200 filtration media produced by Hydrosil LTD (email from DWM dated 2/3/2012). DWM also estimates that maintenance and sampling costs will run from \$1,000 - \$2,000 per month, or \$12,000 - \$24,000 per year for each facility.

The analysis include costs for additional monitoring of \$120 per year and implementation costs for clear sampling techniques of \$3,870 and annual cost of \$7,580 (based on 2010 estimates inflated to 2014 dollars). For more details, see *Appendix III.9: Wastewater Discharges – Cost Information and Appendix III.10: Wastewater Dischargers – Cost Calculations*.

The Division assumed that permit renewals for the affected sites would be distributed evenly over the first five-year permit term after approval of the standards and that installation of the treatment units would occur in Year 1 of the renewed permits.

DWR used the DWM ranges of costs to generate its upper and lower estimates and used the midpoint of each range to generate the estimate for this category of dischargers. These estimated costs are conservatively high for a number of reasons. DWM indicates that many groundwater facilities do not appear to be treating and discharging at this time and may not in the future. They expect that many of the 86 sites are using various treatment technologies, such as air sparging, for site cleanup and are only maintaining their certificates of coverage as a backup option should they need one.

Another consideration for these facilities is that the groundwater standard for lead is 15 µg/L (from the 15A NCAC 02L rules, Water Quality Standards Applicable to Groundwaters). A site may only have to operate until it reduces lead in the groundwater to 15 µg/L to satisfy DWM’s remediation requirements. At that point, the permittee would no longer have to treat for lead and could cease its discharge to surface waters, and the anticipated lead limit would have no real impact.

Some facilities may find relief from lead limits resulting from the proposed standards. Those that are classified as petroleum underground storage tank (UST) incident sites can request financial support for clean-up costs from DWM through the "Leaking Petroleum UST Cleanup Funds" program. Further, any facility subject to the NCG51 permit can apply for coverage under an individual NPDES permit, in which case site-specific factors such as IWC and effluent and instream hardness could result in a less stringent lead limit than that in the NCG51 general permit. These factors could affect the economic impacts of the proposed standards but are not addressed in the cost estimates presented here.

6. References & Data Sources – Groundwater Remediation

- The proposed rules.
- Basinwide Information Management System (BIMS), 2011.
- *Engineering News-Record*, Construction Cost Index History – accessed August 2011, ENR.com.
- *Engineering News-Record*, Construction Economics – accessed June 2012, ENR.com.
- Facilities data and incident site and cost information, provided by NCDENR Division of Waste Management, September 2011 and February 2012.

Table III.B-14
Summary of Estimated Economic Impacts of Proposed Metals Standards (in $Millions)
Wastewater Discharges – Groundwater Remediation Facilities [1,2,3]

	Private				Local Government				State Government				Federal Government				All
Year	Planning	Capital	O&M	Total	Planning	Capital	O&M	Total	Planning	Capital	O&M	Total	Planning	Capital	O&M	Total	Total
2017	$-	$0.01	$0.00	$0.01	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-	$-	$0.01
2018	$-	$0.29	$0.68	$0.97	$-	$-	$-	$-	$-	$0.01	$0.02	$0.02	$-	$0.003	$0.01	$0.01	$1.00
2019	$-	$0.01	$0.68	$0.69	$-	$-	$-	$-	$-	$-	$0.02	$0.02	$-	$-	$0.01	$0.01	$0.71
2020	$-	$0.01	$0.68	$0.69	$-	$-	$-	$-	$-	$-	$0.02	$0.02	$-	$-	$0.01	$0.01	$0.71
2021	$-	$0.01	$0.68	$0.69	$-	$-	$-	$-	$-	$-	$0.02	$0.02	$-	$-	$0.01	$0.01	$0.72
2022	$-	$-	$0.68	$0.68	$-	$-	$-	$-	$-	$-	$0.02	$0.02	$-	$-	$0.01	$0.01	$0.71
2023	$-	$-	$0.68	$0.68	$-	$-	$-	$-	$-	$-	$0.02	$0.02	$-	$-	$0.01	$0.01	$0.71
2024	$-	$-	$0.68	$0.68	$-	$-	$-	$-	$-	$-	$0.02	$0.02	$-	$-	$0.01	$0.01	$0.71
2025	$-	$-	$0.68	$0.68	$-	$-	$-	$-	$-	$-	$0.02	$0.02	$-	$-	$0.01	$0.01	$0.71
2026	$-	$-	$0.68	$0.68	$-	$-	$-	$-	$-	$-	$0.02	$0.02	$-	$-	$0.01	$0.01	$0.71
Cost projections are inherently uncertain, those beyond 10 years even more so. Estimates for Years 11-30 are provided only for general comparison with the benefits estimates presented elsewhere in this document.																	
Yrs 1-10	$-	$0.3	$6.1	$6.5	$-	$-	$-	$-	$-	$0.01	$0.1	$0.2	$-	$0.003	$0.1	$0.1	$6.7
Yrs 11-20	$-	$-	$6.8	$6.8	$-	$-	$-	$-	$-	$-	$0.2	$0.2	$-	$-	$0.1	$0.1	$7.1
Yrs 21-30	$-	$-	$6.8	$6.8	$-	$-	$-	$-	$-	$-	$0.2	$0.2	$-	$-	$0.1	$0.1	$7.1
Yrs 1-30	$-	$0.3	$19.8	$20.1	$-	$-	$-	$-	$-	$0.01	$0.5	$0.5	$-	$0.003	$0.2	$0.2	$20.8
NPV, 10 Yrs	$-	$0.3	$4.2	$4.5	$-	$-	$-	$-	$-	$0.01	$0.1	$0.1	$-	$0.003	$0.05	$0.1	$4.6
NPV, 20 Yrs	$-	$0.3	$7.2	$7.5	$-	$-	$-	$-	$-	$0.01	$0.2	$0.2	$-	$0.003	$0.1	$0.1	$7.7
NPV, 30 Yrs	$-	$0.3	$9.1	$9.3	$-	$-	$-	$-	$-	$0.01	$0.2	$0.2	$-	$0.003	$0.1	$0.1	$9.6

Footnotes:
[1] Economic impacts are the gross sum of estimated costs plus savings.
[2] Annual impacts presented above are not adjusted for inflation.
[3] Net Present Values (NPVs) are 2014$, calculated using a discount rate of 7% after annual impacts were adjusted using an annual inflation of 2%.

(h5) Wastewater Dischargers – Water Treatment Plant Discharges (WTPs)

1. Description and General Baseline – WTPs

Water treatment plants are public or private facilities that treat raw water from ground or surface water sources in order to produce water suitable for human consumption or industrial or other use. The water purification processes generate wastestreams that can require additional treatment for metals and other pollutants prior to discharge to surface waters.

Water treatment plants hold 221(18%) of the 1,250 individual NPDES wastewater permits in North Carolina. The 108 permits with flow limitations account for 168 million gallons per day (9% of all permitted flows statewide). The majority (175) of the 221 facilities discharge to freshwater streams, the remaining 46 to saltwater.

Highlights – WTP Discharges

Total Permits:		221
Permitted Flow (MGD)	- Total:	168.1*
	- Average:	1.56*
	- Median:	0.06*
- Freshwater Discharges:	175	79%
- Saltwater Discharges:	46	21%
Permits with:	No.	% of Total
- Affected Metals Requirements:	216	98%
Cd, Pb, Ni Requirements:	42	19%
Affected Metals Limits:	8	4
Cd, Pb, Ni Limits:	5	2%
- No Affected Metals Requirements:	5	2%

* 108 of 221 permits have flow limits.

Of the 221 water treatment plant permits, 216 contain requirements for one or more of the metals affected by the proposed rules, indicating that the metals have been reported at significant concentrations in those effluents. Of the 216 permits, eight contain effluent limitations for one or more affected metals (five with limits for cadmium, lead, and/or nickel), and 208 have monitoring requirements only (37 with monitoring requirements for cadmium, lead, and/or nickel).

All existing metals limitations for WTPs are water quality-based limitations.

2. Potable Water Sources and Purification Processes – WTPs

Water Treatment Plants can utilize any of several processes to purify raw water for consumption. Different processes generate different types of wastewater with different characteristics; for example, filter backwash from conventional and green-sand systems, regeneration waters from ion exchange systems, or reject waters from reverse osmosis systems. Wastewaters can include significant concentrations of metals. The characteristics of each type of wastewater also vary from plant to plant, depending primarily on the characteristics of the raw water source. For permitting purposes, four types of water purification systems have been identified as having specific wastewater characteristics. See *Appendix III.8: Evaluation of Water Treatment Plant Permits* for more details.

It is not uncommon for these systems to be used in combination to produce drinking water of acceptable quality.

Water treatment plants are designed based on the nature and characteristics of their source waters (surface or groundwaters). Source water characteristics vary from stream to stream or well to well and also vary over time. Chemical usage, frequency of backwashes, and frequency of resin regeneration vary as the source water and other factors change. These factors lead to variability in the characteristics of the wastewaters generated in the water purification process and affect the water quality-based limitations that apply to the discharges.

NPDES permits govern different pollutants in WTPs' discharges. The parameters of concern depend on the type of water purification employed. Standard metals monitoring requirements for each type of system are as follows (including metals not affected by the proposed rule changes):

Table III.B-15
Metals of Concern in Water Treatment Process

Water Treatment Process	Metals of Concern
Conventional:	Cu, Fe, Mn[1], Zn[2]
Ion Exchange:	Cu, Pb, Fe, Mn[1], Zn[2]
Membrane & Reverse Osmosis:	As, Cu, Fe, Zn[2]
Greensand:	Fe, Mn[1], Zn[2]

[1] Manganese (Mn) are not affected by the proposed rule changes.
[2] Zn is only monitored if used in the treatment process

These facilities generally do not discharge cadmium, lead, or nickel, with the exception of ion exchange systems, which often generate wastewaters containing lead. As with all permits, other exceptions occur, and effluent limitations and monitoring requirements in each individual permit are evaluated and set according to the particular needs at each WTP.

In 2002, the Division undertook a multi-year effort to update its permitting strategy for WTPs. Much of the initial implementation of the strategy involves data collection, that is, more frequent monitoring of more parameters (including several metals) to determine which are pollutants of greatest concern for each type of WTP. The most recent addition to the strategy came in 2009, and staffs are still incorporating new requirements in these permits as part of the regularly scheduled renewals. Implementation of the latest requirements will be completed before the proposed metals standards are adopted. The discussion that follows assumes that, for the baseline condition, the WTP strategy will have been fully implemented.

3. Description of Regulatory Impacts – WTPs

Forty-two water treatment plants – 15 discharging to freshwater and 27 discharging to saltwater – currently have monitoring requirements (37 plants) or limitations (5 plants) for cadmium, lead, and/or nickel, indicating that these metals are already parameters of concern. The Division assumed that these 42 WTPs would be the most likely to receive metals requirements in the future.

The remaining WTPs do not monitor for cadmium, lead, and nickel, and it was assumed that these metals are not pollutants of concern in their wastewaters and that they will not be impacted. Most of these 42 facilities use ion exchange, membrane, and/or reverse osmosis systems in their water purification process. A complete list of all facilities evaluated is included in *Appendix III.4: Wastewater Discharges – List of Permits Evaluated*.

The Division reviewed effluent data or conducted reasonable potential analyses on the 42 facilities, as detailed in *Appendix III.8: Evaluation of Water Treatment Plant Permits*, to assist in determining the potential impacts of the proposed standards on the full group. Facilities discharging to freshwater were evaluated separately from those discharging to saltwater. A summary of the potential number of facilities impacted is presented below.

Table III.B-16
Summary of Potential Impacts to WTPs

Discharge to Freshwater	Discharge to Saltwater	Totals	Projected Impacts
1	10	11	New or Revised WQBELs, or action required
-	-	-	Revert to Monitoring Only
14	17	31	No impact based on review of effluent data
160	19	179	No impact - Cd, Pb, Ni are not metals of concern
175	46	221	Totals

4. Cost Baseline – WTPs

Water treatment plants with existing effluent limitations for one or more target metals already own and operate treatment systems or use other means to comply with those metals limits. They already conduct effluent monitoring and reporting as required in their permits and are subject to standard permit fees and related costs.

Estimated Economic Impacts - WTPs

The Division estimates that the economic impacts of these facilities achieving compliance with the anticipated water quality-based metals requirements are $2.1 million for the first twenty years of implementation and $2.3 million for the first thirty years (NPV, 2014 dollars, 7% discount, 2% inflation). Table III.B-18 summarizes these costs by year and by ownership.

Affected dischargers will have to determine the significance of any new or more stringent permit requirements for metals, evaluate alternative actions in response, and implement appropriate measures in order to comply with the requirements. Those dischargers identified as potentially impacted will have to take deliberate steps and, in some cases, expend capital resources for facility improvements or other compliance measures.

The Division considered several compliance alternatives for WTPs potentially subject to new metals requirements. Dischargers would pursue these to either meet new limitations or demonstrate conformance of the existing facilities with new surface water standards:

- Adopt clean-sampling techniques;
- Report analytical results to PQLs to better assess compliance;
- Modify plant operations (e.g., use well blending) to achieve compliance;
- Add a diffuser to the current outfall;
- Perform computer modeling or dye studies to determine available or needed dilution, for permitting purposes;
- Extend or relocate the current outfall to a larger body of water to gain greater dilution and increased limits; and
- Install treatment technologies to remove lead from either the WTP influent (source water) or wastewater streams (filter backwash or other concentrate).

This does not constitute a recommendation of any particular approach, nor is any one measure necessarily sufficient to meet new limitations or compatible with existing treatment systems. The list simply illustrates a range of alternative actions that are available to wastewater dischargers. Permittees will have to develop compliance strategies that best meet their individual needs within their own budgetary and other constraints.

6. Methodology and Assumptions

The proposed metals standards would not result in changes in WTP monitoring requirements. WTPs already monitor metals at a 1/month frequency under the new WTP permitting strategy, even though they have no metals limits. The seven impacted facilities will continue to monitor lead once per month after addition of the lead limits.

In addition, the Division assumed that these 11 WTPs could achieve more consistent laboratory PQL values (at no cost) and, to cover a variety of possible sampling and analytical costs, that one third (4) would implement clean-sampling techniques incurring initially $3,870 in costs and then $7,580 per year for maintenance (based on 2010 estimated inflated to 2014 dollars).

The estimated costs for these facilities include capital costs (varying between $12,000 and $500,000) and operating costs for plant improvements, chemicals costs (chemical precipitation alternative), allowances for evaluation of alternatives (outfall extension and treatment options), and changes in effluent monitoring requirements. Unit costs for these alternative actions are presented in more detail in *Appendix III.9: Wastewater Discharges – Cost Information* and cost calculations are available in *Appendix III.10: Wastewater Dischargers – Cost Calculations*.

All of the impacted facilities are relatively small (much less than 1 MGD), and the Division based its estimates on an average permitted flow of 0.1 MGD per WTP. Due to the uncertainties regarding the permit impacts and the resulting costs to the dischargers, the Division generally used unit costs for larger facilities and over-estimated the costs to these WTPs.

For each compliance alternative, the Division assumed that the affected permits' renewals (and initial compliance actions) would be evenly distributed over the five-year permit cycle.

The most costly compliance alternatives are the addition of chemical precipitation units and the extension of outfalls. To generate low-end and high-end estimates, the Division varied the number of WTPs affected and the numbers likely to employ each of these alternatives, as follows:

Table III.B-17
Alternative Actions - WTPs

Alternative Action	# Affected Dischargers		
	Low-End	Projected	High-End
1. Dye study/ modeling for existing or proposed diffuser	1	1	1
2. Diffuser & outfall extension	1	2	1
3. Extend existing outfall line (minor)	0	1	2
4a. Add-on cartridge filtration of effluent	4	5	6
4b. PAX addition + 3° clarification	1	2	4
Totals	7	11	14

Table III.B-18 summarizes the annual and total estimated costs for Years 1-10, the total costs for Years 11-20, 21-30, and 1-30 and the 10-Year, 20-Year, and 30-Year Net Present Values calculated using a discount rate of 7% and 2% annual inflation rate.

7. References & Data Sources – WTPs

- The proposed rules.
- Basinwide Information Management System (BIMS), 2011.
- *Engineering News-Record*, Construction Cost Index History – accessed August 2011, ENR.com.
- *Engineering News-Record*, Construction Economics – accessed June 2012, ENR.com.
- *Nutrient Reduction Technology Cost Estimations for Point Sources in the Chesapeake Bay Watershed*, Chesapeake Bay Program, Nutrient Reduction Technology (NRT) Task Force, 2002. Available for download at http://archive.chesapeakebay.net/pubs/NRT_REPORT_FINAL.pdf.

Table III.B-18
Summary of Estimated Economic Impacts of Proposed Metals Standards (in $Millions)
Wastewater Discharges – Water Treatment Plants [1,2,3]

	Private				Local Government				State Government				Federal Government				All
Year	**Planning**	**Capital**	**O&M**	**Total**	**Planning**	**Capital**	**O&M**	**Total**	**Planning**	**Capital**	**O&M**	**Total**	**Planning**	**Capital**	**O&M**	**Total**	**Total**
2017	$-	$0.001	$0.002	$0.002	$-	$0.003	$0.01	$0.01	$-	$-	$-	$-	$-	$-	$-	$-	$0.01
2018	$0.01	$0.14	$0.01	$0.15	$0.02	$0.56	$0.02	$0.60	$-	$-	$-	$-	$-	$-	$-	$-	$0.76
2019	$-	$0.10	$0.01	$0.11	$-	$0.40	$0.04	$0.43	$-	$-	$-	$-	$-	$-	$-	$-	$0.54
2020	$-	$0.003	$0.01	$0.01	$-	$0.01	$0.04	$0.05	$-	$-	$-	$-	$-	$-	$-	$-	$0.06
2021	$0.001	$0.02	$0.01	$0.03	$0.004	$0.06	$0.05	$0.11	$-	$-	$-	$-	$-	$-	$-	$-	$0.14
2022	$-	$0.10	$0.02	$0.12	$-	$0.40	$0.07	$0.46	$-	$-	$-	$-	$-	$-	$-	$-	$0.58
2023	$-	$0.002	$0.02	$0.02	$-	$0.01	$0.06	$0.07	$-	$-	$-	$-	$-	$-	$-	$-	$0.09
2024	$-	$-	$0.01	$0.01	$-	$-	$0.06	$0.06	$-	$-	$-	$-	$-	$-	$-	$-	$0.07
2025	$-	$-	$0.01	$0.01	$-	$-	$0.06	$0.06	$-	$-	$-	$-	$-	$-	$-	$-	$0.07
2026	$-	$-	$0.01	$0.01	$-	$-	$0.06	$0.06	$-	$-	$-	$-	$-	$-	$-	$-	$0.07
Costprojectionsareinherentlyuncertain,thosebeyond10yearsevenmoreso.EstimatesforYears11-30 areprovidedonlyforgeneralcomparisonwiththebenefitsestimatespresentedelsewhereinthisdocument.																	
Yrs1-10	$0.01	$0.4	$0.1	$0.5	$0.03	$1.4	$0.4	$1.9	$-	$-	$-	$-	$-	$-	$-	$-	$2.4
Yrs11-20	$-	$-	$0.1	$0.1	$-	$-	$0.6	$0.6	$-	$-	$-	$-	$-	$-	$-	$-	$0.7
Yrs21-30	$-	$-	$0.1	$0.1	$-	$-	$0.6	$0.6	$-	$-	$-	$-	$-	$-	$-	$-	$0.7
Yrs1-30	$0.01	$0.4	$0.4	$0.8	$0.03	$1.4	$1.6	$3.1	$-	$-	$-	$-	$-	$-	$-	$-	$3.8
NPV,10Yrs	$0.01	$0.3	$0.1	$0.4	$0.02	$1.1	$0.3	$1.4	$-	$-	$-	$-	$-	$-	$-	$-	$1.8
NPV,20Yrs	$0.01	$0.3	$0.1	$0.4	$0.02	$1.1	$0.6	$1.7	$-	$-	$-	$-	$-	$-	$-	$-	$2.1
NPV,30Yrs	$0.01	$0.3	$0.2	$0.5	$0.02	$1.1	$0.7	$1.8	$-	$-	$-	$-	$-	$-	$-	$-	$2.3

Footnotes:
[1] Economic impacts are the gross sum of estimated costs plus savings.
[2] Annual impacts presented above are not adjusted for inflation.
[3] Net Present Values (NPVs) are 2014$, calculated using a discount rate of 7% after annual impacts were adjusted using an annual inflation of 2%.

4. Uncertainties (Metals)

It is difficult to prepare sound and defensible estimates of the potential costs and savings that wastewater dischargers can expect following adoption of the proposed rule changes. The complexity of the multiple proposed revisions to the metals standards make it nearly impossible to determine, first, how those standards will impact individual discharger's permit requirements. The range of compliance options available to the dischargers make it difficult to predict which courses of action the affected dischargers will pursue and the costs they will incur in meeting any new metals requirements. Relatively few dischargers currently have treatment processes that are specifically designed to remove metals, so experience with such processes is limited, as is information on their effectiveness and the resulting costs.

The Division collected and applied the technical and economic information essential to its analyses as much as possible. Because much information was lacking or uncertain, the Division made numerous working assumptions in the course of evaluating the regulatory and economic impacts of the proposed rules. It chose to err toward greater impacts in most cases in order to avoid under-estimating those impacts.

1. Uncertainties Regarding Applicable Standards

The proposed rule changes include multiple revisions of the existing metals standards. In addition to changes in the numeric standards themselves, the affected standards will now be expressed as dissolved metals, and most freshwater standards will also be expressed in the rule as hardness-dependent equations. While the metals values derived for permitting purposes can be calculated, each requires effluent hardness data for the discharge of interest. Thus, the actual impact of the revisions on applicable standards is not straightforward.

The affected freshwater metals are sensitive to hardness to differing degrees. Figure III.B-9 shows the effect of hardness on several metals. The steeper lines indicate that a metal is more sensitive to changes in hardness. By extension, it shows that of the projected metals limits and the resulting cost estimates related to the lead and nickel standards are more sensitive than those related to the copper, zinc, or cadmium standards.

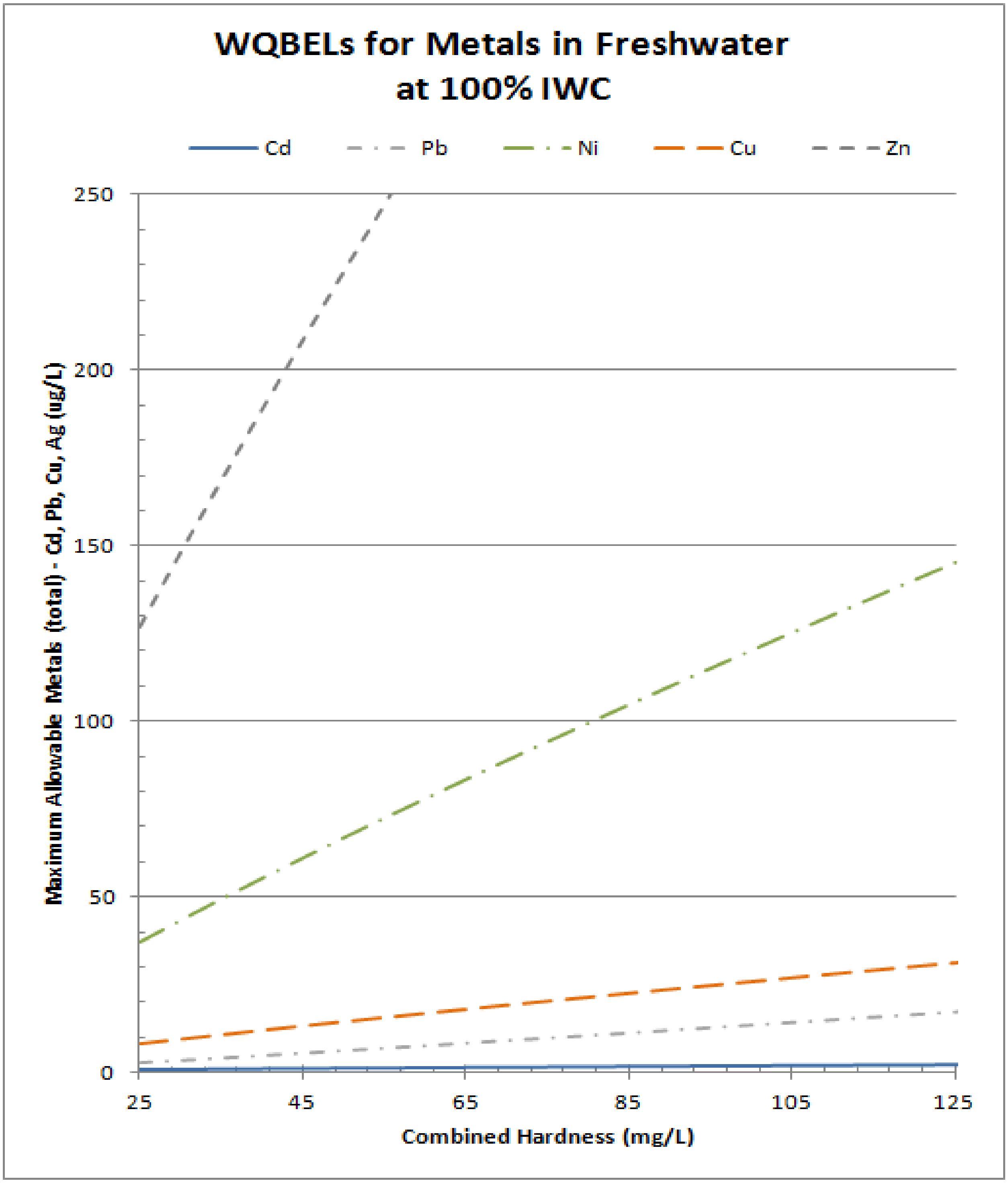
2. Uncertainties Regarding Regulatory (Permit) Impacts

Water quality-based requirements in wastewater permits are, by their nature, unique to each discharge and its receiving stream. Thus, it was not readily apparent how the proposed revisions to the metals standards might impact wastewater dischargers or how many dischargers would be impacted. The Division would have to evaluate most or all discharges in the state to answer these questions, which would require an extraordinary effort. Instead, the Division focused on smaller – but still significant – numbers of permits and extrapolated the results to the rest.

In selecting dischargers for the evaluation, the Division tended to look at those permits most likely to be impacted. For example, the 28 POTWs originally evaluated were chosen to represent large pretreatment POTWs from across the state, and the 33 additional POTWs also tended to be those already subject to metals limits. Thus, the selection of permits (POTWs, in this example) skewed toward those with significant concentrations of metals. This skewed sample may overestimate the impacts of the standards.

Under the proposed rule changes, applicable standards for many metals are expressed as hardness-dependent equations and will have to be calculated for each discharge as needed. Because effluent hardness can vary over time, the *maximum allowable metals (total)* could change as well. The Division used any available effluent hardness data in its analyses, but the actual metals limits for any given discharge – hence, the actual impacts of the proposed standards – will depend on data available at that time.

Figure III.B-9
Sensitivity of Freshwater Metals Limits to Hardness



For the purposes of this fiscal and economic analysis, the Division used the 10th percentile of available effluent hardness data to determine each discharger's combined hardness and, thus, its maximum allowable effluent concentration (MAEC) for each metal. Staff also calculated MAECs using the median effluent hardness and determined that it made a minor difference in the value of the MAEC; however, the resulting differences in metals limits had a lesser effect on which compliance actions the affected dischargers would be likely to take.

The multiplicity of metals requirements in many permits affects the projected impacts of the proposed rule changes. Any given permit can contain requirements for one or more metals (or none). The Division's analyses showed that the proposed standards could result in addition, deletion, or modification of metals limits in seemingly endless combinations. In order to filter out this 'noise' and simplify the analyses, the staff assumed that any limits for the targeted metals (cadmium, lead, nickel, or, in a few case, copper or zinc) based on the proposed standard would impact the discharger, whether the permit was projected to have one limit or five and without considering how many limits it has in its current permit.

The Division could not assess the potential impacts of the proposed chromium standards, due to the lack of chromium III and chromium VI effluent data; therefore, from this point of view the impacts may be underestimated.

Additionally, the Division conservatively assumed that the number of permits and their permitted flows would hold constant over the timespan of the analysis. The number of permits has gradually declined over the last 15-20 years as the net result of issuing permits for new facilities and deleting permits out-of-business or regionalized/ consolidated facilities. This assumption may not hold, especially in the later years of the analysis, if population and economic activity increase. Thus, it could result in under-estimated impacts; however, some of the other conservative assumptions made in the analysis may offset the impact of this assumption.

3. Uncertainties Regarding Compliance Approaches

Dischargers affected by the standards will have a variety of compliance approaches available to them, ranging from low-cost operational changes to capital-intensive treatment plant improvements. The set of most practical alternatives will vary from one wastewater category to another, and the effectiveness of each measure will vary from one facility to another. Different dischargers will likely select different combinations of actions, with differing degrees of effectiveness. For the purposes of this analysis, the Division evaluated a limited number of combinations and assumed varying results in order to generate high-, medium-, and low-range cost estimates.

The treatment of sidestreams (e.g., return flows from solids handling operations), which can carry elevated concentrations of metals, has been shown to be an effective and cost-effective method of controlling metals in some POTWs. The Division did not evaluate this alternative but recognizes it may be a potential part of an effective control strategy.

The approaches evaluated by the Division do not constitute an endorsement or imply any expectation that dischargers use them. They were chosen simply to represent several possible options that would indicate a range of possible costs to be borne by the dischargers.

4. Uncertainties Regarding Regulatory Impacts

The cost estimates are based on the unit costs and assumptions described in each subsection and are subject to the same uncertainties, as any cost estimate generally is.

B4. Evaluation of Impacts: 2,4-D Standards (T15A NCAC 02B .0212, .0214, .0215, .0216, & .0218)

The proposed rules would revise the surface water quality standards for the herbicide 2,4-Dichlorophenoxyacetic acid (2,4-D). Affected Wastewater Dischargers would be identified based on Reasonable Potential Analyses, as with metals and other toxicants. The dischargers would be subject to water quality-based effluent limitations (WQBELs) and required to control their discharges to surface waters.

1. Regulated Parties – 2,4-D

(a) Description

Wastewater Dischargers potentially affected by these rules are those existing and future wastewater facilities that receive 2,4-D-bearing wastes and are subject to requirements for NPDES permits. The Division does not anticipate that any dischargers will be impacted by the proposed rule changes.

(b) General Baseline

As of July 1, 2011, no NPDES-permitted wastewater facilities in North Carolina were subject to permit requirements for 2,4-dichlorophenoxyacetic acid (2,4-D). The primary concern with the herbicide in this rulemaking is as a contaminant in drinking water supplies. The herbicide is not suspected of being present in municipal or industrial wastewaters and is not limited or required to be monitored in any NPDES wastewater discharge permits.

2. Estimated Costs/Savings – 2,4-D

(a) Cost Baseline

No dischargers currently have systems designed to remove 2,4-D.

(b) Description of Impacts

The Division does not anticipate any immediate impacts to wastewater dischargers from the proposed standard

(c) Quantify $

The Division does not anticipate any immediate impacts to wastewater dischargers from the proposed standard. Therefore, it cannot speculate as to what impacts, if any, the proposed standard will have on dischargers.

Chapter C. NPDES Stormwater

C1. Summary of Findings

The proposed rule changes will have positive and neutral cost impacts for local government and private (industry) stormwater permit holders. State and federal agencies are not expected to incur a significant cost impact.

C2. Stormwater Program Overview:

As authorized under 15A NCAC 02H .0126, National Pollutant Discharge Elimination System (NPDES) Stormwater permits are issued in accordance with US EPA regulations, specifically 40 CFR Part 122.21 and 122.26. Point source stormwater discharges are permitted under the NPDES stormwater program. The NPDES Stormwater program issues both individual permits (facility specific) and general permits (same permit covers multiple facilities). Federal NPDES permits regulate three types of activities that result in stormwater discharges. These are: (1) Industrial activities that fall in certain categories; (2) Municipal Separate Storm Sewer Systems ("MS4s"); and (3) Construction activities that disturb an acre or more.

The NPDES stormwater program has been implemented in phases. Phase I of the NPDES stormwater program was established in 1990. Phase I NPDES stormwater permits applied to industrial activities in 10 specifically identified categories, construction activities that disturbed five or more acres, and municipalities with populations of 100,000 or more that owned or operated a municipal separate storm sewer system (MS4). A MS4 is a system of conveyances (catch basins, curbs, gutters, ditches, man-made channels, pipes, tunnels, or storm drains) that moves storm water away from an area and discharges it to a local waterbody. Phase II of the program began in 2005 and expanded permit requirements to construction disturbing an acre or more and smaller communities (< 100,000 population) or public entities that own or operate an MS4.

North Carolina also has a state authorized stormwater program which is separate from the federally delegated stormwater program (NPDES stormwater program). The state post-construction stormwater program (State stormwater program) supplements the federal program by targeting stormwater impacts from development projects (i.e., built-upon area like parking lots, homes and roads) and covers areas of the state not covered by the federal program. The state stormwater program is a permitting program for development projects that requires the use of best management practices (BMPs) to control stormwater runoff from those developments. The state stormwater program will not be impacted by the proposed rules because those permits do not impose any monitoring based on any of the water quality standards regulations proposed for revision.

The proposed rule changes may impact some facilities covered by NPDES stormwater permits because that program incorporates benchmark values into permits, as necessary. For analytical monitoring and stormwater pollution prevention purposes, the NPDES stormwater program utilizes benchmark concentrations for certain pollutants, which are derived from water quality standards. Benchmarks are written into permits to provide a guideline for determining the potential of the stormwater discharge to cause toxic impacts to the surface waters of the state and to trigger response actions. Stormwater benchmarks are not enforceable effluent limits. The difference is important because exceeding a wastewater effluent limit is a violation of permit terms, whereas exceeding a stormwater benchmark is not a permit compliance violation subject to enforcement. However, frequent exceedances of the benchmark concentrations in stormwater monitoring samples may trigger a variety of stormwater pollution prevention actions and sometimes more frequent monitoring.

NPDES stormwater permits include a tiered system that outlines responses to benchmark exceedances and allows flexibility for both the permittee and the Division to address pollution problems and/or resolve difficulties in meeting benchmarks when influences are beyond the permittee's control. All the possible actions the permittee and Division may take are not set in the permit; this way the most appropriate response measures can be determined on a case by case basis. Many of the specific actions are self-directed by the regulated party and not dictated by the Division, particularly in the early stages of the tiered response.

Stormwater benchmarks most often reflect acute aquatic life water quality standards. Chronic aquatic life standards and human health standards protect for a more constant, long term exposure to a pollutant, which is often not appropriate for general stormwater exposures and, therefore, are not normally used in stormwater permitting unless a site specific situation necessitates it. Acute standards are more frequently used to assess the potential for stormwater impacts to surface waters as the exposure scenarios of aquatic life to stormwater discharges are expected to be episodic due to the nature of stormwater flows. Aquatic organisms are exposed to stormwater runoff on an irregular and generally short term basis as rainfall is not a continuous event. Historically, benchmarks have been developed by the Division by using national and state guidance to calculate an acute water quality criterion because NC regulations currently do not contain acute water quality standards for any parameters. The proposed rule revisions include the addition of acute standards for some metals and so the stormwater benchmarks will be updated based on the proposed state standards if they are adopted, as applicable.

C3. Assumptions and Uncertainties:

This analysis was limited by the lack of an electronic database for stormwater monitoring data from individual permits. Furthermore, because of resource limitations, Stormwater Permitting Unit staff enters data reported under general stormwater permits into spreadsheet databases as time allows, after fulfilling permit-writing, technical review, and other programmatic responsibilities. The limitation means that the most recently reported monitoring data are usually not available until several months after receipt by the Division of Energy, Mineral and Land Resources (DEMLR). This lag time between the submission of monitoring reports and data entry creates some uncertainty in the estimates of affected entities discussed in this section.

Due to the flexibility incorporated into the NPDES stormwater program estimating impacts on stormwater permittees also is difficult because investments prompted by benchmark exceedances are not necessarily uniform. Actions taken by permittees in response to benchmark exceedances are not specified in the stormwater permits, allowing these actions to be tailored to specific sites and situations. Permittees are able to select the most cost effective methods to meet their permit requirements. Therefore there is no "average site" on which to base cost estimates. Stormwater pollution prevention measures and control requirements will depend on a wide variety of variables such as industrial activity, topography, receiving water, site constraints, stormwater pollution prevention practices already in place, etc. The net impact on permittees cannot be estimated for this analysis.

1. Rule 15A NCAC 02B .0206 Flow Design Criteria for Effluent Limitations

For stormwater programs, there is no fiscal impact expected with respect to the proposed addition of the flow design criterion proposed in this rule. The NPDES stormwater program does not incorporate the use of ambient water stream flows as outlined in 15A NCAC 02B .0206 as typically no effluent limitations are derived for inclusion in stormwater permits.

2. Rule 15A NCAC 02B .0211 Fresh Surface Water Quality Standards for Class C Waters

At the time of this analysis, approximately 3,495 facilities across the state have NPDES stormwater permits. These permits include both facility-specific stormwater discharge permits (around 260, including Phase I and Phase II municipal separate storm sewer systems, MS4 and industrial facilities) and general permits that cover a specific activity at multiple facilities (about 3,230 facilities covered under 24 general permits).

The MS4 permits cover a municipality's or other entity's storm sewer system throughout its jurisdiction. These permits differ substantially from industrial permits and typically focus less on analytical sampling. The MS4 permits require compliance with minimum measures of stormwater management. Industrial stormwater permits may have more prescribed analytical sampling, depending on the type of activity or other site circumstances.

The proposed changes to the water quality standards for metals are expected to impact facilities currently required under their stormwater permit to monitor for metals. This group may see fiscal impacts that are both positive and/or negative due to the change to the benchmarks and their subsequent impact on monitoring requirements.

Approximately 1,059 facilities across the state, or roughly 30 percent of the total NPDES stormwater permittees, have NPDES stormwater permits containing at least one metal parameter and an associated benchmark. The stormwater benchmarks for those metals will be updated to reflect the proposed acute dissolved metals standards after state adoption and EPA approval. Because NPDES federal regulations require that permits be written to include measurement of the total recoverable form of a metal, default translators will be used to convert the proposed dissolved acute water quality standard to a total recoverable benchmark concentration. Total recoverable stormwater benchmarks for metals will be calculated using the same default US EPA published translators as described in the NPDES wastewater chapter. See Chapter B. Wastewater Dischargers for additional translator information.

The following table (Table III.C-1) provides a comparison of the current stormwater benchmarks for metals and the anticipated revisions based on the proposed changes to the water quality standards. The revised benchmark calculations applied a default hardness of 25 mg/L for use in the hardness dependent standard's equations. The water hardness for stormwater discharges is generally not known but is assumed not to be very different from typical receiving waters. Since the current iron standard is proposed to be removed, iron is not included in the table.

As a result of translating the proposed dissolved metals acute standards into total recoverable metal values, many metal benchmark concentrations would increase (become less stringent), while a few benchmark values would decrease. The proposed benchmarks for beryllium and arsenic show a minor decrease that is not expected to impact stormwater permittees. The benchmarks that are expected to significantly decrease are for silver and chromium; these metals are less commonly monitored in stormwater. The revised silver benchmark, as calculated below in Table III.C-1, continues to remain below the laboratory Practical Quantitation Limit (PQL) for silver, which is approximately 5 µg/L. Assuming there are no short term improvements to laboratory analytical methods for silver that would lower the PQL, implementation of the silver benchmark will not change because any detection of silver in a stormwater discharge that is measured above the laboratory PQL would be considered a benchmark exceedance for both the current and revised benchmark concentrations. Therefore, chromium is likely the only benchmark revision that has the potential to cause additional costs to be incurred by permittees. All the other freshwater benchmark revisions are expected to either lead to a cost savings for permittees or cause no fiscal impact of any kind.

Chromium is one of the least frequently monitored metals in stormwater permits. Given that the majority of permittees in the program are under general permits (3,236 out of 3,495 permits) that do not monitor for chromium and that most individual permits (259 permits) do not contain this parameter, the Division estimates permittees with chromium monitoring make up 1-2 percent of total permittees (or somewhere between 35 and 70 permits). Chromium also usually accompanies other metals monitoring—metals with benchmarks that would become less stringent. The Division anticipates that cost savings to permittees, in most cases, will exceed any cost increases.

Table III.C-1
Estimated Revised NC Stormwater Benchmark Values – Freshwater

	Proposed Aquatic Life Acute Standard (freshwater) Dissolved [µg/l]	Translator*	Calculated Revised Stormwater Benchmark Total Recoverable [µg/l]	*Current NC Stormwater Benchmark Total Recoverable* [µg/l]
Arsenic	340	1	**340**	360
Beryllium	65	1	**65**	70
Hardness Dependent Metals				
Cadmium [(a)]	0.82	0.252	**3.2**	1
Cadmium (Trout) [(a)]	0.51	0.252	**2**	1
Chromium III [(a, b)]	183	0.202	**905**	-
Chromium VI [(b)]	16	1	**16**	10
Chromium, Total	N/A	N/A	**N/A**	1,022
Copper [(a)]	3.6	0.348	**10.5**	7
Lead [(a)]	14	0.184	**75**	30
Nickel [(a)]	145	0.432	**335**	260
Silver [(a)]	0.296	1	**0.3**	1
Zinc [(a)]	36	0.288	**126**	67

* Translators are the same as used for NPDES wastewater permits. See Chapter B. Wastewater Dischargers for further clarification.

(a) This acute aquatic life freshwater standard is expressed as a function of water hardness and has been calculated using a hardness value of 25 mg/L for illustrative purposes in this table.

(b) Unless there is a reason to suspect a source of chromium VI, the Division expects to implement the translated Chromium III benchmark as a total chromium benchmark due to analytical restrictions on the measurement of chromium III.

C4. Estimated Total Number of Impacted NPDES Stormwater Facilities by Category

Table III.C-2 includes only the facilities with NPDES stormwater permits which contain at least one metal parameter and an associated benchmark concentration (estimated 1,059 facilities). At this time, no other NPDES stormwater permits have been identified for analysis in this fiscal note. These numbers are estimates based on DEMLR's best available information and should not be considered actual.

In particular, individual stormwater permittees that may be impacted by the proposed rule changes are extremely difficult to quantify because the Division has no mechanism in place to electronically record monitoring data from individual NPDES stormwater permits or combined NPDES wastewater-stormwater permits that may include metals monitoring.

Table III.C-2
Estimated Number of Affected Facilities with NPDES Stormwater Permits*

Permit Type	Total Number of Facilities	Private Industry	Local Government	State Government	Federal Government
General Permits					
NCG03	526	526	0	0	0
NCG09	27	27	0	0	0
NCG10	201	201	0	0	0
NCG19	84	84	0	0	0
NCG20	77	77	0	0	0
NCG24	31	18	13	0	0
Individual Permits					
Individual Permits (with metals)	107	95	12	0	0
PHASE I MS4 permits	6	0	6	0	0
Total	**1,059**	**1028**	**31**	**0**	**0**
Percent of Total Permits (with metals)		**97%**	**3%**	**0%**	**0%**

*Facilities containing at least one metal parameter and an associated benchmark concentration.

1. Local Government or Municipal Stormwater Impacts

Local governments hold roughly three percent of the estimated 1,059 stormwater permits likely to be impacted by this rule change. Six communities with Phase I MS4 permits may experience minor cost increases due to additional instream monitoring.

Local governments with composting permits (approximately 25 total, or 13 sites anticipated to qualify for coverage under general permit NCG24 in addition to 12 more sites that will qualify for individual permits) may incur cost savings due to the less stringent metal benchmarks leading to the potential for decreased monitoring or a reduced need for stormwater controls. The proposed rule changes will not affect municipalities that have Phase II MS4 stormwater permits because these permits do not currently have metals monitoring requirements. The overall fiscal impact for local governments is expected to be positive; however, with existing data limitations no monetary value can be estimated.

As noted above, there are six municipalities in the state that are covered by Phase I MS4 NPDES stormwater permits which may be impacted by the proposed dissolved metals standards rules and the associated benchmark revisions. Phase I MS4 stormwater permits are unique in that they include instream, ambient monitoring requirements in addition to stormwater discharge monitoring. It is possible that surface water monitoring costs related to Phase I MS4 permit monitoring could increase to some extent based on the proposed dissolved metals standards and particularly the related revisions to instream sampling requirements for metals. These revisions to instream sampling requirements include provisions that will increase the number of instream samples required to make an assessment of attainment of the water quality standards, as well as analytical and sampling changes associated with instream measurement of the dissolved fraction of the metal. However, the Phase I MS4 permits only requires these cities to have an ambient monitoring plan; the permit does not specify details about what must be monitored or how often. Local governments therefore have the ability to develop their own monitoring plan around their available budget.

The majority of the metals (including the more frequently monitored metals) have benchmark concentrations that will become less stringent with the adoption of the proposed rule changes, providing the potential for cost savings to these six permittees. However, the benchmark revision for one metal, chromium, introduces potential cost increases to these same permittees. Two municipalities with Phase I MS4 permits raised the issue of increased monitoring costs when the Division requested information from the public to assist in writing this fiscal and economic analysis. While the cost per sample may increase for each metal sampled, the increase will be minor. One municipality provided a qualitative estimate of less than $10,000 annually to implement additional monitoring. However, the Phase I MS4 permits provide DEMLR the flexibility to work with the permittee to modify their stormwater monitoring program to alleviate some or all of the increased monitoring costs while still meeting the intent of the NPDES permit. These negotiations are a normal part of the workload for DEMLR staff. As previously noted, Phase I MS4 permits provide for instream monitoring plans to be established and directed by the local municipality as opposed to the state. Even with the increased monitoring costs per sample, it is plausible that the net cost of the changes to each permittee could remain the same with some modification of monitoring locations, frequency, number of parameters, etc. as allowed under each permit's structure.

Local governments that hold an individual stormwater permit for a composting operation, as well as those that are covered by the general composting permit, NCG240000 (NCG24), may experience cost savings as a result of the proposed metal standards rule revisions. The metals benchmarks included in composting permits (lead, copper and zinc) will all be made less stringent by implementation of the proposed standards by the NPDES Stormwater Section. This may lead to decreased monitoring and/or reduced need for stormwater control measures for this group of stormwater permittees under an industrial stormwater permit (different from an MS4 permit).

At the time of this analysis, very few permits have been issued for any composting operations; facilities subject to these permitting requirements have been given until July 2012 to apply for permit coverage. Such limited discharge data from these operations precludes the ability to estimate cost impacts, especially when costs to comply with other NPDES stormwater requirements cannot easily be separated from costs specifically related to metals monitoring.

2. Private Funds - Industrial Stormwater Impacts

The vast majority of permitted private facilities are covered under general permits, and of these, about 27 facilities (at the time of this analysis) contain monitoring for a metal with a benchmark that will decrease in concentration, in this case the benchmark for chromium. These 27 facilities are all permitted under General Permit NCG090000 (‘NCG09’), which covers facilities engaged in the manufacture of paints, varnishes, lacquers, enamels and allied products (standard industrial classification (SIC) 285). Along with chromium, NCG09 also contains benchmarks for lead and cadmium, which both will become less stringent when the proposed rules are implemented.

The lack of electronic and timely data makes difficult the estimation of the impact on stormwater permittees. Effluent/stormwater monitoring is required semi-annually and permittees must submit paper copies of sample results to DEMLR. No instream monitoring is required for these permittees. The Basinwide Information Management System (BIMS) does not have the capability to store stormwater monitoring data; instead DEMLR stormwater permitting staff enters these data for general permits as time and priorities permit into an internal spreadsheet database. Individual permit data are not entered into that database. An alternative stormwater monitoring database is still under development.

Currently available stormwater monitoring data from these permittees since 2008 suggest the decrease from an approximately 1,000 µg/L benchmark to a 900 µg/L benchmark for chromium would not result in a substantial increase in benchmark exceedances at these sites. This makes an increase in monitoring burden very unlikely. Data indicate that chromium concentrations in the stormwater discharges at these permitted sites have been well below both the current and revised benchmarks since 2008.

The monitoring data available from these permittees also suggest that the increase in the lead benchmark to 75 µg/L would not alleviate monitoring for the few instances where samples have exceeded the current 30 µg/L lead benchmark. Those data suggest the same conclusion for cadmium. As a result of this data review, no direct fiscal impact, positive or negative, is anticipated for private facilities permitted under NCG09.

For the majority of private facilities covered under general stormwater permits other than NCG09, stormwater benchmarks would either increase, remain the same, or in the case of iron, be removed entirely. These changes could likely result in a monetary benefit to the permitted facilities in the form of decreased monitoring frequency and/or reduced need for stormwater control measures. This benefit is difficult to quantify since the determination would be unique for each permit.

For private facilities covered under individual industrial permits with metals monitoring (about 95 facilities), it is estimated that either no change or a similar net financial benefit may be realized by permittees due to reduced monitoring burden and reduced stormwater BMP implementation in some cases. At this time, DEMLR does not maintain an electronic stormwater monitoring database for the individual industrial permits. Lacking the appropriate database, sufficient data is not available to estimate the number of private facilities with individual permits that might receive a lower chromium benchmark.

DEMLR provides permittees with substantial flexibility through the permit structure to modify specific program details. In the event a facility does have a cost associated with the regulation change, DEMLR could allow increased costs to be offset by changes to the permittee’s stormwater management program. The Division has historically relieved permittees from more frequent monitoring when site operators have put forth all reasonable efforts to decrease or prevent stormwater contamination, or when other circumstances affecting discharge concentration levels are beyond the permittee's control. For example, some landfills have assessed site conditions and improved stormwater BMP structure maintenance but could not reduce bacteriological contamination below benchmarks because of persistent bird populations. The Division also has a process in place to designate a subset of "representative stormwater outfalls" at a site that can be monitored in lieu of other outfalls, which reduces the number of discharge points that must be monitored.

3. State Government Impacts

The proposed rules are not anticipated to have a direct fiscal impact on state government agencies associated with stormwater control. DENR stormwater programs, including inspection staff in the seven regional offices and nine staff members in the Stormwater Permitting Unit, are not expected to incur any direct fiscal impacts associated with the proposed rules. These staff will absorb some additional workload when working with permittees on site-specific response actions related to the potential for multiple chromium benchmark exceedances. However, staff may also see decreases in workload when other benchmarks become less stringent. This assessment is extremely limited because it does not account for recent reductions in force or the fact that stormwater benchmarks and "tiered" response requirements are still being introduced into some older permits, as they are renewed.

The North Carolina Department of Transportation (NC DOT) currently is covered by a Phase I MS4 stormwater permit. However, this permit contains no metals monitoring or benchmarks and DWR does not expect NC DOT to be impacted by the proposed revisions to the metals standards. The NC DOT also has provided fiscal comments to DWR that indicated the proposed rule amendments were not anticipated to directly apply any new requirement or fiscal costs onto the department.

However, NC DOT did note the possibility for future indirect costs to their stormwater program from the proposed rule changes based on the potential for an increase in Total Maximum Daily Loads (TMDLs) and the resulting additional regulations associated with those TMDLs. NC DOT anticipated the potential for an increase in TMDLs based on the assumption there would be an increase in the state's 303 (d) impaired water listings for metals once the proposed changes to the water quality standards were finalized. This assumption cannot be verified at this time. DWR currently does not have sufficient appropriate data available to predict future impairments based on the proposed rule changes to the metals standards. Additionally the outcome of any potential TMDL calculations cannot be determined prior to the TMDL development process. Therefore the potential for future indirect costs to NC DOT cannot be quantified at this time.

4. Federal Government Impacts

The proposed rules are not anticipated to have a direct fiscal impact on federal agencies associated with stormwater control. At this time the Division has not identified any federal entities in North Carolina that have a stormwater permit which contains a requirement to monitor for the metals which have standards that are proposed for revision.

1. Rules 15A NCAC 02B .0212, .0214, .0215, .0216 and .0218: Fresh Surface Water Quality Standards for WS I – V Waters

For stormwater programs, there is no direct fiscal impact expected with respect to the proposed revision to the water quality standard for 2,4-D as applicable in water supply classified waters. The NPDES stormwater program does not incorporate the use of water supply standards as stormwater benchmarks unless a site-specific special situation drives the need for a different benchmark.

2. Rule 15A NCAC 02B .0220 Tidal Salt Water Quality Standards for Class SC Waters

Table III.C-3 shows a comparison of the current saltwater benchmarks (as applied to site-specific concerns) and what a revised saltwater benchmark would be based on the proposed changes to the saltwater acute aquatic life standards for metals. The table demonstrates that none of the saltwater benchmarks would change significantly as a result of the rule proposals. The proposed benchmarks that become more stringent show a decrease that is so minor that it is not expected to cause an impact to permittees.

No direct fiscal impact to stormwater programs or permittees is expected from the proposed revisions to the metals saltwater standards for aquatic life protection. Only a small number of individual industrial stormwater permits contain saltwater benchmarks and there are no general permits that currently contain saltwater benchmarks. As noted previously, the Division has no way to quantify how many permits might be affected because DEMLR does not maintain an electronic stormwater monitoring data database for the individual industrial permits at this time. Regardless, the permit structure provides substantial flexibility that allows alternative stormwater pollution prevention response actions that could defer many of the increased costs that might result from lowered benchmarks. For these reasons, there is no anticipated net financial cost to permittees discharging stormwater to saltwaters.

Table III.C-3
Estimated Revised NC Stormwater Benchmark Values – Saltwater

	Aquatic Life Acute WQ Standard (Saltwater) Dissolved	Default Saltwater Translator	Calculated Revised Stormwater Benchmark Total Recoverable	*Current NC Stormwater Benchmark Total Recoverable*
	(ug/L)		(ug/L)	(ug/L)
Arsenic	69	1	69	69
Cadmium	40	1	40	40
Chromium III	NA	NA	NA	NA
Chromium VI	1100	1	1100	1100
Chromium, Total *	NA	NA	NA	1100
Copper	4.8	1	4.8	5.8
Lead	210	1	210	220
Nickel	74	1	74	75
Silver	1.9	1	1.9	2.2
Zinc	90	1	90	95

* Unless there is a reason to suspect a source of chromium VI, the Division expects to implement the translated chromium VI benchmark in saltwater as a total chromium benchmark due to analytical restrictions on the measurement of chromium VI.

Chapter D. NPDES Coalition Monitoring Program

The NPDES Coalition Monitoring Program is a voluntary, discharger-led, ambient monitoring program that provides an effective and efficient means for assessing water quality in a watershed context. A monitoring coalition is a group of NPDES dischargers that combine resources to collectively fund and perform an instream monitoring program in lieu of performing the instream monitoring required by their individual NPDES permits. By forming a coalition, members have a medium to gather more information about their watersheds, evaluate member-specific interests and collaborate on watershed-specific issues. The collaboration frequently reduces monitoring costs for an individual discharger by sharing the burden across the coalition.

Participating permittees work with DWR staff to develop a monitoring network that uses strategically selected, mutually agreeable sampling locations to evaluate water quality beyond the wastewater treatment effluent discharge. The monitoring locations are coordinated with the state's existing ambient and biological monitoring networks, to provide a more comprehensive picture of watershed conditions without duplicating efforts. Additional information on the Coalition Monitoring Program can be found at: http://portal.ncdenr.org/web/wq/ess/eco/coalition.

To allow time for the adoption of the proposed revised standards, and to facilitate production of data that could/would be used for water quality assessment purposes, DENR suspended the coalitions' ambient metal sampling requirement in 2007.

D1. Summary of Cost Analysis

Costs related to implementation of proposed rules in the Coalition Monitoring Program can be mitigated by the participants by working with the Division to modify the number of stations and frequency of sampling or by withdrawal from the program. As noted above, sampling requirements are selected as mutually agreeable locations to evaluate water quality within the watershed. As such, with potentially increasing sampling, collection and analysis costs, the Division will work to reassess sampling locations and/or monitoring frequencies to keep costs efficiently in line with the anticipated costs of the monitoring requirements expressed in the individual NPDES permit.

The current monitoring program costs approximately $75,000 per year for total recoverable metals monitoring (see Table III.D-1 for cost per coalition). Under the proposed rules, assuming no changes to the current monitoring requirements, monitoring costs for dissolved metals could reach a total of about $346,000 per year (see Table III.D-2 for cost per coalition). No changes to the current monitoring program costs are expected as a result of the proposed rule changes to 2,4-D. It is the Division's intention to work with the coalitions, such that costs are kept to a minimum; however, with no modifications to the current program there could be an additional $271,000 a year cost to the coalitions for dissolved metals monitoring.

Table III.D-1
Estimated costs for total recoverable metals instream sampling for one year (TOTAL) and per sample event

Coalition*	No. of Stations	Frequency	**No. of sample events**	Lab	Labor (5 min)	Overhead Costs	Filter	**TOTAL**	**Cost per sample event**
LCFRP	15	6	**90**	$7,920	$455	$369	$0	**$8,744**	**$97**
LNBA	6	12	**72**	$10,368	$182	$148	$0	**$10,698**	**$149**
MCFRBA	5	6	**30**	$4,320	$152	$123	$0	**$4,595**	**$153**
TPBA	8	12	**96**	$13,824	$243	$197	$0	**$14,264**	**$149**
UCFRBA	35	4	**140**	$20,160	$354	$287	$0	**$20,801**	**$149**
UCFRBA	2	12	**24**	$3,456	$61	$49	$0	**$3,566**	**$149**
YPDRBA	21	4	**84**	$12,096	$213	$172	$0	**$12,481**	**$149**

Table III.D-2
Estimated costs for dissolved metals instream sampling for one year (TOTAL) and per sample event

Coalition*	**No. of Stations**	**Frequency**	**No. of sample events**	**Lab**	**Labor (30 min)**	**Overhead Costs**	**Filter**	**TOTAL**	**Cost per sample event****
LCFRP	15	6	**90**	$33,030	$2,736	$2,214	$5,284	**$43,264**	**$481**
LNBA	6	12	**72**	$42,552	$1,094	$886	$4,227	**$48,759**	**$677**
MCFRBA	5	6	**30**	$17,730	$912	$738	$1,761	**$21,141**	**$705**
TPBA	8	12	**96**	$56,736	$1,459	$1,181	$5,636	**$65,012**	**$677**
UCFRBA	35	4	**140**	$82,740	$2,128	$1,722	$8,219	**$94,809**	**$677**
UCFRBA	2	12	**24**	$14,184	$365	$295	$1,409	**$16,253**	**$677**
YPDRBA	21	4	**84**	$49,644	$1,277	$1,033	$4,932	**$56,886**	**$677**

* The coalition acronyms stand for:

- LCFRP Lower Cape Fear River Program
- LNBA Lower Neuse Basin Association
- MCFRBA Middle Cape Fear River Basin Association
- TPBA Tar Pamlico Basin Association
- UCFRBA Upper Cape Fear River Basin Association (note that two entries appear for UCFRBA, some sites are monitored quarterly and some sites are monitored monthly)
- YRDRBA Yadkin Pee Dee River Basin Association

** Cost per sample event = TOTAL/No. of sample events

D2. Methodology

The detailed cost estimates for sampling total recoverable metals and dissolved metals are provided below. Costs are provided as a cost per sample event. A sampling event is defined as sampling one location (site) one time. The cost estimates below were calculated using information from 2011.

No cost data is available for the New River Basin Coalition at this time as they are a newly formed coalition as of August 2011 with no metals monitoring requirements at this time.

The following information was used to calculate potential costs to the coalition participants (based on their input) of sampling for dissolved metals under the proposed rules:

1) **$\$\mathbf{18}/\boldsymbol{analyte}$ for all coalitions except LCFRP which is $\$\mathbf{11}/\boldsymbol{analyte}$**
   - Note that the concentrations for eight (8) analytes (metals) are measured: arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), manganese, (Mn), nickel (Ni), zinc (Zn).
   - Example, if one result is obtained for each of the eight metals, then the cost is: $\$18/_{metal} \times 8\ metals = \$144$
   - Two sets of samples are necessary for acute metal toxicity assessment. Acute metal sampling requires two independent samples taken within one hour and 15 minutes apart. Two quality control samples are collected – one for each of the acute samples.

2) **$15 for hardness sample**
   - Hardness is a factor in assessing the toxicity of some metals. Only one sample is needed.

3) **$27.07 for filters**
   - Filters are needed to obtain the dissolved components of the water, e.g. dissolved metals.
   - Two filters will be needed one for each set of acute toxicity samples.

4) **$\$\mathbf{2.28}/\boldsymbol{foot}$ for tubing**
   - Tubing is used in conjunction with the filters.
   - Two feet of tubing will be used.

5) **$\$\mathbf{32.26}/\boldsymbol{hour}$ for labor**
   - Cost is based on a the midpoint between the minimum and maximum salary for an Environmental Senior Technician classification ($44,468/year)
   - The NC Office of State Human Resources benefits calculator[38] was used to calculate benefits (retirement contributions, health insurance costs, etc.) based on a $44,468/year salary and 10 years of service for a total compensation package of $67,794.05 computed on June 2014.
   - Hourly rate (reported above in item 5) was calculated as: $\frac{\$67794.05}{year} \times \frac{1\ year}{2080\ hours} = \$32.59/hour$

[38] North Carolina Office of State Human Resources. Employee Total Compensation Calculator. http://www.oshr.nc.gov/Reward/benefits/Compensation%20Calculator.htm

- We are using costs based on NC Office of State Human Resources information since this is public information.
- Estimate of 30 minutes to collect all required analytes and their acute and hardness samples from one site.

6) $\$22.74/hour$ **for overhead**

- This value was calculated from information provided by the contract laboratories regarding hourly costs. This cost was $55.00/hour, but since we are documenting labor costs of $32.59 based on OSP information the difference ($55.00 - $32.59 = $22.41) represents transportation (fuel, vehicle upkeep, insurance) profit and indirect costs.
- Estimate of 30 minutes to collect all required analyses and their acute and hardness samples from one site.

Table III.D-3
Example of How Costs Displayed in Tables III D.1 and III D.2 Are Calculated

No.	Item	Cost
1	$\$18/\text{analyte} \times 8$ analytes $\times 4$ samples	$576.00
2	$\$15.00$ for hardness	$15.00
3	$\$27.07/\text{filter} \times 2$ filters	$54.14
4	$\$2.28/\text{foot} \times 2$ feet	$4.56
5	$\$32.59/\text{hour} \times 0.5$ hours	$16.30
6	$\$22.41/\text{hour} \times 0.5$ hours	$11.20
	Total Cost	**$677.20**[a]

[a] Cost of $677 per sample event should be considered an estimate. This value cannot be used for all coalitions, since the LCFRP laboratory costs are $11/analyte and the LCFRP and MCFRBA use two staff when samples are collected by boat.

Section IV. Private Entities – Estimated Economic Impacts

Tables IV.1 and IV.2 provide a summary of the estimated economic impacts to private entities in North Carolina that would be anticipated due to adoption of the proposed revisions to 15A NCAC 02B .0206, .0211, .0212, .0214, .0215, .0216, .0218 and .0220. Complete descriptions of these fiscal impacts to private entities can be found throughout the Section III chapters of this fiscal and economic analysis. The following summaries have been broken down by the major parameters proposed for revision and by fiscal note chapters (for impacts due to metals regulations) for ease of locating more detailed information.

Table IV-1
Overview of Estimated Economic Impacts to Private Funds

Proposed Rule	Wastewater Dischargers (Section III.B)	Stormwater Dischargers (Section III.C)	Coalitions (Section III.D)
2,4-D	No impact	No impact	No impact
Metals	$16 million – over first 10 years of implementation (NPV)	Mostly unquantifiable benefits expected/potential impact that may be mitigated by variety of options	Unable to quantify

Fiscal Impact by Proposed Standard Change

2,4 D

The proposed revisions to the water quality standards for 2,4-D are found in rules 15A NCAC 02B .0212, .0214, .0215, .0216, .0218. There is no fiscal impact to private entities expected with respect to the proposed revision to the water quality standard for 2,4-D.

Metals

The proposed revisions to the water quality standards for metals protective of aquatic life are found in rules 15A NCAC 02B .0211 and .0220 (see

Appendix I.1: Link to Proposed Rule Text).

Wastewater Dischargers (Section III.B)

The Division estimates that the impacts of the proposed metals standards on private funds for wastewater dischargers will have a net present value of approximately $16.2 million during the first 10 years of implementation. Given the uncertainties inherent in the analysis, the impacts could range in net present value from as low as $12.2 million to as high as $20.2 million in that period.[39]

Stormwater (Section III.C)

Freshwater metals standards

The proposed revisions to water quality standards for metals applicable to freshwaters (.0211) will have positive or neutral cost impacts for private stormwater permit holders.

The vast majority of permitted private facilities are covered under general stormwater permits. Only one general permit includes metals benchmarks that are becoming more stringent. A review of available data indicated no direct fiscal impact, positive or negative for private facilities permitted under this general permit. For other general stormwater permits benchmarks would either increase, remain the same, or in the case of iron, be removed entirely. These changes could likely result in an unquantifiable monetary benefit to the permitted facilities in the form of decreased monitoring frequency and/or reduced need for stormwater control measures.

For private facilities covered under individual stormwater permits with metals monitoring, it is estimated that either no change or a similar net financial benefit may be realized by permittees due to reduced monitoring burden and stormwater BMP implementation in some cases.

In the event a facility does have a cost associated with this regulation change, DEMLR provides stormwater permittees with substantial flexibility through the permit structure to modify specific program details in a way that could allow many of the increased costs resulting from the implementation of the proposed standards to be offset by changes to the permittee's stormwater management program. Therefore, there is not anticipated to be significant expenditures of private funds required for stormwater permittees due to the proposed metal's water quality standards for freshwaters.

Saltwater metals standards

The proposed revisions to water quality standards for metals applicable to saltwaters (.0220) are not expected to have a fiscal impact on private funds for stormwater permittees.

No direct fiscal impact to privately funded stormwater permittees is expected from the proposed revisions to the metals saltwater standards. There is not a substantial change anticipated to stormwater benchmarks for saltwaters due to the proposed rule revisions. Only a small number of individual stormwater permits contain saltwater benchmarks and there are no general permits that currently contain saltwater benchmarks. The stormwater permit structure provides substantial flexibility allowing for alternative stormwater pollution prevention response actions that may defer increased costs resulting from lowered benchmarks.

[39] See "triennial review fiscal note – ww cost calcs 20140908.xlsx" for calculations.

NPDES Coalitions (Section III.D)

Due to the options available to the NPDES Coalitions regarding the amount of sampling locations and sampling events, estimation of economic impacts due to proposed dissolved metals standards is not possible at this time. No impact is expected related to the 2,4-D proposed standard. A fuller evaluation and explanation regarding impacts to private entities expected for NPDES Coalitions is presented in Section III Chapter D.

Impact Summary for Private Entities

Table IV.2
Summary of Estimated Economic Impacts ($Million) – Private Funds*

Year	Study Costs	Capital Costs	Annual Costs	Totals
2017	$-	$0.01	$0.02	$0.03
2018	$0.01	$0.43	$0.71	$1.15
2019	$-	$0.96	$0.89	$1.85
2020	$0.01	$5.95	$1.24	$7.20
2021	$-	$0.88	$1.42	$2.30
2022	$-	$0.10	$1.43	$1.52
2023	$0.01	$2.51	$1.67	$4.18
2024	$-	$-	$1.67	$1.67
2025	$-	$-	$1.67	$1.67
2026	$-	$-	$1.67	$1.67
Yr1-10	$0.0	$10.8	$12.4	$23.3
Yr11-20	$-	$-	$16.7	$16.7
Yr21-30	$-	$-	$16.7	$16.7
Yr1-30	$0.0	$10.8	$45.7	$56.6
NPV,10Yr	$0.0	$7.9	$8.3	$16.2
NPV,20Yr	$0.0	$7.9	$15.6	$23.5
NPV,30Yr	$0.0	$7.9	$20.1	$28.0

* The cost estimates from Table IV.2 were derived in Section III.B., as this section contains the only quantifiable cost impacts assessed for private funds (see Table IV.1.) The cost estimates in the above table represent the potential costs as discussed in Section III.B. and were derived to represent an estimated midrange cost impact. Estimates for potential low and high costs were also developed and detailed calculations for the low and high cost estimates can be found in “triennial review fiscal note – ww cost calcs 20140908.xlsx”.

Section V. Local Governments – Estimated Economic Impacts

Tables V.1 and V.2 provide a summary of the estimated economic impacts to local governments in North Carolina that would be anticipated due to adoption of the proposed revisions to 15A NCAC 02B .0206, .0211, .0212, .0214, .0215, .0216, .0218 and .0220. Complete descriptions of these fiscal impacts to local funds can be found throughout the Section III chapters of this fiscal and economic analysis. The following summaries have been broken down by the major parameters proposed for revision and by fiscal note chapters (for impacts due to metals regulations) for ease of locating more detailed information.

Table V-1
Overview of Estimated Economic Impacts to Local Funds

Proposed Rule	Wastewater Dischargers (Section III.B)	Stormwater Dischargers (Section III.C)	Coalitions (Section III.D)
2,4-D	No Impact	No Impact	No Impact
Metals	$93 million – over first 10 years of implementation (NPV)	Unquantifiable benefit or No Impact	No Impact

Fiscal Impact by Proposed Standard Change

2,4 D

The proposed revisions to the water quality standards for 2,4-D are found in rules 15A NCAC 02B .0212, .0214, .0215, .0216, .0218. There is no fiscal impact to local funds expected with respect to the proposed revision to the water quality standard for 2,4-D.

Metals

The proposed revisions to the water quality standards for metals protective of aquatic life are found in rules 15A NCAC 02B .0211 and .0220 (see

Appendix I.1: Link to Proposed Rule Text).

Wastewater Dischargers (Section III.B)

The Division estimates that the net present value of impacts of the proposed metals standards on local funds for wastewater dischargers will be approximately $93.2 million in the first 10 years of implementation. Given the uncertainties inherent in the analysis, the impacts could range from a net present value as low as $38.7million to as high as $162.9 million in that period.[40]

Stormwater (Section III.C)

Freshwater metals standards

The proposed revisions to water quality standards for metals applicable to freshwaters (15A NCAC 02B .0211) will have positive or neutral cost impacts for local government stormwater permit holders.

Local governments hold roughly three percent of the stormwater permits expected to be impacted by the proposed changes to 15A NCAC 02B .0211. Local governments with composting permits may incur cost savings due to less stringent metal benchmarks. The proposed rule changes will not affect municipalities that have Phase II MS4 stormwater permits because these permits do not currently have metals monitoring requirements. The overall fiscal impact for local governments is expected to be positive; however, with existing data limitations no monetary value can be estimated.

Phase I MS4 stormwater permits are unique in that they include instream, ambient monitoring requirements in addition to stormwater discharge monitoring. The Phase I MS4 permits requires these cities to have an ambient monitoring plan; the permit does not specify details about what must be monitored or how often. Local governments therefore have the ability to develop their own monitoring plan around their available budget. Therefore, no anticipated cost increases for ambient monitoring as part of the stormwater program is anticipated.

Saltwater metals standards

The proposed revisions to water quality standards for metals applicable to saltwaters (15A NCAC 02B .0220) will have positive or neutral cost impacts for local government stormwater permit holders.

No direct fiscal impact to locally funded stormwater permittees is expected from the proposed revisions to the metals saltwater standards. There is not a substantial change anticipated to stormwater benchmarks for saltwaters due to the proposed rule revisions.

Only a small number of individual stormwater permits contain saltwater benchmarks and there are no general permits that currently contain saltwater benchmarks. The stormwater permit structure provides substantial flexibility allowing for alternative stormwater pollution prevention response actions that may defer increased costs resulting from lowered benchmarks.

[40] See “triennial review fiscal note – ww cost calcs 20140908.xlsx” for calculations and low and high data.

NPDES Coalitions (Section III.D)

There are no fiscal impacts to local funds expected for NPDES Coalitions as discussed in Section III.D.

Impact Summary for Local Governments

Table V-2
Summary of Estimated Economic Impacts ($Million) – Local Funds*

	Study Costs	Cap. Costs	Annual Costs	Totals
2017	$-	$0.05	$0.10	$0.15
2018	$0.47	$0.61	$0.21	$1.29
2019	$0.35	$3.64	$1.56	$5.54
2020	$0.29	$51.05	$4.65	$55.99
2021	$0.43	$1.74	$5.39	$7.55
2022	$0.36	$11.72	$6.94	$19.01
2023	$0.02	$2.94	$8.08	$11.04
2024	$0.01	$8.58	$8.49	$17.08
2025	$-	$-	$8.49	$8.49
2026	$-	$-	$8.49	$8.49
Yr1-10	$1.9	$80.3	$52.4	$134.6
Yr11-20	$-	$-	$84.9	$84.9
Yr21-30	$-	$-	$84.9	$84.9
Yr1-30	$1.9	$80.3	$222.1	$304.4
NPV,10Yr	$1.5	$58.2	$33.9	$93.5
NPV,20Yr	$1.5	$58.2	$70.9	$130.6
NPV,30Yr	$1.5	$58.2	$93.9	$153.5

* The cost estimates from Table V.2. were derived in Section III.B., as this section contains the only quantifiable cost impacts assessed for local funds (see Table V.1.) The cost estimates in the above table represent the potential costs as discussed in Section III.B. and were derived to represent an estimated midrange cost impact. Estimates for potential low and high costs were also developed and the detailed calculations for the low and high cost estimates can be found in “triennial review fiscal note – ww cost calcs 20140908.xlsx”.

Section VI. State Government – Estimated Economic Impacts

Table VI-1 provides a summary of the estimated economic impacts to the state government that would be anticipated due to adoption of the proposed revisions to 15A NCAC 02B .0206, .0211, .0212, .0214, .0215, .0216, .0218 and .0220. Complete descriptions of these fiscal impacts to the state can be found throughout the Section III chapters of this fiscal analysis. The following summaries have been broken down by the major parameters proposed for revision and by the chapters of this fiscal note for ease of locating more detailed information.

Table VI-1
Overview of Estimated Economic Impacts to State Government

Proposed Rule	State Programs/Agencies (Section III.A)	Wastewater Dischargers (Section III.B)	Stormwater Dischargers (Section III.C)
2,4-D	No Impact	No Impact	No Impact
Metals	$1.7 million (all in opportunity cost) over the first 10 years of implementation (NPV)	$100,000 over the first 10 years of implementation (NPV)	No Impact

Fiscal Impact by Proposed Standard Change

<u>2,4 D</u>

The proposed revisions to the water quality standards for 2,4-D are found in rules 15A NCAC 02B .0212, .0214, .0215, .0216, .0218. There is no fiscal impact to state funds expected with respect to the proposed revision to the water quality standard for 2,4-D.

<u>Metals</u>

The proposed revisions to the water quality standards for metals protective of aquatic life are found in rules 15A NCAC 02B .0211 and .0220 (see

Appendix I.1: Link to Proposed Rule Text).

State Programs and Agencies (Section III.A)

*DENR –Division of Water Resources (DWR)**:*** The Division's programs are not expected to incur any direct fiscal impacts to state funds associated with the proposed rules. However, the rule change would impact staff time and the estimated opportunity cost is close to $250,000. Note the Division would incur a one-time implementation cost of more than $54,500 in year 2016. Because no state or federal funding is available to cover these additional costs, the Division will redirect resources, where possible, to operate within the existing budget. Although no additional money will be spent, there is an opportunity cost to the Division and society when staff time is used on these revisions.

DENR- Division of Waste Management (DWM): There is no fiscal impact to state funds expected for the Division of Waste Management.

Department of Transportation (DOT): There is no fiscal impact to state funds expected for the NC Department of Transportation.

No other state agency was identified as having any potential financial impact.

Wastewater Dischargers (Section III.B)

The Division estimates the net present value of the proposed metals standards on state funds for wastewater dischargers will be approximately $110,000 in the first 10 years of implementation. Given the uncertainties inherent in the analysis, the impacts could range from a net present value as low as $70,000 to as high as $140,000 in that period.[41]

Stormwater (Section III.C)

There is no fiscal impact to state funds expected due to adoption of the proposed regulations.

[41] See "triennial review fiscal note – ww cost calcs 20140908.xlsx" for calculations and low and high data.

Impact Summary for State Government

Table VI-2
Summary of Estimated Economic Impacts ($Million) – State Government

	Study Costs	Cap. Costs	Annual Costs**	Totals
2017	$-	$-	$0.25	$0.25
2018	$-	$0.01	$0.27	$0.27
2019	$-	$-	$0.27	$0.27
2020	$-	$-	$0.27	$0.27
2021	$-	$-	$0.27	$0.27
2022	$-	$-	$0.27	$0.27
2023	$-	$-	$0.27	$0.27
2024	$-	$-	$0.27	$0.27
2025	$-	$-	$0.27	$0.27
2026	$-	$-	$0.27	$0.27
Yr1-10	$-	$-	$2.68	$2.69
Yr11-20	$-	$0.01	$2.70	$2.70
Yr21-30	$-	$-	$2.70	$2.70
Yr1-30	$-	$0.01	$8.07	$8.08
NPV,10Yr	$-	$0.01	$1.81	$1.82
NPV,20Yr	$-	$0.01	$2.92	$2.93
NPV,30Yr	$-	$0.01	$3.61	$3.61

* The cost estimates in the above table represent the potential costs as discussed in Sections III.A and III.B., and were derived to represent an estimated midrange cost impact. Estimates for potential low and high costs for state facilities affected by the rule change were also developed and the detailed calculations for the low and high cost estimates can be found in “triennial review fiscal note – ww cost calcs 20140908.xlsx”.

** A one-time opportunity cost incurred by DWR in 2016, estimated at $54,500, is not included in this table.

Section VII. Federal Entities – Estimated Economic Impacts

Table VII-1and Table VII-2 provide a summary of the estimated economic impacts to federal funds that would be anticipated due to adoption of the proposed revisions to 15A NCAC 02B .0206, .0211, .0212, .0214, .0215, .0216, .0218 and .0220. Complete descriptions of these fiscal impacts to federal funds can be found throughout the Section III chapters of this fiscal analysis. The following summaries have been broken down by the major parameters proposed for revision and by fiscal note chapters (for impacts due to metals regulations) for ease of locating more detailed information.

Table VII-1
Overview of Estimated Economic Impacts to Federal Funds

Proposed Rule	Wastewater Dischargers (Section III.B)	Stormwater Dischargers (Section III.C)	Coalitions (Section III.D)
2,4-D	No impact	No impact	No impact
Metals	$100,000 – over first 10 years of implementation (NPV)	No impact	No impact

Fiscal Impact by Proposed Standard Change

<u>2,4 D</u>

The proposed revisions to the water quality standard for 2,4-D are found in rules 15A NCAC 02B .0212, .0214, .0215, .0216, .0218. There is no fiscal impact to federal funds expected with respect to the proposed revision to the water quality standard for 2,4-D.

<u>Metals</u>

The proposed revisions to the water quality standards for metals protective of aquatic life are found in rules 15A NCAC 02B .0211 and .0220 (see

Appendix I.1: Link to Proposed Rule Text).

Wastewater Dischargers (Section III.B)

The Division estimates that the net present value of the proposed metals standards on federal funds for wastewater dischargers will be approximately $100,000 in the first 10 years of implementation. Given the uncertainties inherent in the analysis, the impacts could range from a net present value as low as $90,000 to as high as $100,000 during that period.[42]

Stormwater (Section III.C)

The proposed rules are not anticipated to have a fiscal impact on federal agencies associated with stormwater control. At this time the Division has not identified any federal entities in North Carolina that have a stormwater permit which contains a requirement to monitor for the metals in fresh or salt waters which are proposed for revision.

Coalition Monitoring (Section III.D)

There are no federal facilities participating in the Coalition Monitoring Program; therefore, no impact is expected.

[42] See "triennial review fiscal note – ww cost calcs 20140908.xlsx" for low and high data.

Impact Summary for Federal Entities

Table VII-2
Summary of Estimated Economic Impacts ($Million) – Federal Entities

Year	Study Costs	Cap. Costs	Annual Costs	Totals
2017	$-	$-	$-	$-
2018	$-	$-	$0.01	$0.01
2019	$-	$-	$0.01	$0.01
2020	$-	$-	$0.01	$0.01
2021	$-	$-	$0.01	$0.01
2022	$-	$-	$0.01	$0.01
2023	$-	$-	$0.01	$0.01
2024	$-	$-	$0.01	$0.01
2025	$-	$-	$0.01	$0.01
2026	$-	$-	$0.01	$0.01
Yr1-10	$-	$-	$0.1	$0.1
Yr11-20	$-	$-	$0.1	$0.1
Yr21-30	$-	$-	$0.1	$0.1
Yr1-30	$-	$0.003	$0.2	$0.2
NPV,10Yr	$-	$0.003	$0.1	$0.1
NPV,20Yr	$-	$0.003	$0.1	$0.1
NPV,30Yr	$-	$0.003	$0.1	$0.1

* The cost estimates from Table VII-2 were derived in Section III.B., as this section contains the only quantifiable cost impacts assessed for federal funds (see Table VII-1) The cost estimates in the above table represent the potential costs as discussed in Section III.B. and were derived to represent an estimated midrange cost impact. Estimates for potential low and high costs were also developed and the detailed calculations for the low and high cost estimates can be found in “triennial review fiscal note – ww cost calcs 20140908.xlsx”.

Section VIII. Benefits

Background

Regulations aimed at environmental protection provide a wide range of benefits to the public. The economic benefits can be characterized into two main categories; use and non-use benefits. Use benefits include the direct and indirect use of environmental goods and services by humans (such as fish consumption, recreational fishing or protection of property from storms) and the option to use environmental goods and services at a future date or in future generations. Nonuse values are associated with the public's desire to know that an environmental resource exists and is protected even if they do not expect to use the resource for direct economic benefit themselves.

Of these types of benefits, direct use values are the easiest to quantify because an economic market may exist for environmental products directly consumed by humans, meaning a monetary benefit is easier to estimate. The other benefits (indirect, future and non-use) are more difficult, and in some cases impossible, to accurately value. However, these benefits are often just as important to society as the monetized benefits. Because it is challenging to quantify some of the benefits expected from environmental protection, they sometimes are overlooked or undervalued in state agency economic analyses conducted for environmental regulations.

Surface water quality standards are designed to define the condition of waters that protect public and environmental health. The Clean Water Act requires these standards to be based solely on science with no consideration of costs. Since the water quality standards are simply developed to define an appropriate condition, the water quality standards regulations themselves do not produce costs for the public. For this reason, federal water quality criteria promulgated under the Federal Water Pollution Control Act (Clean Water Act) generally do not have an accompanying fiscal analysis conducted before criteria adoption. Consequently, there is no federal fiscal analysis to provide cost/benefit information on the proposed state rule changes addressed in this document. However, costs and benefits are incurred when state and federal regulatory programs use the standards to implement their own rules.

The rule proposals presented in this rulemaking package will ensure that North Carolina maintains compliance with the federal Clean Water Act (CWA) and aligns state regulations with the federal National Recommended Water Quality Criteria (NRWQC). The NRWQC are derived from the current federally verified science and describe concentrations of toxicants and other pollutants in the water column that are harmful to aquatic life and human health.

The state rule proposals incorporate various revisions that will produce different types of benefits to the state, both ecological and fiscal, when implemented by the appropriate programs. The most significant revisions proposed are the changes to the aquatic life water quality standards for some metals.

The changes to the water quality standards for metals are expected to provide a mechanism to both reduce metal concentrations in the waters of the state and to allow a more accurate and scientific assessment of the health of the state's aquatic habitats. Based on current EPA scientific guidance, North Carolina's existing aquatic life based water quality standards for metals are not adequate to accurately determine when metals concentrations may be at problematic levels in the state's waters. More accurate identification of problem areas will allow for better protections to be put into place, including reductions in metals concentrations from anthropogenic (human) sources where necessary.

A reduction in metals' concentrations in the state's aquatic environment is expected to provide a direct ecological benefit to aquatic ecosystems and may indirectly benefit human uses as well; for example by reducing human exposures to metals or aiding in the recovery of fishery resources.

Some of the proposed rule benefits are quantifiable, while other benefits are discussed qualitatively. Table VIII-1 summarizes the types of benefits that will be assessed in this fiscal analysis as well as the level of economic analysis that was completed.

Table VIII-1
Summary of benefits categories considered and level of analysis conducted

Types of Benefits and Level of Analysis				
	Description	**Quantified and Monetized**	**Quantified but not Monetized**	**Qualitative**
Use Benefits				
Aquatic Life (Biodiversity)	Reduced mortality for aquatic wildlife – healthier ecosystems Improved reproductive success of aquatic wildlife Increased diversity of aquatic wildlife Improved conditions for successful recovery of threatened and endangered species Improved integrity of aquatic and aquatic-dependent ecosystems	X		X
Commercial fisheries, shellfisheries, and aquaculture	Maintain or increase harvest volume and value	X		X
Recreation (fishing, boating, swimming)	Improved fishing experiences and aquatic recreation due to cleaner water		X	
Secondary Impacts	Reduced human exposure to pollutants and future economic development opportunities			X
Nonuse Benefits				
Bequest	Intergenerational equity; protecting resources for future generations			X
Resource Existence	Stewardship/preservation Vicarious consumption			X

Summary of Anticipated Benefits

The use benefits from the proposed rules as discussed in this chapter are classified into three broad categories:

1. Maintenance and enhancement of aquatic biodiversity (through protection of aquatic habitats and organisms);
2. Maintenance or enhancement of the state's recreational and commercial fishing industries as well other aquatic recreational activities; and
3. Secondary benefits to human health and economic development.

DENR anticipates that the proposed revisions to the water quality standards will provide benefits to society in all of these categories, as well as provide non-use benefits. Table VIII-2 provides a summary of the anticipated range of annual monetary benefits that are expected to be incurred by the state as a result of adoption of the proposed rules. These values are shown as annual figures in millions of dollars. An average value is provided for each benefit category that was able to be quantified, as well as a low and high estimate of the potential annual benefits. More detailed information on the derivation of these values and on the unquantifiable benefits follows throughout the chapter.

Table VIII-2
Monetized Benefits of Proposed Rules – Annual Summary

Range of Estimated Annual Benefits ($Mil.)	Low	Average	High
Aquatic Life (Biodiversity)	$ 0.92	$ 11.50*	$ 232.02
Commercial Fishing	$0.01	$0.02	$0.04
Other Uses (Nonuse values, Human Health, and Economic Development)	Cannot be monetized – presented qualitatively		
Annual Sum of Monetized Benefits**	$0.93	$ 11.52	$ 232.06

*This value is not an average of the low and high estimates as was done for the other monetized benefits categories. This value accounts for a 0.25 percent change in water quality which would impact 100 percent of NC's population as per the modeling results. See section for more information.

** The estimates in this table are not in net present value terms and have not been adjusted for inflation.

The complete calculations describing the monetary benefits anticipated to be accrued by the North Carolina public due to adoption of the proposed rules can be found in Table VIII-3 below. These calculations account for the benefits expected during a 30-year time period beginning in 2016. Note, however, that the different monetized benefit categories described in Table VIII-2 begin at different points throughout the 30-year period dependent on when the actual benefits were expected to be achieved. The net present value of the sum of the average annual benefits is from Table VIII-2, computed using a seven percent discount rate, and it was determined after applying a two percent rate of inflation to annual benefits.

Table VIII-3
Monetary Benefits Summary Table ($Mil)[1,2]

Year	Aquatic Life	Commercial Fishing	Sum of Benefits
2017	$0	$0	$0
2018	$0	$0	$0
2019	$0	$0	$0
2020	$0	$0	$0
2021	$2.3	$0	$2.3
2022	$4.6	$0	$4.6
2023	$6.9	$0	$6.9
2024	$9.2	$0	$9.2
2025	$11.5	$0	$11.5
2026	$11.5	$0	$11.5
2027	$11.5	$0	$11.5
2028	$11.5	$0	$11.5
2029	$11.5	$0	$11.5
2030	$11.5	$0	$11.5
2031	$11.5	$0	$11.5
2032	$11.5	$0.02	$11.5
2033	$11.5	$0.02	$11.5
2034	$11.5	$0.02	$11.5
2035	$11.5	$0.02	$11.5
2036	$11.5	$0.02	$11.5
2037	$11.5	$0.02	$11.5
2038	$11.5	$0.02	$11.5
2039	$11.5	$0.02	$11.5
2040	$11.5	$0.02	$11.5
2041	$11.5	$0.02	$11.5
2042	$11.5	$0.02	$11.5
2043	$11.5	$0.02	$11.5
2044	$11.5	$0.02	$11.5
2045	$11.5	$0.02	$11.5
2046	$11.5	$0.02	$11.5
Yr1-10	$46.0	$0.00	$46
Yr11-20	$115.0	$0.11	$115
Yr21-30	$115.0	$0.21	$115
Yr1-30	$276.0	$0.32	$276
NPV,10Yr	$28.2	$0.0	$28.2
NPV,20Yr	$78.5	$0.0	$78.5
NPV,30Yr	$109.6	$0.1	$109.7

[1] Annual benefits shown above are unadjusted for inflation.
[2] Net present values (NPV) are in 2014 dollars computed using a 7% discount rate after annual benefits were adjusted for 2% inflation.

The Division estimates the net present value (NPV) of quantifiable public benefits from the proposed rule change will be approximately $110 million during a 30-year period (Table VIII-3).

The maintenance and enhancement of aquatic biodiversity benefit was calculated using an existing study of peoples' willingness to pay for improvements in water quality. DENR customized the model with North Carolina-specific information to provide the most accurate estimate possible. Based on this model, the range of benefits was estimated from a low of $900,000 to a high of $232 million annually (Table VIII-2). For the calculation of overall monetary benefits, an annual benefit of $11.5 was used. This represents a 0.25 percent improvement in water quality for all households in North Carolina. For years 2021-2025, the Division assumed a water quality improvement in an increasing fraction of the surface waters because the rule changes would apply gradually over a 5-year cycle as the regulated community renews their discharge permits.

Uncertainties and General Assumptions

When discussing fiscal analyses of environmental regulations, the Division is often questioned about the use of the North Carolina impaired waters list as a tool for determining the benefits of pollution reductions. The impaired waters list provides information on waters currently known not to be meeting their designated uses based on instream exceedances of surface water quality standards or a demonstrated loss of their uses. High metals concentration are known threats to North Carolina's water quality. There are 533 stream miles, 3,201 reservoir acres and 465,737 estuarine acres impaired due to metals other than mercury.[43]

One of the primary benefits of these rule proposals is that they will allow for a more accurate identification of waters with high metals concentrations as well as a more thorough decision making process for assessing waters for inclusion on the impaired waters list. The revised aquatic life-based metals standards are designed to prevent further water quality degradation and improve the quality of waters with high metals concentrations, assuming that implementation of the rules results in reductions in metals inputs to surface waters. The proposed rules are expected to accomplish these goals by establishing a protective instream concentration that is more reflective of the current science on metals toxicity to aquatic life in ambient waters. Although DENR believes these changes will lead to improved water quality, the methodology for calculating impairment also is changing, making it challenging to determine the absolute improvement in water quality that will result from the rule changes.

Therefore, the impaired waters list cannot be used as a basis for measuring the number of waters or the spatial extent of the potential benefits expected from these rule proposals or to gage the extent of water quality improvements. The impaired waters list provides snap shots in time of the conditions of the state's waters based on the current water quality regulations in place at that point in time. When the proposed water quality standards revisions are adopted by the state, the baseline for water degradation or "impairment" would change and the methods of assessing impaired waters also would change. For example, the number of waters currently impaired for total recoverable copper could not be compared to the number of waters potentially impaired for dissolved copper under the proposed regulations to determine a potential benefit to water quality. An increase or decrease in copper impairments after adoption of new regulations does not necessarily equate to an actual improvement or degradation in water quality. The baseline for impairment, as defined in the water quality standards, would simply be different.

[43] 2012 Final 303(d) list of impaired waters: http://portal.ncdenr.org/web/wq/ps/mtu/assessment.

With this in mind, a range of other options for quantifying benefits were explored. The use benefits from the proposed rules as discussed in this chapter are classified into four broad categories:

1. Maintenance and enhancement of aquatic biodiversity (through protection of aquatic habitats and organisms);
2. Maintenance or enhancement of the state's recreational and commercial fishing industries as well other aquatic recreational activities;
3. Secondary benefits to human health and economic development.

DENR anticipates that the proposed revisions to the water quality standards will provide benefits to society in all of these categories, as well as provide non-use benefits. At the same time, it is challenging to quantify the exact nature and magnitude of these benefits. The agency was not able to bring the same depth of analysis to all of the above categories because of an imperfect understanding of the link between pollutant reductions from point and nonpoint source discharges and benefit categories. Moreover, future federal mandates, community developments and other factors may alter the impact of these rule changes.

DWR made some general assumptions throughout this chapter. This chapter assumes that the sole benefits of wastewater treatment facility upgrades and other control measures will be the reduction of the targeted metals. In reality, capital investments and other actions intended to bring facilities into compliance with this rule package may enhance more than just remove targeted metals. Depending on the nature of the action and the affected facility, removal of non-targeted metals and other pollutants may occur to varying degrees. For example, increased chemical addition and precipitation may result in increased removal of phosphorus.

Use Benefits

Benefits to Aquatic Life (Maintenance and Enhancement of Biodiversity)

The US EPA defines the term biodiversity as referring to the variety and variability among living organisms and the ecological systems in which they live.[44] Essentially, biodiversity can be thought of as encompassing the differences between ecosystems, species, and genes.[45] The concept of biodiversity, as discussed in this fiscal analysis, reflects the benefits of maintaining and protecting a wide range of aquatic habitats, a wide range of organisms in those habitats and a large enough population of individual organisms to ensure genetic diversity and allow organism adaptation.

The US EPA indicates that biodiversity carries a large amount of economic and ecological importance as it helps to maintain the overall health of the environment.[46] Aquatic biodiversity has also been shown to provide many valuable goods and services that benefit humans – some of which are considered to be irreplaceable.[47] The economic value of aquatic biodiversity includes providing a direct contribution to economic productivity (ex. through fisheries, which is discussed in other sections of this chapter as well), providing an "insurance value" to protect

[44] US EPA website. 2012. (http://www.epa.gov/bioiweb1/aquatic/glossary.html)
[45] US EPA website. 2012. (http://www.epa.gov/bioiweb1/aquatic/glossary.html)
[46] US EPA website. 2012. (http://www.epa.gov/bioiweb1/aquatic/)
[47] Covich, A.P. Ewel, K.C., Hall, R.O., Giller, P.E., Goedkoop, W., and Merritt, D.M. (2004). Ecosystem services provided by freshwater benthos. In *Sustaining Biodiversity and Ecosystem Services in Soil and Sediments* (ed. D.H. Wall), pp.45-72. Island Press, Washington D.C., USA.

ecosystems and human society from unexpected events, such as natural disasters, providing a storehouse of genetic information for the future and providing support of ecosystem services.[48] [49] [50]

Ecosystem services are described by the US EPA as being the life-sustaining benefits humans receive from nature which are critical to society's health and well-being, yet are limited and often taken for granted as being free.[51] Ecosystem services provided by aquatic environments include things such as control of stormwater runoff, purification of water to be used as a drinking source, and air purification and climate stabilization, among countless others.[52] Economists have argued that ecosystem services used by humans and supported by biodiversity are more valuable and significant to the economy than the direct economic benefits of biodiversity received from the material goods that are physically taken from the aquatic systems.[53]

Historically, it has been difficult to calculate an economic value that captures the multitude of benefits that biodiversity and the associated ecosystem services provide to society. Some economists have argued that monetary values obtained by traditional economic valuation methods are as arbitrary as values assigned by non-economic methods.[54] [55] [56]These same economists argue that ecosystem services cannot be expressed simply as economic goods or services and that a single monetary value that captures the total value of ecosystems to society does not exist.

Others believe that estimating peoples' willingness to pay for ecosystem services is relatively straightforward for resources and services that are traded in a market such as farmland or pollinating services. For ecosystem services that are not captured in traditional markets, standard economic theory can still be applied: the value an individual places on a particular ecosystem service is presumed to be reflected by that individual's willingness to pay for it. This value depends upon: a) individual preferences; b) income; c) the cost in time and money of gaining access to the resource or service; and d) the availability of perfect or near-perfect substitutes. People's willingness to pay for ecosystem services also depends on their awareness and understanding of why these services are important. The current environmental conditions or stocks of environmental services in the local area may shape marginal willingness to pay. As noted in the Huber *et al.* model presented in this section, peoples' marginal willing to pay for water quality improvements is higher when they live in an area with lower water quality.

Many attempts have been made by economists to quantify the benefits of biodiversity and the dollar amounts are generally substantial. For example, Pimentel et al. (1997) estimated the

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[48] Pearce, D. (1998). Auditing the Earth: the value of the worlds ecosystem services and natural capital. *Environment* 40, 23-27.

[49] Heal, G.M. (2000). Nature and the marketplace: Capturing the Value of Ecosystem Services. Island Press, Washington D.C., USA.

[50] Covich, A.P., Austen, M.C., Barlocher, F., Chauvet, E., Cardinale, B.J., Biles, C.L., Inchausti, P., Dangles, O., Solan, M., Gessner, M.O., Statzner, B. and Moss, B.R. (2004). The role of biodiversity in the functioning of freshwater and marine benthic ecosystems. *BioScience* 54, 767-775.

[51] US EPA website. 2012. http://www.epa.gov/research/ecoscience/eco-questions.htm#1

[52] IUCN, The Nature Conservancy, and The World Bank.(2004). How much is an Ecosystem worth? Assessing the economic value of conservation. The International Bank for Reconstruction and Development/ the World Bank. Washington, DC. http://jncc.defra.gov.uk/pdf/BRAG_SE_Pagiolaetal-HowMuchIsAnEcosystemWorth(WorldBankIUCNReport).pdf

[53] Myers, N. (1996). Environmental Services of Biodiversity. *Proceedings of the National Academy of Sciences.* 93(7), 2764-2769.

[54] Dumont, Henri J. (2005). Biodiversity: A resource with a monetary value?. *Hydrobiologia* 542, 11-14.

[55] Vatn, A. and Bromley, D.W. (1995). Choices Without Prices Without Apologies. In *Handbook of Environmental Economics*. Blackwell, Oxford, pp. 3-25.

[56] Kant, S. (2003). Choices of ecosystem capital without discounting and prices. *Environmental Monitoring and Assessment* 86, 29-45.

economic benefits of all biodiversity in the US to be $319 billion per year.[57] This value would be even greater if inflated into current dollars.

A brief summary of the ecological and economic benefits of maintaining and protecting species and genetic diversity in North Carolina waters through adoption of the rule proposals is presented in the following section.

Species Biodiversity

Species biodiversity relates to the number of different species present in an ecosystem. An ecosystem that contains a diverse number of species will support a more stable and healthy food web and will be more resistant to environmental changes. However, biodiversity around the world is threatened by the loss of many individual species throughout a variety of ecosystems.

The loss or extinction of species is a natural process and historical rates of extinction have been estimated as 9 percent species extinction per million years.[58] However, human activities have likely caused a significant increase in the rate of extinction to unnatural and potentially unsustainable levels. More recent extinction rates have been estimated to be in the range of 1-11 percent species extinction per decade.[59] Aquatic organisms are known to be particularly vulnerable to extinction. For example, the US EPA indicates that two - thirds of the nation's freshwater mussel species and over half of the crayfish species are in danger of extinction.[60]

The southeast region of the US has been found to support the highest aquatic species biodiversity in the entire United States.[61] [62] [63] [64] In North Carolina, as in the rest of the southeast region, individual plant and animal species are in danger due to a variety of factors such as habitat alteration and point and nonpoint source pollution. As of November 2008, the state of North Carolina has designated 109 endangered and threatened species and 129 state species of Special Concern under the State Endangered Species Act (NC General Statute 113 –331 to 113–337).[65] Aquatic species, including amphibians, crustaceans, fish and mollusks account for roughly 70 percent of these species. Risks to the survival of individual species can not only threaten aquatic biodiversity but can also be an indicator of potential future threats to other more stable species, as well as entire ecosystems.

Fish species are one of the most publically recognizable and commonly studied aquatic organisms. Burr and Mayden (1992) have estimated that the freshwaters of the southeastern

[57] Pimentel, D., Wilson, C., McCullum, C., Huang ,R., Dwen, P., Flack, J., Tran, Q., Saltman, T., and Cliff, B. (1997). Economic and Environmental Benefits of Biodiversity. *Bioscience* 47, 747-757.
[58] Raup, D. (1988). Diversity Crises in the Geological Past. In *Biodiversity: Papers from the National Forum on Biodiversity* (ed. E. Wilson), pp. 51-57. National Academy Press, Washington D.C., USA.
[59] Reid, W.V. (1992). How Many Species Will There Be? In *Tropical Deforestation and Species Extinction* (eds. T. Whitmore and J. Sayer,).Chapman Hall, London.
[60] US EPA website. (2012). http://www.epa.gov/bioindicators/aquatic/freshwater.html
[61] Burr, B. M., and R. L. Mayden. 1992. Phylogenetics and North American freshwater fishes. Pages 18 –75 in R. L. Mayden, editor. Systematics, historical ecology, and North American freshwater fishes. Stanford University Press, Stanford, CA.
[62] Taylor, C. A., M. L. Warren, J. F. Fitzpatrick, H. H. Hobbs, R. F. Jezerinac, W. L. Pflieger, and H. W. Robison. 1996. Conservation status of crayfishes of the United States and Canada. Fisheries 21:25 –38.
[63] Warren, M.L., B.M. Burr, S.J. Walsh, H.L. Bart, R.C. Cashner, D.A. Etnier, B.J. Freeman, B.R. Kuhajda, R.L. Mayden, H.W. Robison, S.T. Ross, and W.C. Starnes. (2000). Diversity, distribution, and conservation status of the native freshwater fishes of the southern United States. Fisheries 25(10):7– 31.
[64] Williams, J. D., M. L. Warren, K. S. Cummings, J. L. Harris, and R. J. Neves. (1993). Conservation status of the freshwater mussels of the United States and Canada. Fisheries 18:6 – 22.
[65] NC Wildlife Resources Commission. (Nov 2008). http://www.ncwildlife.org/Portals/0/Conserving/documents/protected_species.pdf

United States support 62 percent of the total United States freshwater fish species and 50 percent of North American freshwater fish species.[66] [67] North Carolina freshwaters sustain a large portion of the southeastern fish species biodiversity, supporting roughly 240 fish species.[68] It was recently noted that 39 percent of all freshwater and diadromous (fish dependent on habitats in both fresh and salt waters) fish species are at a risk for extinction[69] and that the downward trend of fish species heading towards extinction is likely increasing.[70]

The southeastern region of the country, while known to support impressive aquatic biodiversity, seems to be following this national downward trend towards reduced freshwater fish biodiversity. The southeastern region of the United States has a higher number of imperiled freshwater fish species than any other region of the country.[71] [72] Warren *et al.* (2000) indicates that 28 percent of southeastern freshwater and diadromous fish species have been labeled as extinct, endangered, threatened or vulnerable and that the percentage of fish species carrying these labels has undergone a 125 percent increase over the last 20 years alone.[73] North Carolina was ranked third among the individual southeastern states when the number of freshwater fish species in danger within the state was analyzed in the late 1990s.[74]

The rule proposals addressed in this fiscal analysis are expected to aid efforts to stabilize and/or enhance species biodiversity in state waters. Point and non-point source pollution is a recognized factor contributing to decreases of aquatic species in the state's waters.[75] [76] Metals are known to be toxic to aquatic life and particularly to some of the endangered aquatic species.

Any reduction in metals in the state's waters that occurs as a result of these rules will likely be a benefit to these sensitive organisms. The proposed rules will also allow for a more thorough assessment of habitat suitability in relation to the potential for metals toxicity allowing problem waters to be better identified and addressed.

Two endangered NC aquatic organisms are highlighted in *Appendix VIII.1: Impact of Metal Contamination on Endangered Species* to better reflect the negative impacts of metals pollution

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Burr, B. M., and R. L. Mayden. 1992. Phylogenetics and North American freshwater fishes. Pages 18 –75 in R. L. Mayden, editor. Systematics, historical ecology, and North American freshwater fishes. Stanford University Press, Stanford, CA.

[67] North Carolina Wildlife Resources Commission. 2005. North Carolina Wildlife Action Plan. Raleigh, NC. http://www.ncwildlife.org/Portals/0/Conserving/documents/ActionPlan/WAP_complete.pdf

[68] North Carolina Wildlife Resources Commission. 2005. North Carolina Wildlife Action Plan. Raleigh, NC. http://www.ncwildlife.org/Portals/0/Conserving/documents/ActionPlan/WAP_complete.pdf

[69] Jelks, H. L., et al. (2008). Conservation status of imperiled North American freshwater and diadromous fishes. Fisheries 33:372–407

[70] Williams, Jack E. , Williams, Richard N., Thurow, Russell F. , Elwell, Leah, Philipp, David P., Harris, Fred A. , Kershner, Jeffrey L. , Martinez, Patrick J., Miller, Dirk , Reeves, Gordon H., Frissell, Christopher A. and Sedell, James R. (2011). Native Fish Conservation Areas: A Vision for Large-Scale Conservation of Native Fish Communities. Fisheries 36(6): 267-277.

[71] Minckley, W. L., and J. E. Deacon. 1991. Battle against extinction. Native fish management in the American West. University of Arizona Press, Tuscon, AZ.

[72] Warren, M. L., and B. M. Burr. 1994. Status of freshwater fishes of the United States: overview of an imperiled fauna. Fisheries 19:6 –18.

[73] Warren, M.L., B.M. Burr, S.J. Walsh, H.L. Bart, R.C. Cashner, D.A. Etnier, B.J. Freeman, B.R. Kuhajda, R.L. Mayden, H.W. Robison, S.T. Ross, and W.C. Starnes. (2000). Diversity, distribution, and conservation status of the native freshwater fishes of the southern United States. Fisheries 25(10):7– 31.

[74] Warren, M. L., P. L. Angermeier, B. M. Burr, and W. R. Haag. (1997). Decline of a diverse fish fauna: patterns of imperilment and protection in the southeastern United States. Pages 105 –164 in G. W. Benz and D. E. Collins, editors. Aquatic fauna in peril: the southeastern perspective. Southeast Aquatic Research Institute, Decatur, GA

[75] North Carolina Wildlife Resources Commission. 2005. North Carolina Wildlife Action Plan. Raleigh, NC. http://www.ncwildlife.org/Portals/0/Conserving/documents/ActionPlan/WAP_complete.pdf

[76] Deaton, A.S., W.S. Chappell, K. Hart, J. O'Neal, B. Boutin. 2010. North Carolina Coastal Habitat Protection Plan. North Carolina Department of Environment and Natural Resources. Division of Marine Fisheries, NC. 639 pp.

in NC waters and to illuminate the benefits that may be provided to species biodiversity from these rule proposals.

Genetic Biodiversity

Genetic biodiversity relates to the genetic variability within a single species. Genetic variability provides protection to the continued existence of a species by providing a mechanism for the species to adapt to environmental changes, such as climate change. However, genetic biodiversity not only ensures protection to aquatic communities by enabling these communities to respond to an ever changing environment, it also has provided a significant benefit to humans throughout history. The genetic diversity of aquatic organisms has long been harnessed in order to provide benefits for society, particularly in the field of medicine.

The US Fish and Wildlife Service recognizes the value of genetic biodiversity in a pamphlet entitled "Why Save Endangered Species".[77] The US FWS explains that "*Each living thing contains a unique reservoir of genetic material that has evolved over eons. This material cannot be retrieved or duplicated if lost. So far, scientists have investigated only a small fraction of the world's species and have just begun to unravel their chemical secrets to find possible human health benefits to mankind. No matter how small or obscure a species, it could one day be of direct importance to us all. It was "only" a fungus that gave us penicillin, and certain plants have yielded substances used in drugs to treat heart disease, cancer, and a variety of other illnesses*."

Many of today's medications have been derived either directly from plants and animals or through studying them and copying their unique genetic attributes. More than a quarter of all prescriptions written annually in the United States contain chemicals discovered in plants and animals, including antibiotics, anti-cancer agents, pain killers, and blood thinners. It is important to maintain aquatic biodiversity for humans, as well as for its ecological value, since the amount of information to learn from aquatic species is still immense and relatively unexplored. The US FWS indicates that "the biochemistry of unexamined species is an unfathomed reservoir of new and potentially more effective substances."

Quantification of Aquatic Life (Biodiversity) Benefits in Freshwaters

The above sections described qualitative benefits for recreational activities and protection of aquatic life (or biodiversity) expected due to the adoption of the proposed rules. DENR does not have the financial and staff resources to directly measure peoples' preferences for improved water quality through a revealed preference study or with willingness to pay surveys. Instead, the department relied on an existing study of peoples' willingness to pay for improvements in water quality and used the model developed in this research to estimate the monetary benefits of the proposed rule changes. DENR customized the model with North Carolina-specific information on income, demographics, and existing water quality to adjust household willingness to pay for changes in water quality for quantifiable differences between the original study case and this policy case. This approach assumes the beneficiaries of the proposed rules, in this case the residents of North Carolina, have different characteristics, but similar tastes, as people in the nation as a whole.

[77] US Fish and Wildlife Service: http://www.fws.gov/endangered/esa-library/pdf/Why_Save_Endangered_Species_Brochure.pdf

The research used in this fiscal analysis was performed by Duke University researchers Drs. Joel Huber, W. Kip Viscusi and Jason Bell.[78] Their research summarized the results of more than 4,000 national survey responses to estimate how people monetarily value changes in water quality. For the purposes of the Huber *et al.* study, water quality was defined as the percent of lake acres and river miles that are rated 'good' within a 100-mile radius from the respondent's home. The study defined water quality as 'good' if 1) the water is safe for swimming, 2) if fish from the water are safe to eat, and 3) if the lakes and rivers sustain a varied and healthy aquatic environment. For the survey, the percentage of lake acres and river miles that were rated good was taken from the US Environmental Protection Agency's ATTAINS database (Assessment, TMDL Tracking And Implementation System).

Survey respondents provided valuations through a series of hypothetical choices between regions with better water quality and higher annual cost of living versus regions with lower water quality and lower annual cost of living. Survey responses were used to develop a mathematical model which was used to determine the national willingness to pay for good water quality. A summary of the model is presented in *Appendix VIII.2: Valuation of Water Quality Improvement - Model Summary*.

The model developed in the Huber *et al.* study can be used to develop valuations for individual states or regions through the use of region-specific data. The variable data used in the model were specific to North Carolina where possible and were taken from the 2010 US Census, the US Environmental Protection Agency, and the Organization for Economic Co-operation and Development (OECD). Since the original model utilized 2004 dollars, the average income figure was deflated into 2004 values and then model output was inflated into current 2014 dollars to match other information presented in this note.

For North Carolina citizens, the model indicated that the tradeoff between water quality and the annual cost of living has a value of $17.61 per household for each one percent increase in the lake and reservoirs acres that are rated "good" in the region for fishing, swimming and aquatic uses. This value is $11.34 for rivers and streams. (The difference in river and lake values is attributed to the lower level of initial water quality for North Carolina lakes – 31.6 % were rated "good" by the EPA in 2004 – and peoples' greater marginal willingness to pay for water quality improvements in areas with poor water quality.) Combined, the value of a one percent improvement in water quality for both lakes and rivers is $28.96 annually. When this value is inflated to 2014 dollars, it becomes $35.3 (considering 2% annually inflation rate).

For the purposes of this fiscal and economic analysis, it was estimated that changes to existing water quality standards would result in a one quarter of one percent (0.25%) increase of lake acres and river miles rated "good" for 100 percent of North Carolina households. This percentage was selected to indicate that the department anticipates a general positive benefit from this policy change. The figure is not an accurate measure of the exact level of change, because this will depend on many other factors. This may seem like a small change; the percent of river miles with a 'good' rating change from 31.6 to 31.85 and the acres of lakes rated 'good' increases from 68.6 to 68.85. However, this 0.25 percent change could represent a change to a 'good' water quality rating for an estimated 93 miles of rivers and 778 acres of state lakes.

This potentially conservative level of change in water quality represents the uncertainty around the actual change in overall water quality directly attributable to this specific rule change as opposed to water improvement initiatives in general. The Huber *et al.* model considers the value

[78] Huber, Joel, W. Kip Viscusi, and Jason Bell. 2006. "Economics of Environmental Improvement" EPA Cooperative Agreement CR823604 and Grant R827423 to Harvard University with the National Center for Environmental Economics. http://yosemite.epa.gov/ee/epa/eerm.nsf/vwAN/EE-0496-01.pdf/$file/EE-0496-01.pdf

of overall water quality improvements while these rule proposals focus on control of only certain individual pollutants. Therefore overall water quality may remain constant, decline, or increase in the future due to other forms of water pollution not addressed under the rule proposals. Factors such as land use, population growth, additional federal rule requirements, and other factors also will affect future water quality. The percent of lake acres and river miles rated ‘good’ overall may continue to decline even with this rule change.

These water quality improvements are not expected to be uniformly distributed throughout waterbodies in the state. The proposed regulations themselves only define the appropriate condition of a waterbody. Water quality improvements are expected to occur when these rule proposals are implemented through other state and local regulations and programs. For this reason, DWR anticipates the highest levels of water quality improvement will be experienced by surface waters that accept direct waste discharges from NPDES facilities. This is due to the fact that the proposed regulations will be implemented statewide through the DENR programs regulating these entities under Clean Water Act regulations. The water quality improvements are expected to be both close to the facilities and farther downstream.

NPDES point source facilities are scattered throughout the entire state so DENR has made the assumption that 100 percent of the population may receive benefits from the rule proposals. At a minimum, these rule proposals will maintain the existing water quality in all waters and prevent future degradation due to metals and 2,4-D.

To test the sensitivity of this result to the percent of lake acres and river miles rated “good” and the number of affected households, a two-way table was created (Table VIII-4). The model results estimated changes in the percent of lake acres and river miles rated “good” ranging from 0.1 to 5 percent and for the percentage of affected households, ranging from 20 to 100 percent.

According to the latest 2010 Demographic Profile produced by the US Census Bureau, North Carolina has 3,745,155 households. If all households in the state are affected by this change in water quality standards and the anticipated associated water quality improvements, this has a value between $13 and $661 million annually.

Other methodologies to measure peoples’ willingness to pay for water quality improvements could have produced results higher or lower than the ones presented here.

Table VIII-4
Range of Benefit Values for Improved Water Quality

Percent of Population Affected	**Percent Change in Water Quality**				
	0.1%	**0.25%**	**0.5%**	**1%**	**5%**
20%	$2,643,946	$6,609,864	$13,219,729	$26,439,457	$132,197,286
40%	$5,287,891	$13,219,729	$26,439,457	$52,878,915	$264,394,573
60%	$7,931,837	$19,829,593	$39,659,186	$79,318,372	$396,591,859
80%	$10,575,783	$26,439,457	$52,878,915	$105,757,829	$528,789,145
100%	$13,219,729	**$33,049,322**	$66,098,643	$132,197,286	$660,986,431

As seen in Table VIII-4, a 0.25 percent increase of lake and river miles rated “good” has an annual benefit statewide of about $33 million annually. These results need to be adjusted to account for the types of benefits that will be provided by the rule changes. There will be minimal improvements in fish safety for human consumption and in water quality for swimming or boating. These rule changes are being implemented primarily to be more protective of aquatic life. Huber et al. was able to use the survey information to evaluate the total percentage of worth that respondents placed on each these three components of water quality. They were reported as 35.2% for fishing, 30.0% for swimming, and 34.8% for aquatic environment.

The results reported in Table VIII-4 were multiplied by 34.8% to isolate only the benefits associated with aquatic environment protection. When this adjustment is performed, a 0.25 percent increase of lake and river miles rated “good” has an annual benefit of close to $11.5 million annually (Table VIII-5). For the purposes of this fiscal analysis, DENR has chosen to use this value to represent the benefit of improvement to water quality that is expected to result from the proposed rule changes.

Table VIII-5
Range of Benefit Values from Improved Water Quality that is More Protective of Aquatic Life

Percent of Population Affected	Percent Change in Water Quality				
	0.1%	**0.25%**	**0.5%**	**1%**	**5%**
20%	$920,093	$2,300,233	$4,600,466	$9,200,931	$46,004,656
40%	$1,840,186	$4,600,466	$9,200,931	$18,401,862	$92,009,311
60%	$2,760,279	$6,900,698	$13,801,397	$27,602,793	$138,013,967
80%	$3,680,372	$9,200,931	$18,401,862	$36,803,724	$184,018,622
100%	$4,600,466	**$11,501,164**	$23,002,328	$46,004,656	$230,023,278

The state will not receive the full value of the rule change (estimated at more than $14 million annually) until corporate and community facilities upgrade wastewater treatment facilities to reduce metals in wastewater effluent. DENR estimates that the benefits associated with this policy change will not start to occur until 2021 and full benefits will begin in 2025. This schedule reflects the existing 5-year cycle for NPDES permitting and compliance. DENR incorporates these benefits into the model in 20 percent increments between 2021 and 2025.

Appendix VIII.3: Alternative Method for Water Quality Valuation of Freshwater Streams presents a different approach to quantifying potential water quality improvements from changes in metal standards by employing the value of a restored foot of water.

Benefits to Commercial Fishing

North Carolina has more than 730 marine species in its estuarine and coastal waters making it the second most diverse marine ecosystem in the East or Gulf coasts.[79] North Carolina’s estuaries provide nutrients and shelter for some part of the life of 95 percent of the commercial fish species caught. The estuaries are an important fishing ground for North Carolina’s seafood industry, which harvests 39 major fish stocks.[80] Traditionally ranked in the top 10 seafood producing states, North Carolina has more than 4,000 miles of shoreline and 2.5 million acres of marine and estuarine waters.

[79] Hardley, John and Scott Crosson. 2010. “A Business and Economic Profile of Seafood Dealers in North Carolina” North Carolina Division of Marine Fisheries.
[80] http://www4.ncsu.edu/~dbeggles/education/synergy/bluecrab/bhist.html

Marine fishery resources are a major economic driver for many coastal communities in North Carolina. The fisheries support not only the participating fishermen but also accompanying businesses including suppliers, tackle shops, boat manufacturers, restaurants, seafood dealers and more. As money is spent by fishermen, businesses and suppliers, sizable economic impacts are generated. The estimated economic impact of fishermen and seafood dealers in North Carolina for 2009 was approximately $255 million when the contributions of seafood dealers, restaurants and transportation services were included.[81]

The North Carolina Division of Marine Fisheries License and Statistics Section summarized the total economic impact from commercial fishing in NC from 2001 to 2009.[82] Table VIII-6 below shows the value of each year's catch, the total economic impact, number of fisherman, number of jobs created and total jobs related to commercial fishing. Average annual economic impact due to commercial fishery during those nine years was $141 million. Unlike the 2009 estimates, these estimated economic impacts of commercial fisherman based on ex-vessel value of landings do not include the contributions of seafood dealers, restaurants and transportation services.

Table VIII-6
Total Economic Impact from Commercial Fishing in NC from 2001- 2009

Year	Ex-Vessel Value	Total Economic Impact	Participants	Jobs Created	Total Jobs
2001	$88,143,204	$147,383,339	7,067	760	7,827
2002	$94,747,541	$158,421,943	6,743	817	7,560
2003	$87,112,832	$145,661,032	6,177	752	6,929
2004	$79,705,630	$141,572,974	6,154	612	6,766
2005	$64,889,272	$115,256,742	5,504	498	6,002
2006	$70,085,519	$123,348,669	5,120	488	5,608
2007	$82,332,745	$144,832,507	5,338	573	5,911
2008	$86,814,160	$152,789,290	5,299	605	5,904
2009	$77,248,374	$143,423,168	5,560	580	6,140

North Carolina has experienced a decline in commercial fishing, as shown in Table VIII-6. From 2001 to 2009 there has been a decrease of 1,687 total jobs. Additionally, the number of commercial seafood processors or dealers in coastal North Carolina declined 33 percent between 2000 and 2005 despite a concurrent increase in the per capita consumption of seafood nationwide. There has been about an 11 percent decline in the number of standard commercial fishing licenses from 6,900 in 2000 to 6,171 in 2006. [83]

A more localized example of this decline can be seen in the reduced number of commercial fisherman in Carteret County. From 1994 through 2008 the number of commercial fisherman in Carteret County declined by 48 percent.[84] Fishermen now have to rely more on non-fishing work

[81] Hardley, John and Scott Crosson. 2010.
[82] Hardley, John and Scott Crosson. 2010.
[83] Garrity-Blake Barbara J. and Barry Nash. 2007. AN INVENTORY OF NORTH CAROLINA FISH HOUSES, March 27, 2007, The University of North Carolina at Wilmington, The North Carolina Sea Grant College Program at the North Carolina State Seafood Laboratory UNC-SG-07-06.
[84] Nash, Barry and Nancy Sharpless. Understanding the Requirements of Carteret County Fishermen and Dealers to Meet the Rising Demand for Local Seafood within North Carolina : A Situation Assessment. Prepared for the Carteret County Commercial Seafood Industry and the North Carolina Seafood Coalition. February 22, 2011

for supplemental income. This reduction in fishing effort has significant implications for the economic and cultural heritage of small coastal communities, and these implications extend to a reduction in availability of North Carolina seafood to the public at a time when the public is

One factor that negatively affects the commercial fishing industry is declining water quality.[85] A survey conducted in 2003 of fish dealers indicated that pollution and water quality was seen as the most important issue facing fisherman.[86] Researchers have predicted that economic, environmental, and political pressures will cause a continued reduction in the fishing industry. However, they do not think that the industry is collapsing, but instead is undergoing a painful transformation that could result in a very different commercial fishing industry compared to the past. One component to maintain North Carolina's commercial fishing industry is continued improvement and restoration of water quality of coastal areas.

Recognizing the critical importance of healthy and productive habitats to produce fish for human benefits, the North Carolina General Assembly included a provision in the Fisheries Reform Act of 1997 instructing DENR to prepare Coastal Habitat Protection Plans (CHPPs). The legislative goal of the plans is long-term enhancement of coastal fisheries associated with each of six habitat types. The Fishery Reform Act mandated that three environmental regulatory commissions (Environmental Management, Coastal Resources, and Marine Fisheries Commissions) must adopt and implement the plan, thus requiring a coordinated management approach.[87]

One important fishery habitat identified for protection in the CHPP is the soft bottom habitat. Soft bottom habitat is unconsolidated, unvegetated sediment that occurs in freshwater, estuarine, and marine systems. The CHPP definition of soft bottom includes deeper subtidal bottom as well as shallow bottom areas. Soft bottom covers approximately 1.9 million acres, or 85 percent of the total bottom area in North Carolina's coastal waters, excluding the coastal ocean. Soft bottom habitat is a key foraging habitat for juvenile and adult fish and invertebrates and aids in storing and cycling of sediment, nutrients, and toxins between the bottom and water column. Shallow unvegetated bottom is particularly productive and, by providing refuge from predators, is an important nursery area.

Unfortunately, the soft bottom is a storage reservoir of chemicals and microbes in coastal ecosystems. Intense biogeochemical processing and recycling allow for deposition and resuspension of natural and human-induced nutrients and toxic substances. The NC CHPP identifies nutrients and heavy metals specifically as pollutants of concern for this habitat type.[88]

Although the soft bottom habitat is always changing, there are several threats to the overall habitat stability. These threats may be direct impacts to the soft bottom or they may affect water quality thereby altering the soft bottom community.[89] The condition of soft bottom is determined by the character and quality of bottom sediments and the quality of the overlying water column. Because water quality inevitably affects soft bottom, many of the same threats to the water quality are threats to soft bottom.

[85] Garrity-Blake Barbara J. and Barry Nash. 2007.

[86] Cheuvront, Brian. A Social and Economic Analysis of Commercial Fisheries in North Carolina: Beaufort Inlet to the South Carolina State Line. A Report for the NC Technical Assistance to the South Atlantic Fisheries Management Council, Task 5: NEPA Related Activities, Contract No. SA-03-03-NC. Division of Marine Fisheries, NC Department of Environment and Natural Resources. December 2003.

[87] Deaton, A.S., W.S. Chappell, K. Hart, J. O'Neal, B. Boutin. 2010. North Carolina Coastal Habitat Protection Plan. North Carolina Department of Environment and Natural Resources. Division of Marine Fisheries, NC. 639 pp.

[88] Deaton, A.S., W.S. Chappell, K. Hart, J. O'Neal, B. Boutin. 2010. North Carolina Coastal Habitat Protection Plan. North Carolina Department of Environment and Natural Resources. Division of Marine Fisheries, NC. 639 pp.

[89] Deaton, A.S., W.S. Chappell, K.Hart, J.O'Neal, B. Boutin. 2010. North Carolina coastal Habitat Protection Plan. North Carolina Department of Environment and Natural Resources. Division of Marine Fisheries, NC. 639pp.

One study of bottom sediments throughout coastal North Carolina waters found that between 37.5 to 75.8 percent of soft bottom surface sediments were contaminated, primarily with the metals nickel, arsenic, chromium, and mercury, the pesticide DDT and PCBs, suggesting that these contaminated areas may not fully support food chains that sustain the commercial fisheries.[90] This same study by Hackney *et al.* (1998) also found other heavy metals present in the sediments such as antimony, copper, lead, cadmium, silver, and zinc.

Studies have shown that fine-grain sediments are the primary reservoir for heavy metals, particularly organic rich muds (ORM). Since ORM is the most extensive sediment type in North Carolina's estuaries, and since many primary nursery areas (PNA) are composed of ORM, resuspension of contaminated ORM sediments in nursery areas is of particular concern.[91]

As time passes, toxins tend to accumulate in sediments at concentrations several orders of magnitude greater than in overlying waters. Toxins in sediments or the water column can affect benthic invertebrates by inhibiting or altering reproduction or growth, or causing mortality in some situations. Early life stages are the most vulnerable to toxins and benthic invertebrate diversity significantly declines with increasing sediment contamination.

While the survival of some aquatic organisms is affected by toxins, other organisms survive and bioaccumulate the chemicals to toxic levels, passing them along the food chain. Metal contamination of sediments has been documented to result in elevated metal concentrations in shrimp, striped mullet, oysters and flounder.

To estimate the value of reduced metal contamination on the North Carolina commercial fishing industry, the department used values for estuarine ecosystem services. A study by Johnston *et al.* (2002) estimated the value of estuarine resource services of several types of habitats in a New York estuary system. One of the values that the study estimated was the productivity value that puts an economic value of the habitats, based on the value of fish, shellfish and bird species that these ecosystems help produce. The focus is on the nursery and habitat services of these ecosystems in the production of commercial fisheries. The study suggests an annual value per acre for existing mud flats (one type of soft bottom) at $67 (1995 dollars).[92]

Soft bottom habitats provide a variety of services to the public associated with the ecological productivity of this habitat and an improvement to the ecological integrity of this habitat may ultimately lead to a measurable increase in the production of finfish and shellfish. This increase in fish may directly benefit North Carolina's commercial fishers. This analysis uses the following assumptions to estimate a potential benefit of improvements to soft bottom habitats from the proposed rules.

North Carolina has 1.9 million acres of soft bottom habitat and this habitat would potentially benefit the most from reduction in metals compared to other coastal water habitats (submerged aquatic vegetation, hard bottom, etc). The estimated percentage of primarily metals contaminated sediments, 37.5% to 75.8% in North Carolina was used to quantify the potential area that might not be fully supporting food chains that sustain commercial fisheries (Column B in Table VIII-7
Potential Benefits to Commercial Fisheries

[90] Hackney, C. T., J. Grimley, M. Posey, T. Alphin, and J. Hyland. 1998. Sediment contamination in North Carolina's estuaries. Center for Marine Science Research, UNC-W, Wilmington, NC, Publication #198 , 59p.

[91] North Carolina Division of Marine Fisheries. North Carolina Southern Flounder (*Paralichthys lethostigma*) Fishery Management Plan. 2010.

[92] Johnston, R.J., Thomas A Grigalunas, James J. Opaluch, Marisa Mazzotta and Jerry Diamantedes. 2002. Valuing Estuarine Resource Services Using Economic and Ecological Models: The Peconic Estuary System Study. Coastal Management 30:47-65. http://www.peconicestuary.org/pdf/RJ-Johnsonetal2002.pdf

Table VIII-7
Potential Benefits to Commercial Fisheries

Estimate	Potential acres contaminated (B)	Annual value / acre (C)	Potential total lost value (D=B*C)	Total potential annual loss due to metal contamination (E=D*% loss)	Total potential annual loss avoided (F=E*1%)
Low (37.5% metal contaminated sediments; 1% potential loss due to metals)	721,500	$98	$69,544,523	$695,445	$6,954
Medium 1 (37.5% metal contaminated sediments; 2.5% potential loss due to metals)	721,500	$98	$69,544,523	$1,738,613	$17,386
Medium 2 (75.8% metal contaminated sediments; 1% potential loss due to metals)	1,440,200	$98	$140,572,663	$1,405,727	$14,057
High (75.8% metal contaminated sediments; 2.5% potential loss due to metals)	1,440,200	$98	$140,572,663	$3,514,317	$35,143

To quantify the potential benefit, the annual value per acre of mudflats was used ($67) and was converted to 2014 dollars, which was approximately $98 per acre (Column C). The total value of the loss to commercial fisheries due to sediment contamination was computed by multiplying the annual value (Column C) by the potential area contaminated (Column B) and it is shown in Column D of Table VIII-7
Potential Benefits to Commercial Fisheries

Realizing that metals carried in freshwater rivers to the ocean is only one of many pollution sources, it was assumed that metals contributed between 1 and 2.5 percent to the contamination; therefore, the value of the loss was adjusted to reflect that and lost value due to metal contamination is shown in Column E. These percentages assume that the proposed rule changes will have positive, quantifiable benefits to commercial fishers and that there is a high level of uncertainty around the magnitude of the benefit due to the numerous factors contributing to healthy aquatic habitats. Using these figures, calculations indicate that the total loss of soft bottom that may be due to contaminated sediment is between $695,000 and $3,514,000 each year.

Many factors affect soft bottom habitat quality, making it difficult to tease out the ones solely related to metals contamination in the water column. The cumulative effect of many different pollutants combined will have a more toxic effect on estuary productivity. Another uncertainty is the use of the literature value of $67 for mudflats to value all soft bottom types in NC. Mudflats represent only one type of soft bottom habitat. The values of the full range of soft bottom types may be more or less than this value when all soft bottom types are considered. This estimate is a conservative representation of the costs that North Carolina's fishing industry experiences through impaired habitats due to metal contamination.

Any reductions of metal contamination in the soft bottom may take years to occur due to the implementation schedule for compliance with the proposed rules.

For the final benefits analysis, it was assumed that no benefits will be realized for the first ten years (benefits will begin to accrue in year 2032). After that, it was assumed that one percent of contaminated soft bottom acreage, between 7,215 and 14,402 acres, would have reduced metal contamination attributable to the regulated sources. This reduction will result in a decrease of the cost of the total annual loss of soft bottom due to metals contamination to $7,000 to $35,000 per year, with an average estimate of $21,000.

If the assumption regarding the percent of contaminated soft bottom acreage that would have reduced metal contamination due to the rule change were to be between 0.1% and 2.5%, the average avoided annual loss could range between $2,000 and $53,000.

For the final calculations, this 1 percent annual loss of metals contaminated soft bottom was estimated to occur yearly for the remainder of the 30-year implementation period used in this fiscal analysis.

Benefits to Recreational Fishing, Other Recreational Activities

Aquatic ecosystems provide a wide variety of services to individuals, suggesting that the benefits of policies that protect or improve these ecosystems can be evaluated in terms of the change in the amount or quality of services provided. Among the most important and frequently studied ecosystem services are outdoor recreation services.[93] Fishing, boating, and other water activities provide important recreational opportunities for North Carolinians, as well as tourists. This section describes recreational activities' contribution to the economy and the potential benefit for maintained or improved water quality to these ecological services.

Recreational fishery value

Concerns about the health effects (or at least perceived) of eating contaminated fish may reduce the value of recreational fishery because the ability to consume fish may be an important part of the overall fishing experience.[94] A survey conducted of recreational saltwater anglers by the North Carolina Division of Marine Fisheries in 2009 found that the number one concern of respondents was the issue of water quality/pollution.[95] These concerns may reduce the value of the recreational fishing industry in two ways: fewer fishing trips taken because of health concerns and the value of trips that continue to be taken is reduced.

[93] Houtven, George Van, Kelly Jones and John Powers. September 2005. Estimating Economic Values for Outdoor Recreation: A Synthesis of Three Review Papers.
[94] U.S. Environmental Protection Agency. October 1999. Economic Analysis of the California Toxics Rule. Prepared by Science Applications International Corporation EPA Contract No. 68-C4-0046 http://water.epa.gov/lawsregs/rulesregs/ctr/upload/2000_04_28_standards_rules_ctr_rule.pdf
[95] Crosson, Scott. July 2010. A Social and Economic Survey of Recreational Saltwater Anglers in North Carolina. North Carolina Division of Marine Fisheries. http://portal.ncdenr.org/c/document_library/get_file?uuid=b7469160-d5e9-458a-9d16-a5e7b76d7f31&groupId=38337

Conversely, reduced water pollution may increase stability, resilience, and overall health of numerous ecosystems, and may indirectly translate to higher catch rates and increase recreational fishing in North Carolina. Maintaining and improving water quality through the reduction of elevated concentrations of metals has two potential benefits for the recreational fishing industry and anglers:

1. An increase in value of the fishing experience and;
2. An increase in participation in fishing.

Because this analysis was conducted on a statewide level and does not take into account site-specific considerations that would affect the level of benefits and because it is extremely difficult to determine to what extent improvements in water quality would actually result in positive effects on the value placed on fishing, the results are intended to provide an approximation of the potential magnitude of recreational benefits. Potential benefits that may occur to recreational fishing are discussed qualitatively in this section and are not included in the overall estimate of monetary benefits.

In 2011, 1.5 million state residents and nonresidents 16 years or older fished in North Carolina. Of this total, 1.2 million anglers (80 percent) were state residents and 329 thousand anglers (20 percent) were nonresidents. These anglers fished for a total of 23.5 million days in North Carolina.[96]

All fishing-related expenditures in North Carolina totaled $1.5 billion in 2011.[97] Trip-related expenditures, which include food and lodging, transportation, and other trip expenses like equipment rental and bait, totaled $1 billion. Anglers spent $480 million on equipment in 2011, which includes fishing equipment (rods, reels, line etc.), auxiliary equipment expenditures (tents, special fishing clothes, etc.), and special (boats, vans, etc.) equipment. Finally, $23 million was spent on other items, such as magazines, membership dues, licenses and permits. See Table VIII-8 - Fishing Expenditures in North Carolina in 2011 for a more detailed break-down of angler expenditures.

Table VIII-9
Fishing Expenditures in North Carolina in 2011
(State residents and nonresidents 16 years old and older)

Total	**$1.5 billion**
Trip-related	$1.0 billion
Food and Lodging	*$443 million*
Transportation	*$239 million*
Other	*$338 million*
Equipment (total)	$480 million
Fishing	*$270 million*
Auxiliary and special	*$210 million*

[96] U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. http://www.census.gov/prod/2013pubs/fhw11-nc.pdf
[97] U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2011. http://www.census.gov/prod/2013pubs/fhw11-nc.pdf

Other	$23 million

The economic sectors most affected by trip expenditures in the recreational fishery are food stores, wholesale trade, oil and gas sales, domestic trade, ice manufacture, hotels, charter fees, realty, homework and repair, business management, food services, and medical services.

These sectors create indirect effects, defined as changes in inter-industry transactions, as supplying industries respond to increased demands from the directly affected industries. These sectors also create induced effects which reflect changes in local spending that result from income changes in the directly and indirectly affected industry sectors.[98]

Boating and Other Recreational Activities

Good water quality also benefits other recreational pursuits, and improving lakes' and rivers' water quality could boost those benefits. The North Carolina State Park Service conducted a survey in 2005-2006 to determine what activities bring people to parks and the economic impact of these natural resource-based attractions.

According to the survey, one of the main purposes of visiting the parks is to enjoy the water.[99] Table VIII-10 presents the 14 parks and the percentage of respondents per purpose of the visit. Predictably, people indicated one of the main reasons to visit parks with water-based attractions was to use and enjoy these water attractions by fishing, boating/canoeing/kayaking, and swimming.

Table VIII-10
Results of Recreational Use Survey of NC State Parks Visitors
(Percent of Users who Reported Activity as the Main Purpose of Visit)

[98] Crosson, Scott. July 2010. A Social and Economic Survey of Recreational Saltwater Anglers in North Carolina. North Carolina Division of Marine Fisheries. http://portal.ncdenr.org/c/document_library/get_file?uuid=b7469160-d5e9-458a-9d16-a5e7b76d7f31&groupId=38337

[99] Greenwood, Jerusha, B. and Candace G. Vick. 2008. Economic Contribution of Visitors to Selected North Carolina State Parks. Prepared for North Carolina State Parks by Recreation Resources Service and NC State University. http://ncparks.gov/News/special/docs/eco_study.pdf

Park	Fishing	Boating	Canoeing/ Kayaking	Swimming
Eno River	25%	0%	14%	14%
Fort Fisher	34%	0%	7%	4%
Fort Macon	43%	0%	0%	26%
Gorges	2%	0%	0%	0%
Hammock's Beach	24%	0%	15%	58%
Hanging Rock	22%	0%	12%	45%
Jockey's Ridge	6%	0%	3%	9%
Jordan Lake	42%	8%	6%	45%
Kerr Lake	54%	29%	17%	25%
Merchant's Millpond	12%	0%	92%	0%
Morrow Mountain	38%	6%	40%	15%
Mount Mitchell	0%	0%	0%	0%
Pilot Mountain	7%	0%	8%	0%
Stone Mountain	11%	0%	0%	0%

Recreational boating is a popular activity, with 75 million people participating throughout the US, and it is also an important contributor to the US economy, generating $30.4 billion in sales and services in 2010.[100] In 2010, North Carolina ranked 10th in the Nation with 400,846 recreational boat registrations. While North Carolina was 10th in boat registration, it ranks 7th in total expenditures for new powerboats, motors, trailers and accessories in 2010 with a total expenditure of almost $361 million.

This analysis does not monetize benefits for recreational fishing and other recreational activities because they will be minimally or indirectly impacted by the change in rules. Recreational and aquatic life benefits for saltwaters were also not quantified in this analysis and are described qualitatively throughout the individual benefit sections.

Nonuse Benefits

Nonuse benefits, also referred to as passive uses, are benefits that people receive from the existence of an environmental feature independent of people's current resource use. For example, some people value protection of coastal waters even if they may never visit the beach. Nonuse benefits include bequest, existence, and ecological values. The people who answered the survey questions in Huber *et al.* may have implicitly included some of these non-use values in their estimate of willingness to pay for water quality.

Nonuse benefits are difficult to value since they lack traditional markets, but these values can be significant and highly relevant in policy formation.[101] This section articulates the three different types of non-use values and describes the potential non-use value of cleaner water.

[100] National Marine Manufacturers Association. 2011. 2010 Recreational Boating Statistical Abstract. https://higherlogicdownload.s3.amazonaws.com/NASBLA/NMMA%202010%20Recreational%20Boating%20Statistical%20Abstract%20%28253%20pages%29.pdf?AWSAccessKeyId=AKIAJH5D4I4FWRALBOUA&Expires=1369172293&Signature=NClHzQiMEbgx8u6PvvrsddHqeZg%3D

[101] Tietenberg, Tom. Environmental Economics and Policy Harper Collins, 1994.

First, the bequest value of a natural resource or place is the value people place on being able to provide future generations with a pristine natural resource. Many people are concerned about the effects of current pollution production on future generations and engage in activities such as recycling, habitat preservation, and selecting low-emission vehicles to reduce these future impacts. Policies associated with either a long-term or irreversible impacts can lead to losses that consist primarily of bequest value. Others make an intergenerational equity argument that the current generation does not have the right to make irreversible ecological choices for future human beings.

Second, existence benefits occur when people value a resource, location, or natural feature maintained in its current condition. These individuals do not personally benefit from preservation efforts but still support them financially indicating that they derive some pleasure from knowing that undeveloped lands are preserved. Some proof of existence value is the substantial amount of money directed to conservation groups for land preservation. Another indicator is people's willingness to fund the preservation of spaces such as the Grand Canyon even if they will never be able to visit it.[102]

A final non-use benefit is ecological preservation. Unlike the preservation of a physical place or object, ecological preservation is the protection of an entire ecology or system of plants and animals and their physical habitat. Strong ecosystems preserve biodiversity, making organisms more resistant to environmental stresses.[103] These benefits are likely to embody reduced risks of direct mortality and increased reproductive success in a range of important fish and wildlife species as well as improved ecosystem health. Some of the benefits people receive from ecological preservation may be based on social, religious, ethical or cultural beliefs.

This fiscal and economic analysis does not attempt to estimate any additional non-use value of cleaner water and the portion of this value other than those measured by Huber *et al*.; however, this benefit does exist and should be taken into account when policy decisions are made.

[102] Freeman, A. Myrick. The Measurement of Environmental and Resource Values: Theory and Methods. Resources for the Future, 2003.
[103] Chapin, F. Stuart et al. "Consequences of Changing Biodiversity" *Nature* No. 405, pp. 234-242. 11 May 2000.

Section IX. Policy Alternatives and Risk Analysis

Several alternatives were considered before the final decision to move forward with the dissolved metals proposal. Then during the development of this fiscal analysis, a variety of assumptions were made that could impact the final cost and benefit estimates. These rules, like many environmental regulations, are proposed without historical economic data upon which to inform some of the assumptions. In addition, there is not a clear understanding of the link between pollutant reductions from point and nonpoint source discharges and benefit categories.

The following paragraphs examine the alternatives and uncertainty to provide a better understanding of why the rules were written as they are and possible events that may jeopardize anticipated benefits and costs or change assumptions that made during the analysis.

Fiscal Impact by Proposed Standard Change

The following alternatives were considered during the development of the triennial review package.

Alternative 1 – Recommending no changes to current surface water quality standards

One alternative considered was not to make any changes; however, there were several factors that made this alternative unattractive. A major consideration is that taking no action to update the state's standards for metals and nutrients may result in the US EPA promulgating revised standards per the Clean Water Act Section 303(c)(4)(B) to bring North Carolina's regulations into accordance with 304 (a) National Recommended Water Quality Criteria (NRWQC) .

The US EPA and a variety of stakeholders have requested that DWR review and update the state's water quality standards protective of aquatic life, specifically for metals and nutrients. This update is needed in order to address differences between North Carolina's standards regulations and the NRWQC and other applicable federal regulations.

Updating North Carolina's water quality standards regulations for metals also gives the state the ability to incorporate flexibility into the regulations, which is currently not inherent in the 02B rules. Regarding metals, most of the nation has adopted standards based on the most current NRWQC for metals. Many states have adopted the metals criterion in the "dissolved" form, which are considered to represent the more bioavailable portion of metals in surface waters.

The current rules also assume a fixed hardness; the rule proposals would allow for more location-specific indicators of metals toxicity, such as ambient water hardness or biological assessment, to be used to allow for a more accurate assessment of instream aquatic toxicity due to metals. Additionally, North Carolina is proposing to incorporate a recalculated criterion for Cadmium. This recalculation, which uses more recent scientific information, provides for a criterion that is equally as protective of the state's waters as the NRWQC, but, is a slightly higher concentration than the national. While this is an EPA approved protocol, there is no guarantee that the state would be afforded the same favorable conditions if the US EPA were to promulgate revised standards.

Additionally, current metals regulations are written as "maximum levels," concentrations never to be exceeded in the water column. The proposed rules provide clear and definitive evaluation criteria of the allowable frequency and duration of standards exceedances. This clarity and flexibility is expected to benefit both the environment and regulated parties by providing for a more accurate and consistent application of the metals standards regulations. If Alternative 1 (no action) had been chosen, the state would continue to interpret an exceedance of the numeric standard as a violation of the rules, resulting in potentially improper 303(d) listings of waters as “impaired”, additional costly investigations and potentially more regulatory control on affected dischargers. If Alternative 1(no action) is taken, then the flexibility afforded by these modifications will not be available to affected dischargers.

Costs to regulated parties associated with choosing a “no action” alternative would hinge on whether US EPA promulgated revised standards for the state to meet CWA requirements. Exact costs to the state that could result from federal water quality standards promulgation cannot be quantified but could likely be significant. Should the State fail to modify standards in a scientifically defensible and timely manner, the US EPA could make an Agency determination that NC was out of compliance with the Clean Water Act obligations. It is possible that the DWR will lose millions in funds required to establish and implement its ongoing water pollution control programs. The Division has proposed revisions with a number of variations from the published NRWQC; it is almost impossible to predict exactly which new or revised standards and associated implementation regulations would be required if federal promulgation were to occur. Additionally, a significant time lapse has occurred between the state’s proposals and completion of the Triennial Review. This lapse is a violation with the CWA and could result in NGO lawsuits, thus adding further strain to state resources.

The US EPA has published additional NRWQC not considered or incorporated into this proposal, so, other impacts may occur if the federal promulgation takes place. Under a federal promulgation scenario, the state could lose the ability to adopt balanced regulations that attempt to reduce the economic burden on regulated parties while maintaining protection for the environment. The proposed package of rules allow for some flexibilities that would most likely not be part of federally promulgated rules for the State. The absence of such flexibilities as allowing ambient water hardness or biological assessment to be used for a more accurate consideration of potential instream aquatic toxicity would likely increase the cost of water clean-up significantly. After considering these factors, the Division decided to move forward with developing modifications to the water quality standards regulations.

Alternative 2 – Recommend updating metals standards

Once it was decided that the state would move forward with updating the metals standards to reflect the updated NRWQC, there were still two major options to choose from expressing the standards as total recoverable metal or as dissolved metal. EPA supports both options and this choice is generally left up to individual states.

DWR anticipated that updating standards to reflect the NRWQC while retaining the use of total recoverable metals standards would increase treatment costs for regulated facilities. The use of standards expressed as total recoverable metals is assumed to be “over protective”, as it assumes that all of the metals present in a permitted discharge will add toxicity to the ambient receiving waters.

In general, current scientific literature, considers metals that are dissolved in the ambient water to be the more toxic fraction of metals to aquatic organisms.[104] Metals that are not in the dissolved form instream (for example metals attached to sediments in the water column) have shown very little toxicity to aquatic organisms in laboratory toxicity tests. Therefore, the use of dissolved metals water quality standards would result in measurement of only the most toxic form of a metal instream and would provide a more accurate assessment of the potential for actual toxicity to aquatic life.

Adoption of dissolved metals standards provides an added economic benefit to the state by allowing for reduced implementation costs. Regulated parties would have to control only the portion of metals in their discharge that are expected to be in the more toxic dissolved form in the receiving waters. The state is proposing dissolved metals standards instead of total recoverable standards due to the fact that the measurement of dissolved metals is currently the most scientifically accepted measurement of toxicity and would provide the most economically feasible regulations for implementation by regulated parties. The use of dissolved metals standards may reduce the economic burden to regulated parties to the maximum extent possible while maintaining adequate protection for aquatic organisms.

Uncertainty

The cost and benefit estimates calculated for implementation of these rules were developed using the most recent research and best available data and accounting tools. However, numerous assumptions and estimates are necessary to project long range costs and benefits of implementation. The individual chapters include detailed explanation of the assumptions used and provide a discussion of the uncertainties related to the cost and benefit estimates calculated.

Costs

The majority of costs identified were related to implementation of the proposed metals standards in ambient monitoring and in NPDES permits. Most states in the United States already implement their metals standards as dissolved in ambient waters and have experience with metals reductions. Technology and techniques for reducing total metals in wastewater are available and the increased need for reductions may result in more cost-effective options. These innovations may result in compliance costs that are lower than those projected.

Another factor that could potentially impact costs related to implementation of the metals standards was identified in comments and estimates submitted by stakeholders and the US EPA. North Carolina currently has language in the standards rules (15A NCAC 02B .0211 and .0220) that identifies some metals as “Action Levels for Toxic Substances”. These “action level” standards allow facilities to avoid permit limits if they are consistently meeting their whole effluent aquatic toxicity testing requirements. No change is proposed to those rules; however, were they no longer to apply, cost estimates would increase. The US EPA, in its letter to Alan Clark, DENR/ DWR at that time Chief of Planning Section, of August 20, 2010, indicates they “no longer supports the use of action levels in lieu of the reasonable potential analysis for

[104] U.S. EPA. “The Metals Translator: Guidance For Calculating A Total Recoverable Permit Limit From A Dissolved Criterion.” EPA 823-B-96-00, June 1996.
http://water.epa.gov/scitech/datait/models/upload/2009_03_26_models_guidance_pdf.pdf

NPDES permitting for copper and zinc." If the US EPA were to promulgate standards with the action level metals standards removed, the costs for compliance would be increased.

Other states were contacted to verify what costs were associated with their adoption of dissolved metals standards; however, due to the fact that water quality standards are not based on costs and the length of time that has past (more than 15 years since the adoption of dissolved metals standards in some cases), none of the states contacted had implementation cost information.

A variety of factors could impact final effluent metal concentrations and either increase or decrease removal costs. These are discussed more fully in Chapter III.B and C, and include:

- Changes in flow coming into the plant may cause an increase in metals or a decrease in metals concentrations that could increase or decrease the facility's clean-up costs;
- Change in types and amounts of discharges to the system (new business or industry, closure of business or industry, additional domestic loading due to new subdivisions, etc.) – could change constituents of the influent resulting in changes to the permitted effluent limits and therefore increasing facility costs;
- Sewer system upgrades increasing facility costs:
    - reduced infiltration of groundwater resulting in more concentrated influent; or
    - removal of stormwater from sewer system – also concentrating influent;
- Facility-specific effluent and regionally specific instream hardness will be used to calculate permit requirements– these updated permit requirements can result in an increase or decrease in metal permit limits, and therefore an increase or decrease, respectively, in the costs of the regulated entity; and
- Compliance approaches may vary from facility to facility and allow flexibility by the dischargers. The solutions may range from low-cost operational changes to capital-intensive treatment plant improvements.

Additionally, the analysis does not account for the following:

- The impact of transitioning from Total Chromium to Chromium III and Chromium VI it is unclear due to the lack of Chromium III and Chromium VI data;
- <u>The replacement costs of capital investments</u>: Typically, the life cycle of such investments is considered to be 20 years for the purposes of planning wastewater treatment. It is probable that over the 30 years facilities would have had to be upgraded. However, there are considerable uncertainties related to future technologies' performance and cost to provide any meaningful estimation of replacement/improvement costs. Therefore, the cost to facilities beyond year 20 is uncertain.

Benefits

Analysis of uncertainty and risks associated with benefits is provided in more detail in Section VIII. Staff made assumptions in the benefits analysis based on best professional judgment. Results derived from a subset were extrapolated to the total number of facilities due to the inability of staff to visit every impacted site and make site-specific determinations for specific assumptions. Staff chose estimates based on knowledge of point source impacts to North

Carolina waters and used a range of values in the analysis for each variable to help mitigate uncertainty.

In general, there are many factors that could alter the benefits of these rule changes including future federal mandates and community developments. The Division assumed that 100 percent of the population would receive benefits from the rule proposals based on the distribution of NPDES point source facilities throughout the entire state. However, if that assumption were to change to 20% of the population incurring the benefits of improved water quality, the benefits could decrease to $2.3 million per year from the estimated $11.5 million. See Table VIII-5 for additional sensitivity analysis regarding the benefit estimates.

Appendices

Appendix I.1: Link to Proposed Rule Text

The text of the proposed rule changes is available on the DENR website at:

http://portal.ncdenr.org/c/document_library/get_file?folderId=521751&name=DLFE-13938.pdf

Appendix I.2: Summary of Comments Received

In June of 2010, following the Environmental Management Commission's approval of taking the proposed rule changes to public hearing, the Division of Water Resources solicited business and agricultural organizations, organizations representing municipalities, environmental groups, and other interested parties for cost and benefit estimations for inclusion in this fiscal and economic analysis . Specifically, stakeholders were asked to provide DWR with information on any additional costs or benefits to their operations resulting from the proposed standards revisions. The Division received valuable information from a number of sources including NPDES permit holders, environmental advocates, the North Carolina League of Municipalities, the Manufacturers and Chemical Industry Council of North Carolina, the North Carolina Pretreatment Consortium, Inc., the Southern Environmental Law Center and the US Fish and Wildlife Service. In all, approximately 50 responses were received. Cost and benefit information from these submittals was used, as appropriate, in the development of this fiscal analysis. These comments are part of the public record and are posted at: http://portal.ncdenr.org/web/wq/ps/csu/swtrirev.

A generalized overview of the types of information received follows:

- Cost estimates related to the proposed metals rule changes in 15A NCAC 02B .0211 and .0220 included implementation costs related to disposal of wastewater, biosolids handling, dewatering of sludge, additional staff time associated with analytical sampling, increased costs of chemicals used in a treatment plant, additional analytical laboratory costs, operation and maintenance resources and treatment plant upgrades.
- Potential benefits included the need for updated and upgraded equipment and facilities that could increase jobs in the form of engineers, construction laborers, samplers, inspectors and laboratory personnel. Benefits to aquatic life were expected from improved ambient water quality.

A list of responders follows:

1. American Rivers – Peter Raabe
2. Greenville Utilities
3. PWC – Fayetteville
4. CMU - Charlotte Mecklenburg Stormwater
5. CMU - Charlotte Mecklenburg Utilities
6. Coalogix -– Charlotte
7. KiddeAero – Wilson
8. NC Environmental Professionals
9. City of Hickory
10. City of Wilson
11. Saiden Technologies- Sanford
12. Lower Neuse River Basin Association
13. Upper Cape Fear River Basin Association
14. Harris and Covington – High Point
15. Town of Mooresville
16. Coty – Sanford

17. Aqua NC
18. City of Winston Salem
19. Fairmont Metal Finishers – High Point
20. City of Oxford
21. Charlotte Pipe and Foundry – Charlotte
22. Cargill – CMUD
23. Town of Spindale
24. Town of Cary
25. NC League of Municipalities
26. City of Goldsboro
27. Ultra Coatings – High Point
28. Akzonobel – High Point
29. City of Durham - Pretreatment
30. City of Durham - Stormwater
31. City of Raleigh
32. City of High Point
33. US Fish and Wildlife
34. NC PreTreatment Consortium
35. City of Greensboro
36. City of Burlington
37. Syntec – High Point
38. City of Rocky Mount
39. Sandoz/Novartis – Wilson
40. Moen – Sanford
41. City of Monroe
42. NC Farm Bureau
43. NC Water Quality Association
44. Static Control – Sanford
45. Pfizer – Sanford
46. Siemens Energy – CMU
47. City of Asheboro
48. Charlotte Chamber of Commerce – Manufacturers Council

Appendix II.1: Overview of Water Quality Standards

Water quality standards define the goals for a waterbody by designating the water's uses, setting narrative or numeric criteria to protect those uses, and establishing provisions such as antidegradation policies. The Federal Water Pollution Control Act (commonly known as the Clean Water Act) regulations require that surface water quality standards must protect for the most sensitive use that a waterbody has been designated to support. The basic uses designated for all North Carolina waters require protection for, at a minimum, human health and aquatic life. Different pollutants affect these two groups in different ways. For example, aquatic organisms are often more sensitive to metals than human beings. Toxic impacts caused by metals pollution occur at much lower concentrations for aquatic life than they do for humans.

In recognition of this, the proposed water quality standards for metals evaluated in this fiscal analysis have been calculated to protect the aquatic life in fresh and saltwater. Since humans are less sensitive to these metals, any standard that is protective of aquatic life will ultimately be protective of human health. In contrast to this, the proposed standard for 2,4-D, an herbicide, is based on human health protection.

Introduction to Aquatic Toxicity Testing (as it relates to water quality standards development)

Aquatic life water quality standards are most often based on laboratory aquatic toxicity tests. Laboratory aquatic toxicity tests provide a controlled environment where individual species can be tested for their sensitivity to an individual chemical or pollutant. Controlled laboratory environments, rather than ambient (instream) studies, allow for the toxic effects identified in the aquatic organism to be directly associated with the concentration of the chemical or pollutant in the water. The laboratory environment allows the researcher to control or eliminate the occurrence of other potential toxic influences which may be present in the natural environment. This provides the best situation in which to study the toxic effects of a single pollutant. The ability to study one pollutant at a time is both strength and weakness in regards to toxicity testing. It allows the researcher to characterize the toxic influence of individual chemicals on the actual aquatic organisms of concern but it generally does not provide information on the toxic impacts of mixtures of chemicals, along with other environmental stressors, that the aquatic organisms are collectively exposed to in natural systems.

Toxicity testing allows for a range of aquatic species to be examined for acute and/or chronic impacts. Acute impacts are the result of short term exposure to a pollutant and the toxic impact usually observed as the outcome of this type of exposure is death of the test organism. Chronic impacts are the result of a long term exposure, often to low levels of a pollutant. The toxic impacts assessed through chronic toxicity testing are typically sub-lethal, such as decreased growth or reproduction of the test organism. Aquatic toxicity tests can also be conducted under a range of water chemistry conditions (pH, temperature, water hardness, etc.). However, just as single chemical toxicity tests are often unable to account for the potential toxic effects of an exposure to mixtures of chemicals and stressors, they are also generally unable to account for all of the potential impacts to toxicity caused by the variable and complex water chemistry changes that occur daily in natural environments. This is a necessary trade off made in order to be able to characterize the toxic effects of a single chemical to an aquatic organism. These same tradeoffs exist when characterizing the toxic risk of pollutants to human health.

Introduction to Water Quality Standards Calculations - Aquatic Life Protection

The United States Environmental Protection Agency (US EPA) calculates protective concentration thresholds for toxic compounds or other pollutants and publishes these thresholds as National Recommended Water Quality Criteria (NRWQC). The US EPA has issued a guidance document used to calculate aquatic life criteria for toxic chemicals. This guidance document is referred to as the 1985 Guidelines[105] in this chapter.

The 1985 Guidelines document describes how water quality standards are developed and calculated and provides certain data availability requirements. Water quality standards are established with the intention of protecting the majority of organisms present in an aquatic system (rather than just a single species). Therefore, a wide variety of organisms that occupy different places in the food chain are considered in developing standards. To accomplish this evaluation, the 1985 Guidelines require aquatic toxicity test data to be available for at least one species in each of eight families of aquatic organisms.

For example, toxicity data for representatives of each of the following groups is required to calculate a freshwater standard:

1) Salmonid family (e.g., trout, salmon)
2) A fish family other than salmonids (e.g., bass)
3) A third family in phylum Chordata (e.g., salamander, frog)
4) A planktonic crustacean (e.g., daphnia)
5) A benthic crustacean (e.g., crayfish)
6) An insect (e.g., stonefly, mayfly)
7) A rotifer, annelid (worm), or mollusk (e.g., mussel, snail), and
8) Another insect family or a phylum not already represented above.

Incorporating data from a variety of organisms from different functional levels of an ecosystem is important because the organisms used in the derivation of a water quality standard must act as surrogates to represent the toxic effects that may occur to organisms that have not been evaluated through the laboratory aquatic toxicity test process. The vast majority of aquatic species have not been evaluated through toxicity testing and therefore little to nothing is known about their sensitivity to numerous pollutants of concern. Staff with the United States Fish and Wildlife Service (USFWS) provided an estimate that less than 1% of aquatic species in the United States have been tested for their sensitivity to pollutants (Tom Augspurger, USFWS, personal communication, fiscal note development comment period – September 7, 2010). Similarly, the United States Geological Survey (USGS) has stated that there are over a thousand times more aquatic animals present in North America than the number that have actually been tested for their short term sensitivity to the metal cadmium (there are even fewer tested for long term exposure scenarios).[106] The 1985 Guidelines for water quality criteria derivation are built around the assumption that the aquatic toxicity test data that are available for tested species can be considered to be indicative of the sensitivities of the abundant untested species when specified data requirements are met.

[105] Stephen, Charles E., Mount, Donald I., Hansen, David J., Gentile, John R., Chapman, Gary A. and Brungs, William A. 1985. Guidelines for Deriving Numerical National Water Quality Criteria for the Protection Of Aquatic Organisms and Their Uses: Office of Research and Development Environmental Research Laboratories Duluth, Minnesota Narragansett, Rhode Island, Corvallis Oregon. http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/upload/85guidelines.pdf

[106] Mebane, C.A., 2006 (2010 rev.). Cadmium risks to freshwater life: Derivation and validation of low-effect criteria values using laboratory and field studies (version 1.2): US Geological Survey Scientific Investigations Report 2006-5245, 130 p.

The 1985 Guidelines provide information on what constitutes an acceptable toxicity test and how the resulting test data should be used. Test results should follow certain procedures in order to be used in the calculation of a standard. For example, tests must be set up and conducted in accordance with the 1985 Guidelines, use “resident” organisms, last for an appropriate duration relative to the organism’s life span, and have acceptable results for study controls. “Resident” species are defined by the 1985 criteria derivation guidelines to include aquatic organisms which have a wild reproducing population in North America (species do not have to be native to North America to be considered resident).[107]

A significant portion of the 1985 criteria derivation guidelines explains the process and statistical procedures that should be used when calculating a water quality criterion from the gathered (or generated) aquatic toxicity test data. Acute and chronic toxicity test data are analyzed separately to calculate acute and chronic water quality criteria, respectively. However, there is often not enough chronic toxicity test data available to meet the eight family requirements as listed above. Chronic toxicity testing is expensive and time consuming as it is often necessary to test an organism continuously throughout its whole life cycle, or at least a significant portion of it, in order to get an understanding of toxic impacts produced by a long term exposure. In cases where not enough chronic data is available to satisfy the necessary eight family requirements, chronic standards can be calculated using acute toxicity test data along with a specified minimum amount of limited chronic toxicity test data. This process is detailed in the 1985 Guidelines.

To calculate the criteria, all toxicity test data from peer reviewed studies for a pollutant of concern are gathered and then are screened for acceptability under the 1985 Guidelines. The toxicity test studies provide data for individual species in the form of chemical concentrations which indicate the organism’s sensitivity to the tested pollutant. For example, an organism that is most sensitive to the metal cadmium will have the lowest concentration value reported. This means that the harmful toxic effects occur with even a small amount of cadmium present. The organism least sensitive to cadmium would have the highest reported concentration, indicating that it can tolerate a higher amount of cadmium before toxic effects occur. The sensitivity data for the different organisms (at the genus level) are then ranked from most sensitive to least sensitive. These sensitivity data are used to determine the concentration of the pollutant that would be expected to protect for 95% of all aquatic organisms. This concentration is then used to calculate the water quality criteria.

All NRWQC calculated by the US EPA are peer reviewed and go through a public process before finalization. Once finalized the criteria are published, along with their supporting information, in a chemical specific criteria document. These criteria documents form the basis for state adoption of water quality standards.

Site Specific Standard Development for Aquatic Life Protection – Three Options

In some cases the NRWQC may not adequately reflect the aquatic ecosystem conditions of a certain region of the country, state or a specific waterbody. In these instances the national criteria may be modified to account for specific conditions found at a site, within certain established guidelines. When discussing site specific criteria, a site may be defined, for

[107] Stephen, Charles E., Mount, Donald I., Hansen, David J., Gentile, John R., Chapman, Gary A. and Brungs, William A. 1985. Guidelines for Deriving Numerical National Water Quality Criteria for the Protection Of Aquatic Organisms and Their Uses: Office of Research and Development Environmental Research Laboratories Duluth, Minnesota Narragansett, Rhode Island, Corvallis Oregon. http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/upload/85guidelines.pdf

example, as an entire state or region, watershed, waterbody, or a certain segment of a waterbody. [108] The US EPA documents on the subject describe three allowable methods for deriving a site specific water quality standard for the protection of aquatic life.

1) Recalculation Procedure
2) Water Effects Ratio Procedure
3) Resident Species Procedure

These procedures can be used to modify any aquatic life water quality standard which has been calculated for a toxicant. However, two important steps should be completed prior to beginning any of the three procedures for standard modification.[109] First, an entity that is undertaking the standard revision must verify that a site specific standard is actually needed. For example, the use of clean sampling[110] and/or analytical techniques may result in attainment of existing standards – clean sampling may be especially important to consider for metals. Second, the "site" boundaries for application of the site specific standard must be defined in detail. The three options for deriving a site specific water quality standard for the protection of aquatic life are described in more detail below.

Option 1 - The Recalculation Procedure

The Recalculation Procedure allows additions and/or deletions (or corrections if needed) of toxicity test data from an aquatic life criterion's data set in order to modify the criterion to better reflect aquatic organism assemblages specific to a site. This procedure is often used to modify a national criterion or an adopted statewide criterion to make it more specific to a particular site. US EPA guidance documents are available that describe this process and outline required steps relating to how data may be added or deleted from a data set.

An important aspect of this process is determining which aquatic organisms "occur at a site". The US EPA defines organisms that "occur at a site" as the species, genera, families, orders, classes, and phyla that are usually present at the site or present seasonally or intermittently. Organisms also are considered to occur at a site if they were present at the site in the past but are not currently at the site due to degraded conditions or if they are found to be present in nearby bodies of water. [111] Species, or in some cases other closely related organisms, cannot be deleted from the national/state criterion's dataset if they are determined to "occur at the site".

Recalculation of a state or national criterion may result in a more or less stringent site specific standard depending on the sensitivity of the species present at the site. For example, North Carolina's proposed freshwater aquatic life standards for cadmium are based on a recalculation of the NRWQC conducted by Chadwick Ecological Consultants (for the Association of Metropolitan Sewerage Agencies).[112] This recalculation added newer toxicity data and deleted data, where allowable, resulting in standards which are slightly less stringent than the national criteria. Site specific standards developed using the recalculation procedure must be adopted into state regulations and be approved by the US EPA.

[108] Water Quality Standards Handbook: Second Edition EPA-823-B-12-002; March 2012 http://water.epa.gov/scitech/swguidance/standards/handbook/index.cfm
[109] Water Quality Standards Handbook: Second Edition EPA-823-B-12-002; March 2012
[110] Clean sampling is the use of techniques designed to reduce trace metal contamination during sampling.
[111] Water Quality Standards Handbook: Second Edition EPA-823-B-12-002; March 2012
[112] Chadwick Ecological Consultants, Inc. 2004. US EPA Cadmium Water Quality Criteria Document – Technical Review and Criteria Update. Report prepared for AMSA. Addendum to this report released December 2004.

Option 2 - The Water Effects Ratio Procedure

The Water Effects Ratio (WER) procedure is intended to take into account relevant differences between the toxicity of a chemical in laboratory test water and in site water. As discussed earlier, water chemistry can play an important role in the toxicity of a pollutant. This is especially true for some metals. Laboratory toxicity tests are conducted in standard laboratory water which often doesn't mimic all of the unique and variable water chemistry conditions that can occur at a site. The WER procedure can be used when it is suspected that site water chemistry may change the toxic impacts of a pollutant. Basically, the WER procedure consists of conducting concurrent toxicity tests using the same aquatic organism in laboratory water and in site water to determine if there is a difference in the toxicity of a metal in the two waters.

The WER procedure commonly is used to modify metals standards at sites smaller than the state level. EPA has extensive guidance available on performing the WER procedure, including an abbreviated methodology specifically used for deriving site specific copper standards. The WER procedure results in a multiplier which is applied to the applicable standard at the defined site to create a new site specific standard. Based on current regulations in North Carolina, each site specific standard developed using the WER procedure must be adopted by the state and be approved individually by the US EPA as a change to water quality standards. The WER procedure may result in more or less stringent standards depending on the water chemistry at the site in question.

Option 3 - The Resident Species Procedure

The Resident Species Procedure can be used when both site water chemistry and resident species sensitivity to a toxicant are in question. This procedure requires toxicity tests to be conducted with the site's resident species in actual site water. After the necessary toxicity test data are completed with a sufficient selection of resident species in site water, calculation of a site-specific standard can be done. The site specific standard is derived by following the aquatic life criteria derivation procedures as described in the US EPA 1985 Guidelines.[113] As with the other two options for developing site specific aquatic life standards, state rulemaking and US EPA approval are required and the resulting site specific standard can be more or less stringent based on site characteristics.

[113] Stephen, Charles E., Mount, Donald I., Hansen, David J., Gentile, John R., Chapman, Gary A. and Brungs, William A. 1985. Guidelines for Deriving Numerical National Water Quality Criteria for the Protection Of Aquatic Organisms and Their Uses: Office of Research and Development Environmental Research Laboratories Duluth, Minnesota Narragansett, Rhode Island, Corvallis Oregon. http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/upload/85guidelines.pdf

Appendix III.1: Division of Water Resources Programs

The following paragraphs provide a brief overview of Division of Water Resources programs that are involved (or potentially involved) in the implementation of the proposed rule changes.

Water Sciences Section - Ambient Monitoring System

The DENR DWR is responsible for providing the US EPA and interested parties with site-specific, long-term water quality information on significant rivers, streams, and estuaries throughout the state. The program is located within the Water Sciences Section (WSS) and is known as the Ambient Monitoring System (AMS).

The AMS program has been active for more than 30 years. Water quality sampling stations are visited at least monthly for the collection of a variety of physical, chemical and bacterial pathogen samples and measurements. Details of the program design and implementation can be found in the Quality Assurance Project Plan (QAPP), Standard Operating Procedures, and other links on the Water Sciences Section homepage: http://portal.ncdenr.org/web/wq/ess/eco/ams.

The AMS's primary objectives are:

- To monitor waters for levels of chemical, physical and bacterial pathogen indicators for comparison to the state's water quality standards;
- To identify locations where unacceptable exceedances of water quality standards for physical and chemical indicators occur; and
- To identify long-term temporal or spatial patterns.

Data produced by the AMS are used to support several DWR water quality management programs, including Basinwide Water Quality Management Planning, federally required CWA biennial 305(b) and 303(d) reporting to the US EPA, Total Maximum Daily Load development, and development of NPDES permit limits.

Currently there are 323 active AMS stations. Stations are located in all seventeen major river basins of the state, and in 95 of North Carolina's 100 counties. The AMS focuses primarily on chemical, physical and bacterial pathogen characteristics of the water column. The indicators are generally selected from chemicals that have current state water quality standards and can be cost-effectively analyzed. Additional indicators may be included that do not have specific associated standards but are useful for interpretation of other standards or criteria.

A portion of AMS stations have been identified as "long term indicator sites". On-going collection of ambient data dates back to before 1980. The data from these sites are evaluated on an annual basis to summarize regional trends across North Carolina including dissolved oxygen (DO), turbidity, temperature, pH, conductivity, and fecal coliform bacteria. All data collected as part of the AMS are readily available online from the US EPA's STORET[114] database. Approximately 100,000 new records are added annually. Ambient monitoring data are also summarized by basin on a rotating five-year cycle.

[114] US EPA STORET database. http://www.epa.gov/storet

Proposed changes to the water quality standards for metals will necessitate some changes to sampling protocols, and additional biological assessments may be warranted. These changes and potential costs are further outlined in “Estimated Costs to DWR”.

Water Sciences Section - Random Ambient Monitoring System

The Random Ambient Monitoring System (RAMS) was initiated in January 2007 with funding provided by US EPA through a federal grant. It is a probabilistic monitoring initiative where sampling locations are randomly located on freshwater streams throughout the state. DWR’s AMS has historically focused on large rivers and areas with known water quality problems. So, RAMS is designed to allow assessment of water quality on smaller streams not traditionally sampled in the AMS.

Because a number of streams in North Carolina are small, the majority of RAMS sites are also on small streams. RAMS allows DWR to answer broad questions about the water quality of North Carolina streams with a statistical rigor that had not been possible before. The RAMS study allows DWR to collect data on water quality parameters that are rarely, or never, examined. RAMS includes analysis of both dissolved and total recoverable metals and so, when a statistically relevant number of results can be compiled, and the revised standards are adopted, the RAMS data will aid in the assessment of compliance with the proposed dissolved metals standards. These assessments will be used in federally required 305(b) and 303(d) reports. The information from RAMS may aid in developing site-specific standards using the proposed US EPA biotic ligand model for copper.

Every two years, thirty sampling sites are chosen for the RAMS program. These sites are sampled once per month for two years, and then new sites are chosen for the following two-year cycle. This sampling protocol will continue for the life of the RAMs program, which is dependent upon federal funding. No changes to the current RAMS sampling protocols are expected with the adoption of the proposed water quality standards for metals or 2,4-D. Therefore, no additional costs or benefits are expected.

Water Sciences Section - Biological Assessments

The Biological Assessment Unit is tasked with evaluating the water quality of streams and rivers by examining the biological communities that live there. This examination involves two areas: benthic macroinvertebrates (or “benthos”) and fisheries. These distinct biological communities can reflect both long and short term environmental conditions given the variety of life cycles these organisms exhibit. Proposed changes to the 15A NCAC 02B .0211 and .0220 allow the determination that even though metals (except mercury and selenium) are above standards a stream is not impaired if biological monitoring indicates attainment of biological integrity. For the purposes of this note, it is assumed that a biological assessment will consist only of benthic macroinvertebrate examination.

Benthic macroinvertebrates are composed of aquatic insects but also include: crustaceans such as crayfish; mollusks, like mussels, clams and snails; and aquatic worms. Many of these organisms are associated with the bottom substrates of streams and rivers or along the submerged sides of the river channel and reside for long periods (from several months to three years) in their larval stage before emerging as an adult for a relatively short aerial or terrestrial existence. As such, they are strong indicators of the conditions of the waters and allow the development of biocriteria for assessing water quality. Biocriteria to assess biological communities are developed using the diversity, abundance and pollution sensitivity of the organisms that inhabit lotic (flowing) waterbodies in North Carolina. One of five bioclassifications is typically assigned to each waterbody sampled: Excellent, Good, Good-Fair, Fair and Poor. Waters identified as "Excellent" or "Good" will contain diverse, stable and pollution-sensitive communities of aquatic macroinvertebrates. The information is used to document both spatial and temporal changes in water quality, and to complement water chemistry analyses, ambient toxicity data, and habitat evaluations. In addition to assessing the effects of water pollution, biological information is also used to define High Quality or Outstanding Resource Waters, support enforcement of stream standards, and measure improvements associated with management actions.

Estimation of the number of sites that might require follow-up biological assessments to determine if biological integrity is being met is not possible due to a lack of historical precedent; however, the cost of conducting an individual biological assessment is estimated under "Costs to DWR" below.

The proposed changes to 2,4-D standards are not expected to require any changes to biological assessments.

Water Sciences Section - Special Studies

The Water Sciences Section maintains the capacity to perform dissolved metals sampling using the proposed chronic and acute metals standards. Various special (unforeseen) studies may be needed in the future and may require the determination of dissolved metals concentrations associated with attainment of the proposed water quality standards. This includes stream reclassification studies, special studies related to specific site impacts across the state, and study requests from DENR regional offices or for the evaluation of NPDES wastewater impacts. Cost estimates for samples collected during special studies, which include dissolved metals, would be similar to those associated with ambient monitoring activities and are provided under "Costs to DWR" below.

Water Sciences Section - Chemistry Laboratory

The DWR Chemistry Laboratory Section provides analytical services for DWR Water Sciences Section AMS and RAMs programs, Surface Water Protection and Aquifer Protection Sections and the Division of Waste Management's Underground Storage Tank (UST) Section.

The Chemistry Laboratory Section staff analyzes water quality samples from a variety of sources including streams, lakes, rivers, monitoring wells, wastewater discharges and underground storage tank sites as well as a variety of compliance monitoring activities and emergency incidents. The Chemistry Laboratory Section is located in Raleigh, NC. A satellite laboratory (Asheville Regional Office Laboratory) is located in Swannanoa, NC to provide assistance with time-sensitive tests. The Chemistry Laboratory Section reports approximately 120,000 analytical data results per year. Within the Chemistry Laboratory Section, the Microbiology and Inorganic Chemistry Branch is responsible for the analysis of bacteriological samples, nutrients, metals and a variety of inorganic parameters.

Laboratory costs are provided in the "Cost Per Analysis Fee Schedule (updated 7/18/2011)"[115] and are available on the DWR Chemistry Laboratory Section website. The Fee Schedule relates only to the North Carolina Division of Water Resources Chemistry Laboratory Section's cost recovery fees. This fee structure reflects the characteristics of the different types of analyses

[115] DENR, Lab, Technical Assistance Documents for Sample Collectors. http://portal.ncdenr.org/web/wq/lab/staffinfo/techassist

performed, the different matrices encountered, the regulations to which they are subject, and the level of effort expended by the Chemistry Laboratory Section in producing the data. The primary focus of the Chemistry Laboratory Section's fee setting process and structure is to directly link the fees to be charged to the costs of activities required for sample preparation and handling and the issuance of reports and to recover the full costs of these activities.

Fees are based on an estimate of the number of hours laboratory personnel spend on work necessary for processing a sample and generating a report. It should be noted that the posted fees were determined per average load – a single sample generally demands more resources on a per sample basis. Different sample matrices (e.g., water, soil, fish tissue) are charged differential fees in recognition of the relative complexity of these samples and the frequency of laboratory surveillance. The following items also were considered when these estimates were established:

- Sample collection materials supplied by the Chemistry Laboratory Section;
- Sample receipt and login activities;
- Reagent preparation;
- Quality control;
- Consumables;
- Man-hours required for all aspects of sample analysis and reporting;
- Instrument maintenance;
- Personnel salaries; and
- Building utilities.

Proposed changes to the water quality standards for metals may require additional analysis of metals samples by the chemistry laboratory personnel. As no new staff or equipment resources are expected to be added to the chemistry laboratory operations, the number of samples submitted for chemical analyses of different water quality parameters may be adjusted to accommodate an altered sampling and analysis protocol required by the rule changes. The state will not incur additional costs through this rule change but there may be changes to the overall numbers of sampling sites evaluated given the laboratory resource constraints. The reduction in numbers of evaluated sites may diminish the Division's ability to assess the overall water quality within the state. The proposed changes to 2,4-D standards are not expected to require any changes to chemistry laboratory operations.

Water Planning Section

The DWR Planning Section is responsible for reporting requirements of Section 305(b) and Section 303(d) of the federal Clean Water Act. Under Section 303(d) of the Clean Water Act, the list of impaired waters signifies that these waters are too polluted or otherwise degraded to meet the water quality standards established by the state. Once a waterbody is section 303(d) listed - the law requires that states establish priority rankings for waters and develop Total Maximum Daily Loads (TMDLs) for these waters. A Total Maximum Daily Load, or TMDL, is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards. The TMDL is used to establish limits on point and nonpoint sources of the pollutant. The TMDL must account for seasonal variation in water quality and include a margin of safety to ensure adequate protection for the body of water. The Modeling and TMDL Unit within the Planning Section publishes the 303(d) list and develops TMDLs based on US EPA guidance.

The proposed changes to water quality standards for metals will result in a change to the type of data collected and will, therefore, alter the assessment needs to comply with the federal reporting requirements. We are unable to predict if changes to the metal standards will result in a higher or lower number of TMDLs. Any changes to the number of waters with TMDLs will change the amount of staff time and other resources needed for TMDL development and associated load allocations.

Water Quality Permitting Section – NPDES Wastewater Permitting and Pretreatment

The Clean Water Act prohibits any discharge of pollutants from discrete point sources to surface waters except as authorized in an NPDES permit. The Division of Water Quality administers two types of NPDES wastewater permits for direct dischargers to surface waters: individual permits and general permits. Both types of permit authorize the discharge of wastewater in accordance with the terms and conditions specified in the permit. Each 'individual' permit governs a single facility and is tailored specifically to that facility and the particular characteristics of its discharge and its receiving stream. Each general permit, on the other hand, governs a whole class of facility and includes standardized requirements and conditions. Facilities seeking coverage under a general permit must satisfy certain eligibility criteria in order to obtain a Certificate of Coverage (certificate, or COC); if they fall outside the criteria, they must apply for and obtain an individual permit prior to discharging. Individual and general permits (but not the certificates of coverage issued to dischargers under those general permits) must be made available for public and agency review prior to issuance and are subject to change in response to comments received.

Federal and state law prohibits industrial facilities from discharging wastes to a Publicly Owned Treatment Works (POTW) if those wastes would interfere with the proper operation and performance of the POTW, pass through the POTW and impact surface waters, or contaminate the POTW's waste residuals (also referred to as waste sludge or biosolids). POTWs that receive specific types or amounts of industrial wastewaters are required to develop and administer a pretreatment program to regulate these wastewaters, subject to Division approval and oversight.

The Water Quality Permitting Section administers the NPDES wastewater permit program and the state pretreatment program. The proposed rules potentially affect both the regional and central offices. Central office staff would:

- incorporate new metals requirements into affected permits;
- develop guidelines to ensure proper implementation of any metals strategies;
- continue to oversee local pretreatment program regulation of industrial users in response to the standards revisions; and
- administers the Authorization to Construct permits program for facilities discharging to surface waters.

Regional office staff would assist with technical reviews, provide compliance oversight, conduct on-site investigations to develop permit recommendations, and otherwise assist with implementation of the proposed standards.

Infrastructure Finance Section (now the Division of Water Infrastructure)

The Infrastructure Finance Section (now established as the Division of Water Infrastructure) administers various funding programs for wastewater collection system and treatment improvements.

Appendix III.2: Wastewater Dischargers – Selection of Target Metals

Rationale for Selection of Target Metals for Use in Economic Analysis

Numeric water quality standards are the primary basis for setting water quality-based effluent limitations (WQBELs). When the value of a standard is increased or decreased, effluent limitations based on the standard tend to do likewise. Still, water quality-based limits are discharge-specific, and a definitive assessment of the impact of a standard requires individual analyses (such as Reasonable Potential Analyses) of each permit. Such an assessment would require extraordinary time and effort to complete.

The Division conducted an initial assessment of the proposed standards in order to identify those most likely to impact wastewater dischargers and, thus, to focus its economic analysis of the standards of greatest concern. This section summarizes the Division's rationale and findings.

The Division started by comparing the Maximum Allowable Effluent Concentrations (MAECs) that would be found using the existing and the proposed standards. MAECs are the values that are used as effluent limitations when a discharger shows 'reasonable potential' to cause an exceedance of a standard.

Staff looked at both the chronic and acute aquatic life standards for each affected metal. Since the state has no acute metals standards at present, the assessment compares the US EPA's national recommended acute water quality criteria as a measure of short-term impacts, just as the Division currently uses them in setting metals requirements in NPDES permits.

To be conservative, the MAECs were calculated using worst case conditions; that is, assuming no available dilution in the receiving waters (IWC = 100%) and, for hardness-dependent metals, a combined hardness of 25 mg/L. All concentrations of dissolved metals were translated to total recoverable values. The Division used the US EPA translators in Table III.2-1 for freshwater and assumed a translator of 1.0 for all metals in saltwater.

Table III.2-1
US EPA Translators - Freshwater

PARAMETER	US EPA Translators	PARAMETER	US EPA Translators
Cadmium	0.252	Lead	0.184
Chromium III	0.202	Nickel	0.432
Chromium VI	1.000	Silver	1.000
Chromium, Total	N/A	Zinc	0.288
Copper	0.348		

[1] Using Default Partition Coefficients, TSS = 10 mg/L

(a) Freshwater Standards

Table III.2-2 compares the MAECs calculated using freshwater standards and assuming worst-case conditions: IWC = 100% and, where applicable, combined effluent/ instream hardness = 25 mg/L.

The proposed chronic standards for arsenic, beryllium, cadmium (Trout waters), copper, silver, and zinc will not result in limits any more stringent than with existing standards, even under the worst-case conditions used. The MAEC of 150 µg/L for arsenic is greater than the 50 µg/L calculated with the existing standard; however, the current human health standard of 10 µg/L remains in effect and will continue to be the controlling standard for most or all permit requirements for arsenic. Fewer than 20 permits from various categories have WQBELs based on any of these standards.

Table III.2-2
Worst-Case Comparison of Maximum Allowable Effluent Concentrations (MAECs) Based on Existing and Proposed Freshwater Standards for Metals

Metal	MAECs (µg/L) [1]				Cursory Assessment of Resulting WQBELs	
	Existing Chronic	Proposed Chronic	Existing Acute	Proposed Acute	Based on Chronic Impacts	Based on Acute Impacts
Arsenic	50	150	-	340	Less stringent, but existing human health std. (10 µg/L) continues to control	Not likely to be more stringent
Beryllium	6.5	6.5	-	65	No more stringent	Not likely to be more stringent
Chromium, total	50	-	1022	-	(Proposed for removal)	-
Chromium III [2]	-	117.5	-	905	Uncertain	Uncertain
Chromium VI	-	11	-	16		
Iron	1,000	-	-	-	(Proposed for removal)	-
Cadmium [2]	2	0.6	15	3.24	Likely to be more stringent	Likely to be more stringent
Cadmium (Trout)	0.4	0.6	2.1	2.01	Less stringent	Likely to be more stringent
Lead [2]	25	2.9	33.8	75.5	Likely to be more stringent	Less stringent
Nickel [2]	88	37.2	261	335	Likely to be more stringent	Less stringent
Copper (AL) [2]	7	7.9	7.3	10.5	Less stringent	Less stringent
Silver (AL) [2]	0.06	0.06	1.23	0.3	(No change proposed)	Likely to be more stringent
Zinc (AL) [2]	50	127	67	125.7	Less stringent	Less stringent

[1] Assuming IWC = 100% and, where applicable, combined effluent/ instream hardness = 25 mg/L. All concentrations are expressed as total recoverable metal.
[2] Hardness-dependent in freshwater. AL = Action-Level metal.

Total Chromium is a measure of the metal's two species: chromium III (trivalent chromium, or Cr^{3+}) and chromium VI (hexavalent chromium, or Cr^{6+}). The proposed rule changes would replace the total chromium standard with new standards for chromium III and VI. It would be premature to evaluate the impacts of the proposed standards at this time, because no data are available for chromium III and VI: the existing standard and water quality-based permit requirements apply to total chromium only, not the component species.

The draft rules also propose to remove the iron standard. Water quality-based limitations for iron would be deleted from the one affected permit. However, technology-based limitations for iron (18 steam electric power generating facilities) based on federal effluent guidelines are not impacted by this rule change and will remain in effect. As a result, the removal of the iron water quality standard would not result in any savings for the one facility that is currently impacted by it.

Water quality-based limitations for cadmium (non-Trout) and lead would likely be more stringent under the proposed standards. However, the degree of any impacts is discharge-specific, and permit-by-permit analyses are required to determine those impacts. Limits based on the nickel standard could be more stringent, but impacts may be tempered because the existing human health standard of 25 µg/L is not affected by the proposed rule changes and would likely continue to be the controlling standard for permitting purposes.

In addition, the ‘action level’ policy in Subparagraphs 02B .0211(4) and .0220(4) of the rules provides that a discharger is not subject to discharge limits for an action level metal (iron, copper, silver, or zinc) unless it has failed its whole-effluent toxicity test due to excessive concentrations of that metal. Many discharges contain one or more of the action level metals, but only a few permittees are currently subject to water quality-based limitations for the metals under this policy.

Many of the proposed acute standards would not result in more stringent limits. Those that do are not expected to have significant impacts overall, because the chronic standards will tend to determine whether or not a discharger must take action to comply with its metals limits. Impacts of the chromium standard are again unknown. Limits for cadmium and silver (an action level metal) are likely to be more stringent, and these metals have already been identified as having impacts based on their chronic standards. However, no dischargers are subject to water quality-based limits for silver at this time.

(b) Saltwater Standards

Fewer metals standards apply to saltwater. Neither the existing nor the proposed metals standards are hardness-dependent. The proposed standards would, like the freshwater standards, be expressed in terms of dissolved metals. Concentrations will require translation to the total recoverable form; however, translators have yet to be developed for these metals in saltwater, so a value of 1.0 is used.

The proposed chronic and acute standards for cadmium, silver (AL), and zinc (AL) and the chronic standard for copper (AL) would likely result in less stringent limitations than with the existing standards under worst-case conditions. The acute standard for copper (AL) will likely result in more stringent limits for the one industry with WQBELs. Limits based on the proposed arsenic standard would be more stringent but, as in freshwater, the human health standard of 10 µg/L is not affected by the proposed rule changes and will continue to be the controlling standard for any water quality-based limitations. Limitations based on the proposed chronic standards for lead and nickel are the most likely to impact wastewater discharges into saltwater.

There are no saltwater standards, existing or proposed, for beryllium, chromium III, or iron. The standard for total chromium is proposed for removal.

Table III.2-3 compares the MAECs calculated using saltwater standards.

Table III.2-3
Worst-Case Comparison of Maximum Allowable Effluent Concentrations (MAECs) Based on Existing and Proposed Saltwater Standards for Metals

Metal	MAECs (µg/L) [1]				Cursory Assessment of Resulting WQBELs [1]	
	Existing Chronic	Proposed Chronic	Existing Acute	Proposed Acute	Based on Chronic Impacts	Based on Acute Impacts
Arsenic	50	36	-	69	More stringent, but existing human health std. (10 µg/L) continues to control	Not likely to be more stringent
Beryllium	No standards, existing or proposed.				No standards, existing or proposed.	
Chromium, total	20	-	-	-	Proposed for removal	-
Chromium III	No standards, existing or proposed.				No standards, existing or proposed.	
Chromium VI	-	50	-	1,100	Less stringent	Uncertain
Iron	No standards, existing or proposed.				No standards, existing or proposed.	
Cadmium	5	8.8	15	40	Less stringent	Less stringent
Lead	25	8.1	221	210	Likely to be more stringent	Likely to be more stringent
Nickel	8.3	8.2	75	74	Likely to be more stringent	Likely to be more stringent
Copper (AL)	3	3.1	5.8	4.8	Less stringent	Likely to be more stringent
Silver (AL)	0.1	0.1	1.9	1.9	No more stringent	No more stringent
Zinc (AL)	50	127	67	125.7	Less stringent	Less stringent

[1] Assuming IWC = 100%. All concentrations are expressed as total recoverable metal.

(c) General Conclusions Regarding Impacts to Effluent Limitations

The Division concluded that, assuming worst-case conditions, the freshwater standards for cadmium, lead, and nickel and the saltwater standards for lead are the most likely to result in more stringent water quality-based limitations and result in economic impacts to NPDES wastewater dischargers. Numeric values for nickel are lower under the proposed standards, but the differences are negligible from a laboratory perspective. In this analysis, cadmium, lead, and nickel are referred to as the 'target' metals.

Sufficient data are not available to evaluate the impacts of the proposed standards for chromium III and chromium VI. Most of the freshwater and saltwater standards for copper, silver, and zinc will result in less stringent limitations for those few facilities subject to limitations under the Action Level Water Quality Standards. The exception is the saltwater acute standard for copper, which will likely result in more stringent limits for the one facility with such limit.

Return to:

Chapter B. Wastewater Dischargers

B1. Summary of Findings

B2. Background: NPDES Permit and Pretreatment Programs

B3. Evaluation of Impacts: Metals Standards

(a2) Projected Regulatory Impacts – NPDES Wastewater Permits

(b) Existing Metals Requirements – NPDES Wastewater Permits

3. Impacts – Metals

(e) Cost Baseline

(a2) Projected Regulatory Impacts – NPDES Wastewater Permits

c) Description of Potential Compliance Alternatives

(d) Quantify Costs/ Savings

(e) Quantification Methods and Assumptions

(f) General Assumptions

(g) Data Sources – Wastewater Dischargers

(h1) Wastewater Dischargers – Municipal WWTPs

(h2) Wastewater Dischargers – 100% Domestic WWTPs

(h3) Wastewater Dischargers – Industrial WWTPs

(h4) Wastewater Dischargers – Groundwater Remediation Facilities

(h5) Wastewater Dischargers – Water Treatment Plant Discharges (WTPs)

4. Uncertainties (Metals)

B4. Evaluation of Impacts: 2,4-D Standards

Appendix III.3: Wastewater Dischargers – Determination of Permit Requirements for Metals

This appendix provides additional details of Reasonable Potential Analyses and the existing methods for the use of surface water quality standards in setting metals limits in NPDES wastewater permits.

Metals Limits – NPDES Permits

(a) Existing Process – NPDES Permits

At permit issuance and at each permit renewal thereafter, the Division determines what limitations and other requirements are warranted for each parameter of concern. Permit requirements for metals can include (1) effluent limitations and monitoring requirements or (2) monitoring requirements alone.

The key steps in establishing permit requirements for metals are as follows:

- Identify pollutants of concern (metals, in this case) in the wastewater, based on expected or actual characteristics;
- Compile available effluent data for metals from the permittee's discharge monitoring reports, permit applications, long-term monitoring plan results (LTMPs are an element of pretreatment programs), and other sources;
- Identify applicable treatment performance and surface water quality standards.
- Calculate technology-based limits (TBELs) based on applicable performance standards;
- Conduct a Reasonable Potential Analysis (RPA) for each metal of concern and each applicable surface water standard and calculate water quality-based limits (WQBELs) where warranted;
- Apply the more stringent limits for each metal, if more than one; and
- Specify monitoring requirements for each limited metal and for each metal that does not warrant limits but is present in significant amounts.

A discharger's permit requirements for metals can change at each renewal, depending on the outcome of these analyses.

The proposed revisions to the surface water standards for metals affect only the water quality-based limitations for metals. The following paragraphs briefly describe how the standards are used in calculating WQBELs for discharges to freshwater and to saltwater; how stream flows specified in the current and proposed 15A NCAC 02B .0206 rule are used in the calculations; the differences in the process when action level metals standards are involved; and several controllable factors that can influence the outcome of an RPA.

1. Effluent Limitations

RPAs and Freshwater Aquatic Life Standards

A Reasonable Potential Analysis evaluates actual effluent data from a wastewater facility and determines whether the discharge is likely to cause an exceedance of one or more water quality standards in the receiving stream. The RPA consists of calculating the *maximum predicted effluent concentration* for each parameter of concern and comparing it to the *maximum allowable effluent concentration*. A discharge is said to exhibit 'reasonable potential' to cause a standards exceedance when the maximum predicted effluent concentration of a pollutant exceeds its maximum allowable effluent concentration.

- *Maximum Predicted Effluent Concentration (MPEC).* The MPEC for a given metal in a particular discharge is the maximum effluent concentration of the metal that is predicted to occur in the discharge, based on the average value and variability of effluent concentrations. Effluent data should include at least twelve samples taken in the last 2-3 years. The standard deviation of the data divided by its mean is the Coefficient of Variation (CV) for the data set. The Coefficient of Variation and the number of effluent values, *n*, in the data set are used to determine the Multiplier Factor. The maximum value in the data set multiplied by the Multiplier Factor equals the maximum predicted effluent concentration.
- *Maximum Allowable Effluent Concentration (MAEC).* The MAEC for a given metal in a particular discharge is the effluent concentration that, at certain low-flow conditions, would cause the instream concentration of the metal downstream of the discharge to equal but not exceed the metal's standard. The MAEC is calculated separately for acute and chronic standards and is expressed as:

$$\text{MAEC } (\mu g/L) = \frac{\text{Surface Water Quality Standard } (\mu g/L)}{\text{Instream Waste Concentration (IWC)}}$$

The Instream Wastewater Concentration (IWC) is a measure of the percent of wastewater flow in the receiving stream downstream of the discharge. For example, a one million gallon per day (1 MGD) wastewater discharge to a stream with the same flow has an IWC of 50%; if the stream flow is nine times the effluent flow, the discharge has an IWC of 10%.

The IWC is calculated differently depending on whether it will be used with chronic standards or with acute standards. The current regulation at15A NCAC 02B .0206 specifies that the 7Q10 flow value shall be used with chronic standards. Thus, the IWC is calculated as follows:

$$\text{IWC (chronic)} = \frac{\text{Permitted Flow (MGD)}}{[\text{Permitted Flow (MGD)} + \text{7Q10 (MGD)}]}$$

where MGD = million gallons per day, and
7Q10 = the lowest 7-day average stream flow expected to occur once in ten years

The 7Q10, 1Q10, and other statistical measures of flow used for permitting purposes are determined by the US Geological Survey, which maintains a system of over 200 continuous-measurement flow gages in North Carolina's rivers and streams.[116]

Until recently, the Division applied acute criteria at the point of discharge, meaning that facilities had to meet the acute criteria without benefit of dilution. In 2010, it began calculating IWCs for acute criteria using 1Q10 flows. Acute IWCs are now calculated as follows:

[116] (http://pubs.usgs.gov/fs/FS-046-01/#streamflow).

$$\text{IWC (acute)} = \frac{\text{Permitted Flow (MGD)}}{[\text{Permitted Flow (MGD)} + \text{1Q10 (MGD)}]}$$

where 1Q10 = the lowest 1-day average stream flow expected to occur once in ten years,
which can be calculated as follows:

$$\text{Receiving stream 1Q10 (MGD)} = 0.843 \times 7Q10^{0.993}$$

The proposed changes to Rule 15A NCAC 02B .0206 would formally incorporate this change and specify that the 1Q10 flow value shall be used with acute standards. In this way, both measures of low flow used in RPAs correspond to the exposure period associated with each type of standard: 1-day low flows with acute exposure and 7-day low flows with chronic exposure.

A discharger's Reasonable Potential Analyses are conducted at each permit renewal to account for the varying characteristics of the effluent and receiving stream. The RPA calculations are repeated for each metal of concern and each applicable standard (acute and chronic aquatic life, human health-water supply, human health-fish ingestion, trout), and a separate determination is made in each case.

The RPA results for a discharger and, thus, the metals requirements in its NPDES permit can change from one renewal to the next if the effluent or stream characteristics change sufficiently during the five-year term of the permit. Such changes most often add or delete an effluent limitation rather than change its numeric value. That is because a show of reasonable potential standard exceedance depends primarily on the metal's average concentration in the effluent and the variability of those concentrations, which can vary from year to year for a variety of reasons. The numeric value of the limit, on the other hand, depends on the metal's surface water standards in the receiving stream, the treatment facility's permitted flow, and the stream's 7Q10 or 1Q10 flows, all of which are less prone to change over the permit term.

Application of RPA Results to Permit Requirements. The following guidance is used in establishing effluent limitations or monitoring requirements based on the results of the RPA:

- If the maximum predicted effluent concentration exceeds the maximum allowable effluent concentration, the discharge is subject to an effluent limitation equal to the maximum allowable effluent concentration (MPEC ≥ MAEC, effluent limitation = MAEC).
- If the maximum predicted effluent concentration is between 50% and 100% of the maximum allowable effluent concentration, routine effluent monitoring is warranted to provide data for reassessment at the next permit renewal (MPEC >50% MAEC but not ≥ MAEC, routine monitoring).
- If the maximum predicted effluent concentration is less than 50% of the maximum allowable concentration, no metals requirements are necessary in the permit (MPEC < 50% MAEC, no monitoring or limits).

If a discharge is subject to both technology-based and water quality-based limitations for the same metal, the more stringent limitation is used in the facility's NPDES permit.

Effluent limitations based on chronic standards (long-term impacts) are set as monthly average limits in the permit. Those based on acute standards and criteria (short-term impacts) are set as weekly average limits for publicly owned facilities and as daily maximum limits for private facilities.

The Division uses the same RPA methodology for all NPDES permit determinations. The methodology has been approved by the US EPA as being consistent with its national guidance. [117]

RPAs and Saltwater Aquatic Life Standards

Reasonable Potential Analyses are much the same for discharges to fresh and salt waters. However, dischargers to saltwater can be affected differently by surface water standards. Waters classified as saltwater are usually influenced by tidal action, making it difficult to determine a critical low-flow rate and IWC for a discharge. By default, the Division assumes an IWC of 100% (zero dilution) in these tidal waters, and effluent limitations for metals of concern are set equal to the numeric standards. A discharger can perform computer modeling to estimate the dilution rate in a tidal setting, and the Division would then use the resulting IWC in the same way as for a freshwater discharge.

Data Quantity and Quality

The amount and quality of effluent data collected at a discharge can influence the results of the RPA and the water quality-based metals requirements set for the discharge.

- *Variability of Data:* The MPEC can depend as much on the variability of effluent metals concentrations as it does on the average value. Effluent concentrations do vary, but other factors can increase the apparent variability of the data and may also be manageable, to the discharger's advantage.
- *Peak Effluent Concentrations:* Effluent data with occasional high values can average well below the maximum allowable concentration and still show reasonable potential due to the variability of the data set. All valid data for the period of analysis[118] are used in the RPA; peak values are discarded only if the permittee demonstrates that values it previously reported are truly faulty. Better control of data quality can reduce variability and the likelihood of receiving water quality-based limitations.
- *Reporting Levels:* Effluent data reported as 'non-detect' are still used in the RPA calculations, entered not as zero values but as ½ of the reported value (for '<10 µg/L', 5 µg/L is used). If the reporting levels vary over the analysis period, it creates artificial variability in the data and can have a significant impact on the RPA results, especially if the effluent limitation is near the metal's Practical Quantitation Limit (PQL).
  A discharger that did not detect a metal for the past three years could still show reasonable potential and receive a limitation; for example, if its maximum allowable concentration were 12 µg/L and its data were reported as '<10', '<20', '<20', '<10', '<10', '<20', and so on (no data would be considered greater than the MAEC, but the MPEC would be well above 12 µg/L). Taking more care in the laboratory could help avoid the limitation.
- *Limited Effluent Data:* The statistical variability of effluent data tends to increase as the number of samples decreases. For facilities that sample effluent less frequently, occasional peak values have a greater impact on the maximum predicted value for that discharge. More frequent sampling can help reduce the apparent variability of the data (unless, of course, the wastewater is variable by nature) and provides a clearer picture of a wastewater's characteristics. Dischargers can elect to sample more frequently than required by their permits.

[117] Technical Support Document for Water Quality-Based Toxics Control, EPA Document Number 505/2-90-001, March, 1991.
[118] That is, those data produced in accordance with the Analytical Procedures rule, 15A NCAC 02B .0103.

‘Action Level’ Considerations for Toxic Substances

Existing rules (T15A NCAC 02B .0211 and .0220) establish action level standards for permitting purposes for four metals – copper, iron, silver, and zinc. Both the existing and proposed rules specify that, if a discharge shows a reasonable potential to exceed any of these standards but has consistently passed its Whole Effluent Toxicity (WET) tests, the facility is not subject to effluent limits for the metal. Instead, the facility must continue to monitor the metal and conduct WET tests in order to verify that the permitting decision is justified. If the facility fails two WET tests and also shows reasonable potential to exceed an action level standard, it then receives a permit limit for the metal of concern, as would be the case for other metals.

2. Monitoring Requirements

Permittees monitor their discharges for parameters of concern as specified in their NPDES permits. The monitoring frequencies specified for metals depend on the grade of the facility and whether or not the metal is limited in the permit.

Independent of this triennial review of standards and the proposed rule changes, the Division modified its metals monitoring guidelines in July 2010, as shown in Table III.2-1.

The modified guidelines substantially reduce metals monitoring frequencies for those facilities with metals requirements. For example, monitoring at a 5 MGD facility with cadmium limits would drop from Weekly to Monthly.

The Division began incorporating the new monitoring frequencies in affected permits in July 2010, as part of the regularly scheduled renewals. Thus, the reduced frequencies will be in place prior to any permit revisions based on the rules changes now proposed and are used to represent baseline conditions for this fiscal analysis.

Table III.3-1
Conditions for Setting Limits and Monitoring Requirements in NPDES Permits

Does Reasonable Potential Exist?	Monitoring Frequencies	Limits
Yes (except action level metals)	Monthly	Yes
Yes (action level metals only)	Quarterly, with Whole Effluent Toxicity (WET) test	No, except if failed WET test and metals contributed
No, and MPEC ≥ 50% of MAEC [2]	Quarterly (or per LTMP)	No
No, and MPEC < 50% MAEC [2]	No Monitoring	No
No, due to lack of data	Monthly, for metals of concern	No

[1] LTMP = Long-Term Monitoring Plan, required of pretreatment programs.
[2] MPEC = Maximum Predicted Effluent Concentration; MAEC = Maximum Allowable Effluent Concentration

3. Metals Requirements in General Permits

Of the five wastewater general permits administered by the Division, only the NCG51 permit for groundwater remediation facilities sets limits for a metal. The permit applies to discharges from a variety of petroleum-contaminated sites and sets a water quality-based discharge limit for lead that applies only to gasoline-contaminated sites. The limit is set equal to the existing chronic lead standard of 25 µg/L (total recoverable) for both freshwater and saltwater to ensure that the standards are met at the point of discharge regardless of the receiving stream. Thus, no RPA or other site-specific analysis is necessary. Permittees must monitor their effluent for lead at least once per calendar quarter; however, the permit allows them to discontinue monitoring if lead is not detected above the Practical Quantitation Limit during the first eight quarters of a five year permit cycle.

(b) Potential Revised Process – NPDES Permits

1. Metals Requirements in Individual Permits for Freshwater Dischargers

Effluent Limitations.

The proposed revisions to the metals standards (15A NCAC 02B .0211) will not alter the conceptual approach to setting metals limitations: water quality-based limits will continue to be based on the RPA methodology described above. However, the proposed adoption of formula-based metals standards will require calculation of the applicable standards for each discharge before the permit's RPAs are conducted.

The Division expects that, with the proposed standards, one or both of the following new steps will be routinely required prior to conducting RPAs. Both steps would be required in the case of discharges to freshwater; only the second step is required for discharges to saltwater.

New Step #1: Calculate the Hardness-Dependent Maximum Allowable Metal (Dissolved) in Receiving Stream for Permitting Purposes

The proposed rules express freshwater standards for cadmium, chromium III, copper, lead, nickel, and zinc as hardness-dependent equations (15A NCAC 02B .0211 (11) (e), Table A). The hardness value used for permitting purposes will be the combined hardness of the effluent and receiving stream downstream of the discharge, calculated as follows:

$$\text{Combined Hardness} = \frac{\text{Instream Hardness (mg/L)} * \text{7Q10 (MGD)} + \text{WWTP Hardness (mg/L)} * \text{WWTP Flow (MGD)}}{\text{7Q10 (MGD)} + \text{WWTP Flow (MGD)}}$$

Whenever possible, the Division will use actual effluent to calculate combined hardness values for wastewater discharges. If sufficient effluent hardness data are not available for a facility, a default value of 25 mg/L will be used.

Actual instream hardness data are available for surface waters across the state. The proposed 02B .0211 rule specifies that, for NPDES permitting purposes, the required hardness values shall be established using the 10th percentile of hardness data collected within the local USGS and NRCS 8-digit HUC and that the standards formulas apply within a hardness range of 25-400 mg/L. Existing rules for Water Supply-classified waters (WS-I through WS-V) also set a hardness standard of 100 mg/L for drinking water supplies. Where actual hardness values fall outside the allowable ranges, the Division will calculate the standard using those boundary values.

The metals value determined using the standards equation is an interim result, calculated for permitting purposes only since it uses the combined hardness, and is meant only to be carried forward to New Step #2. It has no meaning outside of the context of these calculations. For our purposes, it can be called the *Maximum Allowable Metal (dissolved)* value *or MAM-dissolved*.

New Step #2: Calculate the Maximum Allowable Metal (Total) in Receiving Stream for Permitting Purposes

Most of the proposed aquatic life standards for metals are expressed as the dissolved form of the metal. However, federal regulation (40 CFR 122.45(c)) requires that NPDES permit limitations be expressed as total recoverable metals. A translator for each metal must be used to convert between the dissolved and total forms of the metal for permitting purposes.

For each metal of interest, the *MAM-dissolved* value from New Step #1 must be translated to the total recoverable form. The result is the *Maximum Allowable Metal (total)* value *or MAM-total. This is also an interim result with no meaning outside this context. It* is calculated as follows:

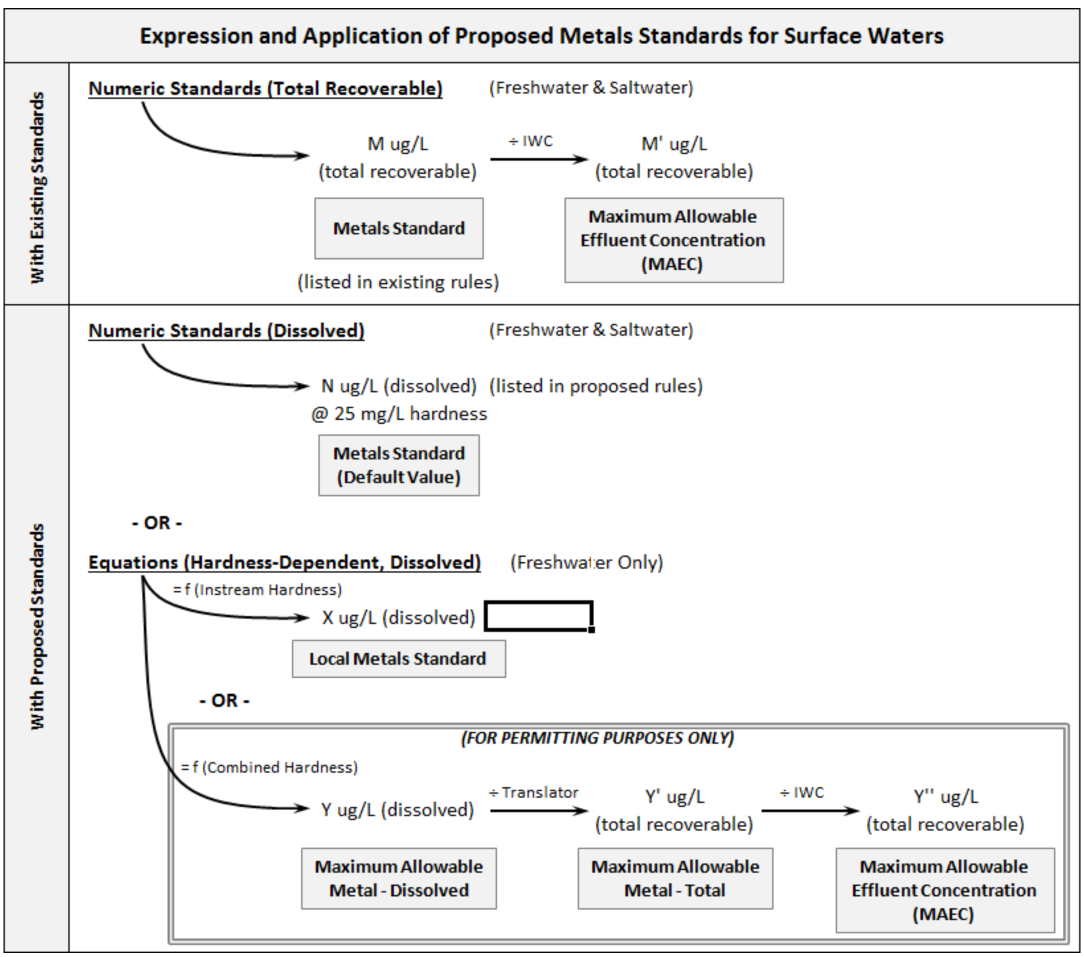
$$\text{Maximum Allowable Metal (total) } (\mu g/L) = \frac{\text{Maximum Allowable Metal (dissolved) } (ug/L)}{\text{Translator}}$$

For permitting purposes, MAM-total for each metal is the discharge-specific, total recoverable expression of the proposed dissolved standard and will be used to represent the standard in the ensuing Reasonable Potential Analyses.

The Division will employ freshwater translators developed by the US EPA, which are already in wide use in other states in EPA's Region 4. The translators can be found on the US EPA website at the following link:
http://water.epa.gov/scitech/datait/models/upload/2009_03_26_models_guidance_pdf.pdf

Figure III.3-1 illustrates the application of metals standards in determining *Maximum Allowable Metal (total)* values for permitting purposes and illustrates differences between this process under the existing and the proposed standards.

Figure III.3-1
Expression and Application of Proposed Metals Standards



Monitoring Requirements:

The proposed standards revisions will not require any change in how monitoring requirements for metals are set. However, specific requirements in any given permit (metals to be monitored, monitoring frequency, etc.) may change as limits are added to or removed from the permit based on the new standards. Metals monitoring is generally required more frequently for those metals with limits.

Independent of this triennial review, the Division modified its permitting guidelines in July 2010, substantially reducing the standard monitoring frequencies for metals. The Division began incorporating the new requirements in affected permits in July 2010, as part of the regularly scheduled renewals, and expects to complete the task in July 2015, at the end of one permit cycle. Thus, the net result for many dischargers in the next several years will be a net reduction (or no change) in monitoring frequencies. Even so, the Division assumes that the new guidelines will be fully implemented prior to application of the proposed metals standards and that those reduced requirements are the baseline condition for the purposes of this fiscal note.

2. Metals Requirements in Individual Permits for Saltwater Discharges

Under the proposed rule changes (T15A NCAC 02B .0220), saltwater standards for metals are also expressed as dissolved metals. However, saltwater standards for metals are not hardness-dependent. Therefore, only New Step #2 applies for determining permit limits for discharges to saltwater. There is less scientific agreement on applicable saltwater translators; so, for the purposes of this fiscal note, the Division will assume a value of 100% (or 1) for all metals in these waters.

3. Metals Requirements in General Permits

The proposed standards do not require significant change in the administration of the NCG51 general permit. The permitting process will continue as before, and the Division will modify the permit's lead limit as necessary to ensure compliance with the new standards.

The Glossary at the beginning of the document provides an explanation of the terms used in the figure.

(c) Potential Revised Process – Pretreatment Programs (Indirect Dischargers)

The Division does not expect the proposed rule changes to affect the existing methods for determining MAHLs or MAILs or for setting metals limits in local permits. It does expect that more stringent limits at some POTWs will lead to reduced local limits for SIUs and that, as a result, some POTWs that will receive more stringent metals limitations will reconsider the practice of setting limits far in excess of their significant industrial users' needs.

Return to:

Chapter B. Wastewater Dischargers
B1. Summary of Findings
B2. Background: NPDES Permit and Pretreatment Programs
B3. Evaluation of Impacts: Metals Standards
(a2) Projected Regulatory Impacts – NPDES Wastewater Permits
(b) Existing Metals Requirements – NPDES Wastewater Permits

Appendix III.4: Wastewater Discharges – List of Permits Evaluated

The following facilities and their permits or COCs were evaluated in order to estimate the potential impacts of the proposed metals standards on their NPDES permit requirements. The results of individual evaluations were then generalized and extended to the remaining permits in each wastewater category.

#	Permit	Ownership	Owner	Facility	Type	Fresh/ Salt Water
	Municipal WWTPs					
1	NC0020761	Municipal	Town of North Wilkesboro	Thurman Street WWTP	Municipal, Large	FW
2	NC0024970	Municipal	Charlotte Mecklenburg Utilities	McAlpine Creek WWTP	Municipal, Large	FW
3	NC0027103	Municipal	Town of Pembroke	Pembroke WWTP	Municipal, Large	FW
4	NC0031836	Municipal	City of Statesville	Fourth Creek WWTP	Municipal, Large	FW
5	NC0037508	Municipal	Moore County Public Utilities	Moore County WPCF	Municipal, Large	FW
6	NC0048879	Municipal	Town of Cary	North Cary WRF	Municipal, Large	FW
7	NC0050342	Municipal	City of Winston-Salem	Muddy Creek WWTP	Municipal, Large	FW
8	NC0020338	Municipal	Town of Yadkinville	Yadkinville WWTP	Municipal, Large	FW
9	NC0020591	Municipal	City of Statesville	Third Creek WWTP	Municipal, Large	FW
10	NC0021601	Municipal	Town of Tryon	Tryon WWTP	Municipal, Large	FW
11	NC0030317	Municipal	City of Rocky Mount	Tar River Regional WWTP	Municipal, Large	FW
12	NC0046728	Municipal	Town of Mooresville	Rocky River WWTP	Municipal, Large	FW
13	NC0020036	Municipal	Town of Stanley	Lola Street WWTP	Municipal, Large	FW
14	NC0020427	Municipal	City of Rockingham	Rockingham WWTP	Municipal, Large	FW
15	NC0020648	Municipal	City of Washington	Washington WWTP	Municipal, Large	FW
16	NC0021474	Municipal	City of Mebane	Mebane WWTP	Municipal, Large	FW
17	NC0021865	Municipal	Town of Chadbourn	Chadbourn WWTP	Municipal, Large	FW
18	NC0023876	Municipal	City of Burlington	Southside WWTP	Municipal, Large	FW
19	NC0023884	Municipal	City of Salisbury	Salisbury-Rowan WWTP	Municipal, Large	FW
20	NC0023949	Municipal	City of Goldsboro	Goldsboro WWTP	Municipal, Large	FW
21	NC0024147	Municipal	City of Sanford	Big Buffalo WWTP	Municipal, Large	FW
22	NC0024228	Municipal	City of High Point	Westside WWTP	Municipal, Large	FW
23	NC0024236	Municipal	City of Kinston	Kinston Regional WRF	Municipal, Large	FW
24	NC0024571	Municipal	City of Lumberton	Lumberton WWTP	Municipal, Large	FW
25	NC0024911	Municipal	MSD of Buncombe County	French Broad River WRF	Municipal, Large	FW
26	NC0025984	Municipal	Town of Forest City	Forest City WWTP	Municipal, Large	FW
27	NC0026646	Municipal	Town of Pilot Mountain	Pilot Mountain WWTP	Municipal, Large	FW
28	NC0026913	Municipal	Town of Sparta	Sparta WWTP	Municipal, Large	FW
29	NC0029033	Municipal	City of Raleigh Public Utilities Department	Neuse River WWTP	Municipal, Large	FW

#	Permit	Ownership	Owner	Facility	Type	Fresh/ Salt Water
30	NC0039594	Municipal	Town of Maiden	Maiden WWTP	Municipal, Large	FW
31	NC0047562	Municipal	City of Hamlet	Hamlet WWTP	Municipal, Large	FW
32	NC0047597	Municipal	City of Durham	South Durham WRF	Municipal, Large	FW
33	NC0020401	Municipal	City of Hickory	Northeast WWTP	Municipal, Large	FW
34	NC0021873	Municipal	Town of Mayodan	Mayodan WWTP	Municipal, Large	FW
35	NC0024210	Municipal	City of High Point	East Side WWTP	Municipal, Large	FW
36	NC0024325	Municipal	City of Greensboro	North Buffalo Creek WWTP	Municipal, Large	FW
37	NC0040797	Municipal	City of Hickory	Henry Fork WWTP	Municipal, Large	FW
38	NC0020290	Municipal	Town of Burnsville	Burnsville WWTP	Municipal, Large	FW
39	NC0020354	Municipal	Town of Pittsboro	Pittsboro WWTP	Municipal, Large	FW
40	NC0020621	Municipal	Town of Boone	Jimmy Smith WWTP	Municipal, Large	FW
41	NC0021369	Municipal	Town of Columbus	Columbus WWTP	Municipal, Large	FW
42	NC0021491	Municipal	Town of Mocksville	Dutchman's Creek WWTP	Municipal, Large	FW
43	NC0023736	Municipal	City of Lenoir	Gunpowder Creek WWTP	Municipal, Large	FW
44	NC0023906	Municipal	City of Wilson	Wilson WWTP	Municipal, Large	FW
45	NC0024112	Municipal	City of Thomasville	Hamby Creek WWTP	Municipal, Large	FW
46	NC0025445	Municipal	City of Randleman	Randleman WWTP	Municipal, Large	FW
47	NC0031879	Municipal	City of Marion	Corpening Creek WWTP	Municipal, Large	FW
48	NC0047384	Municipal	City of Greensboro	T.Z. Osborne WWTP	Municipal, Large	FW
49	NC0055786	Municipal	City of Lexington	Lexington Regional WWTP	Municipal, Large	FW
50	NC0020737	Municipal	City of Kings Mountain	Pilot Creek WWTP	Municipal, Large	FW
51	NC0021920	Municipal	City of Whiteville	Whitemarsh WWTP	Municipal, Large	FW
52	NC0024937	Municipal	Charlotte Mecklenburg Utilities	Sugar Creek WWTP	Municipal, Large	FW
53	NC0024945	Municipal	Charlotte Mecklenburg Utilities	Irwin Creek WWTP	Municipal, Large	FW
54	NC0025577	Municipal	Town of Red Springs	Red Springs WWTP	Municipal, Large	FW
55	NC0025909	Municipal	Town of Rutherfordton	Rutherfordton WWTP	Municipal, Large	FW
56	NC0044725	Municipal	Laurinburg-Maxton Airport Commission	Laurinburg Industrial WWTP	Municipal, Large	FW
57	NC0085359	Municipal	Union County	Twelve Mile Creek WWTP	Municipal, Large	FW
58	NC0023965	Municipal	Cape Fear Public Utility Authority	James A. Loughlin (Northside) WWTP	Municipal, Large	SW
59	NC0023973	Municipal	Cape Fear Public Utility Authority	Southside WWTP	Municipal, Large	SW
60	NC0086819	Municipal	Brunswick County	Northeast Brunswick Regional WWTP	Municipal, Large	SW
61	NC0025348	Municipal	City of New Bern	New Bern WWTP	Municipal, Large	SW

100% Domestic WWTPs						
			(None evaluated.)			

Industrial WWTPs						
1	NC0004944	Private	Performance Fibers Operations, Inc.	Salisbury Facility	Industrial Process &	FW

#	Permit	Ownership	Owner	Facility	Type	Fresh/ Salt Water
					Commercial	
2	NC0065081	Private	C P I USA North Carolina LLC	Roxboro plant	Industrial Process & Commercial	FW
3	NC0038377	Private	Progress Energy Carolinas, Inc.	Mayo Steam Electric Power Plant	Industrial Process & Commercial	FW
4	NC0004774	Private	Duke Energy Carolinas LLC	Buck Steam Station	Industrial Process & Commercial	FW
5	NC0004618	Private	Alamac American Knits LLC	Alamac American Knit / Lumberton	Industrial Process & Commercial	FW
6	NC0005312	Private	True Textiles, Inc.	561 Main Street plant	Industrial Process & Commercial	FW
7	NC0001228	Private	Global Nuclear Fuel - Americas LLC	GNF-A Wilmington Plant	Industrial Process & Commercial	FW
8	NC0000311	Private	M-B Industries Inc	M-B Industries WWTP	Industrial Process & Commercial	FW
9	NC0001881	Private	Phillips Plating Company Inc	Phillips Plating Company	Industrial Process & Commercial	SW
10	NC0045993	Private	Allegheny Technologies, Inc.	ATI Allvac Monroe Plant	Industrial Process & Commercial	FW
11	NC0003875	Private	Elementis Chromium L P	Castle Hayne Manufacturing Facility WWTP	Industrial Process & Commercial	FW
12	NC0003719	Private	DAK Americas, LLC	Cedar Creek Site	Industrial Process & Commercial	FW
13	NC0003760	Private	E. I. DuPont de Nemours	Kinston facility	Industrial Process & Commercial	FW
14	NC0004979	Private	Duke Energy Carolinas LLC	Plant Allen Steam Station	Industrial Process & Commercial	FW
15	NC0004987	Private	Duke Energy Carolinas LLC	Marshall Steam Station	Industrial Process & Commercial	FW
16	NC0000396	Private	Progress Energy Carolinas Inc	Asheville Steam Electric Power Plant	Industrial Process & Commercial	FW
17	NC0025135	Private	Huffman Finishing, Inc.	Huffman Finishing	Industrial Process & Commercial	FW
18	NC0003344	Private	House of Raeford Farms, Inc.	Wallace Chicken Processing Facility	Industrial Process & Commercial	FW
19	NC0049743	Municipal	New Hanover County Water & Sewer District	Landfill WWTP	Municipal, < 1MGD	FW
20	NC0005258	Private	SGL Carbon LLC	SGL Carbon	Industrial Process & Commercial	FW
21	NC0004685	Private	PPG Industries Fiber Glass Products	PPG - Shelby facility	Industrial Process &	FW

#	Permit	Ownership	Owner	Facility	Type	Fresh/ Salt Water
			Inc		Commercial	
22	NC0028169	Private	BV Hedrick Gravel & Sand Company	Aquadale Quarry	Industrial Process & Commercial	FW
23	NC0071463	Private	Apex Oil Company	Apex Oil Company	Industrial Process & Commercial	FW

	Groundwater Remediation WWTPs					
1	NC0084395	Private	Terraine, Inc.	ABC One Hour Cleaners remediation site	Groundwater Remediation	SW
2	NC0085057	Private	Unocal Corporation	Orr Road remediation site	Groundwater Remediation	FW
3	NC0086002	Private	Livingstone Coating Corporation	Livingstone Coating Corporation	Groundwater Remediation	FW
4	NC0086126	Private	Alcatel USA Sourcing LP	Alcatel Network Systems	Groundwater Remediation	FW
5	NC0087858	Private	Equipment And Supply, Inc.	Union County remediation site	Groundwater Remediation	FW
6	NC0088129	State	North Carolina State University	Lot 86 remediation site	Groundwater Remediation	FW
7	NC0088226	Private	Wachovia Bank N A	Wachovia Tryon Street BTS	Groundwater Remediation	FW
8	NC0088811	Private	Pharmaceutical Product Development, Inc.	PPD remediation site	Groundwater Remediation	SW
9	NC0088919	Private	Quality Oil Company	former Coliseum Shell	Groundwater Remediation	FW
	NCG51 General Permit COCs					
1	NCG510084	Private	McCracken Oil Bulk Plant	McCracken Oil Bulk Plant	Groundwater Remediation	FW
2	NCG510418	Private	Riverview 76	Riverview 76	Groundwater Remediation	FW
3	NCG510003	Private	Blalock's Convenience Mart	Blalock's Convenience Mart	Groundwater Remediation	FW
4	NCG510046	Private	Exxon Party Pickup	Exxon Party Pickup	Groundwater Remediation	FW
5	NCG510070	Private	Dixie Grocery	Dixie Grocery	Groundwater Remediation	FW
6	NCG510251	Private	Town& Country Superette#2	Town& Country Superette#2	Groundwater Remediation	FW
7	NCG510488	Private	Grocery Mart	Grocery Mart	Groundwater Remediation	FW
8	NCG510302	Private	Sportsman Trading Post 2nd	Sportsman Trading Post 2nd	Groundwater Remediation	FW
9	NCG510492	Private	Sandy Plains Mini Mart	Sandy Plains Mini Mart	Groundwater Remediation	FW
10	NCG510515	Private	Northern Bait and Tackle	Northern Bait and Tackle	Groundwater Remediation	FW
11	NCG510523	Private	RDU Jet Fuel-HPV Release	RDU Jet Fuel-HPV Release	Groundwater Remediation	FW
12	NCG510240	Private	Davis Auto (L.M.Crawford)	Davis Auto (L.M.Crawford)	Groundwater Remediation	FW
13	NCG510350	Private	West Lexington Sav-A-Sum	West Lexington Sav-A-Sum	Groundwater Remediation	FW
14	NCG510413	Private	Bennett & Bailey	Bennett & Bailey	Groundwater Remediation	FW
15	NCG510502	Private	Moser's Grocery	Moser's Grocery	Groundwater Remediation	FW
16	NCG510522	Private	Pantry #161	Pantry #161	Groundwater Remediation	FW
17	NCG510518	Private	Climax General Store - B	Climax General Store - B	Groundwater Remediation	FW
18	NCG510384	Private	Springs Road Gas House	Springs Road Gas House	Groundwater Remediation	FW
19	NCG510340	Private	Fisher Auto	Fisher Auto	Groundwater Remediation	FW
20	NCG510462	Private	Johnny's Sav-A-Sum	Johnny's Sav-A-Sum	Groundwater Remediation	FW
21	NCG510464	Private	Bantam Mart	Bantam Mart	Groundwater Remediation	FW

#	Permit	Ownership	Owner	Facility	Type	Fresh/ Salt Water
22	NCG510268	Private	Rainbow Amoco #2	Rainbow Amoco #2	Groundwater Remediation	FW
23	NCG510481	Private	Ramsey's 66	Ramsey's 66	Groundwater Remediation	FW

	Water Treatment Plants					
1	NC0083909	Municipal	Dare County Water Department	Rodanthe/Waves/Salvo Reverse Osmosis WTP	Water Treatment Plant	SW
2	NC0085707	Municipal	Dare County Water Department	Cape Hatteras Reverse Osmosis WTP	Water Treatment Plant	SW
3	NC0027600	Municipal	Town of Creswell	Creswell WTP	Water Treatment Plant	SW
4	NC0084565	Private	Carolina Water Service, Inc. of North Carolina	The Harbour - Wells 1 & 2 WTP	Water Treatment Plant	SW
5	NC0083224	Municipal	Town of Chocowinity	Edgewood Drive WTP	Water Treatment Plant	SW
6	NC0086606	Private	Carolina Water Service, Inc. of North Carolina	The Harbour - Well #4 WTP	Water Treatment Plant	SW
7	NC0086606	Private	Carolina Water Service, Inc. of North Carolina	The Harbour - Well #4 WTP	Water Treatment Plant	SW
8	NC0086592	Private	Carolina Water Service, Inc. of North Carolina	The Point / Well 1 WTP	Water Treatment Plant	SW
9	NC0072699	Municipal	Town of Beaufort	Pine Street WTP	Water Treatment Plant	SW
10	NC0072702	Municipal	Town of Beaufort	Glenda Drive WTP	Water Treatment Plant	SW
11	NC0088323	Municipal	Pamlico County	Grantsboro WTP	Water Treatment Plant	SW
12	NC0044806	Municipal	Town of Atlantic Beach	Atlantic Beach WTP	Water Treatment Plant	SW
13	NC0077143	Private	West Carteret Water Corporation	West Carteret WTP	Water Treatment Plant	SW
14	NC0088340	Municipal	Pamlico County	Millpond WTP	Water Treatment Plant	SW
15	NC0088617	Private	Aqua North Carolina, Inc.	Snow Hill subdivision	Water Treatment Plant	FW
16	NC0032221	Private	Carolina Water Service, Inc. of North Carolina	Belvedere Well #1 & Well #2 WTP	Water Treatment Plant	SW
17	NC0044806	Municipal	Town of Atlantic Beach	Atlantic Beach WTP	Water Treatment Plant	SW
18	NC0060321	Municipal	First Craven Sanitary District	First Craven Sanitary District	Water Treatment Plant	SW
19	NC0070157	Municipal	Dare County	Dare County North Reverse Osmosis WTP	Water Treatment Plant	SW
20	NC0072699	Municipal	Town of Beaufort	Pine Street WTP	Water Treatment Plant	SW
21	NC0072702	Municipal	Town of Beaufort	Glenda Drive WTP	Water Treatment Plant	SW
22	NC0077143	Private	West Carteret Water Corporation	West Carteret WTP	Water Treatment Plant	SW
23	NC0077500	State	NC Department of Transportation	Ferry Division WTP	Water Treatment Plant	SW
24	NC0078131	Municipal	City of Havelock	Brown Blvd WTP	Water Treatment Plant	SW
25	NC0081191	Municipal	City of Washington	Washington WTP	Water Treatment Plant	SW
26	NC0082520	Municipal	Town of Pine Knoll Shores	Pine Knoll Shores WTP	Water Treatment Plant	SW
27	NC0083321	Municipal	Onslow Water And Sewer Authority	Hubert WTP	Water Treatment Plant	SW
28	NC0083551	Municipal	Onslow Water And Sewer Authority	Dixon WTP	Water Treatment Plant	SW

#	Permit	Ownership	Owner	Facility	Type	Fresh/ Salt Water
29	NC0083909	Municipal	Dare County Water Department	Rodanthe/Waves/Salvo Reverse Osmosis WTP	Water Treatment Plant	SW
30	NC0084808	Municipal	Beaufort County Water System	Richland WTP	Water Treatment Plant	SW
31	NC0085707	Municipal	Dare County Water Department	Cape Hatteras Reverse Osmosis WTP	Water Treatment Plant	SW
32	NC0086681	Municipal	Camden County	Camden County Reverse Osmosis WTP	Water Treatment Plant	SW
33	NC0086924	Municipal	Tyrrell County	Reverse Osmosis WTP	Water Treatment Plant	SW
34	NC0086975	Municipal	Carteret County	Laurel Road WTP	Water Treatment Plant	SW
35	NC0087009	Municipal	Washington County	Washington County WTP	Water Treatment Plant	SW
36	NC0087041	Municipal	Town of Chocowinity	Hill Road WTP	Water Treatment Plant	SW
37	NC0088307	Municipal	Cape Fear Public Utility Authority	New Hanover County Well Field System WTP	Water Treatment Plant	SW
38	NC0088323	Municipal	Pamlico County	Grantsboro WTP	Water Treatment Plant	SW
39	NC0088331	Municipal	Pamlico County	Kershaw WTP	Water Treatment Plant	SW
40	NC0088340	Municipal	Pamlico County	Millpond WTP	Water Treatment Plant	SW
41	NC0088358	Municipal	Pamlico County	Vandemere WTP	Water Treatment Plant	SW
42	NC0088447	Municipal	Town of Oriental	Oriental WTP	Water Treatment Plant	SW

Return to:

Chapter B. Wastewater Dischargers
B1. Summary of Findings
B2. Background: NPDES Permit and Pretreatment Programs
B3. Evaluation of Impacts: Metals Standards
(a2) Projected Regulatory Impacts – NPDES Wastewater Permits
(b) Existing Metals Requirements – NPDES Wastewater Permits

Appendix III.5: Evaluation of Municipal Wastewater Treatment Plant Permits

This appendix provides additional details of the methodology used to estimate the number of publicly owned treatment works (POTWs) that would be impacted by the proposed changes to surface water quality standards for metals.

Evaluation of POTW Permits

The Division adopted three working assumptions in an attempt to identify the POTWs most likely to be impacted. These assumptions are similar to those used by the NC League of Municipalities in a separate analysis of the proposed rule changes; the methods and findings in that analysis are discussed later in this subsection. The three working assumptions were that:

- POTWs with local pretreatment programs have the greatest contributions of industrial wastewater and so are most likely to have significant levels of metals in their wastewater;
- Larger POTWs are more likely to have metals than smaller POTWs, due to greater contributions from commercial and minor industrial facilities; and
- POTWs discharging to smaller streams, which offer less dilution (thus, a higher instream waste concentration, or IWC), are more likely to receive metals limits. To be consistent with the League's study methodology, the Division initially chose facilities with an IWC greater than 15%.

Based on these assumptions, the Division initially selected a subset of 26 POTWs for evaluation. Each POTW had a local pretreatment program, a design capacity (permitted flow) of at least 1 MGD, and an IWC greater than 15%. Within these boundaries, permits were selected to represent a variety of facilities and conditions across the state. In particular, facilities were drawn from various river basins so as to capture differences in instream hardness in mountain, piedmont, and coastal waters. The numbers and types of facilities evaluated are summarized in Table III.5-1.

Table III.5-1
Numbers of POTWs Evaluated, by Subcategory

Subcategory		Freshwater Discharges	Saltwater Discharges
Large POTWs (> 1MGD)			
IWC > 15%	With Pretreatment Program	32	3
	No Pretreatment Program	5	-
IWC < 15%	With Pretreatment Program	12	1
	No Pretreatment Program	2	-
Small POTWs (< 1 MGD)			
IWC > 15%	With Pretreatment Program	2	-
	No Pretreatment	2	-
IWC < 15%	With Pretreatment Program	1	-
	No Pretreatment Program	1	-
	Subtotals	57	4
	Total	61	

A complete list of all facilities evaluated is included in *Appendix III.4: Wastewater Discharges – List of Permits Evaluated*.

The Division collected the most recent RPAs for each of the selected facilities. If the effluent data used in an RPA were more than five years old (2006), new data were gathered from the most recent three years (2008-2011), consistent with standard RPA procedures. The Division developed a tool to calculate local standards for the hardness-dependent metals and made this available on its website.[119]

Staff gathered facility-specific hardness data, where available, from each facility's Whole Effluent Toxicity (WET) tests and permit applications. They calculated the 10th-percentile values for instream and effluent hardness using the available data. If the instream or effluent hardness data were less than 25 mg/L or greater than 400 mg/L (or 100 mg/L in Water Supply waters), numeric metals standards were calculated at those boundary concentrations.

Staff calculated the combined hardness and, with the standards equations, the *Maximum Allowable Metals (total)* for each POTW.[120] They then performed new RPAs to determine what metals limits (if any) would be required under the proposed standards.

Initial results indicated that, while the three working assumptions held true in general, a facility's capacity (permitted flow), pretreatment status, and IWC are not consistently useful in predicting impacts from the proposed metals standards. Instead, the most reliable indicator was simply the presence of metals limitations or monitoring requirements in the facility's current permit. However, the results verified that permit requirements for cadmium, lead, and nickel are the most likely to be affected under the proposed standards and result in economic impacts to wastewater dischargers. Based on these findings, subsequent efforts focused on those dischargers with existing permit requirements for cadmium, lead, and nickel and with limits for the action level metals copper, silver, or zinc.

The Division performed additional RPAs for POTWs outside the original subset in order to examine the impacts to a broader range of facilities. Eventually, staff evaluated a total of 61 POTWs (57 freshwater and 4 saltwater).

(a) POTWs Discharging to Freshwater

The Division evaluated the permits for 57 freshwater POTWs. The permits were grouped according to their existing metals requirements (see Table III.5-2). These groupings provided a useful frame of reference and were employed through the remainder of the evaluation.

[119] Available at http://portal.ncdenr.org/web/wq/swp/ps/npdes/calc/userguide.

[120] *Maximum Allowable Metals (total)* are the total recoverable values that, upon adoption of the proposed standards, will be used in Reasonable Potential Analyses wherever the existing total recoverable standards are now used.

Table III.5-2
Freshwater POTW Permits Evaluated (n=57)

Permits	Existing Requirements for Affected Metals
7	Have no requirements (limits or monitoring) for any of the affected metals
25	Have monitoring requirements only (but no limits) for one or more of the affected metals
25	Have one or more existing limits for cadmium, lead, &/or nickel or for copper, silver, &/or zinc
57	**Total**

Staff updated each permit's RPAs for the target metals using the proposed standards. The projected effluent limitations and monitoring requirements were compared with existing requirements and the differences noted. Impacts were categorized as follows:

- Continued absence of requirements for affected metals or continued 'Monitor Only' requirements – no impact
- Continued metals limits, facility shows marginal 'reasonable potential'– minor impact
- Continued metals limits, facility shows clear 'reasonable potential'– significant impact
- Metals limits deleted – less stringent requirements
- Indefinite results – need additional data to assess impacts

The Division extrapolated the impacts on these 57 POTWs to the 275 freshwater POTWs statewide. The results for both sets of permits are summarized below in Table III.5-3.

NOTE: With this extrapolation, the Division's focus shifts from permit-specific analyses to an evaluation of the generalized impacts on POTW permits in the aggregate. Thus, it does not identify which facilities might be impacted nor what specific changes might occur in the permits.

Table III.5-3
Projected Impacts Based on Subset of All Freshwater POTWs (n1 = 57, n2 = 275)

Subset	Projected Permit Impacts	All FW POTWs
7 of 7 (100%)	With no requirements for affected metals will continue to have no req'ts	125 of 125
19 of 25 (76%)	With 'Monitoring Only' for affected metals will continue to monitor only	85 of 112
5 of 25 (20%)	With 'Monitoring Only' for affected metals will be impacted (marginal RPA)	23 of 112
1 of 25 (4%)	With 'Monitoring Only' for affected metals require additional data to assess	4 of 112
6 of 25 (24%)	With existing limits for target metals will be impacted (marginal RPA)	9 of 38
12 of 25 (48%)	With existing limits for target metals will be impacted (clear RPA)	18 of 38
4 of 25 (16%)	With existing limits for target metals will revert to 'Monitor Only'	6 of 38
3 of 25 (12%)	With existing limits for target metals require additional data to assess	5 of 38
57 of 57		275 of 275

The Division assumed in this assessment that any continued limits for the target metals, as well as new limits, would be more stringent than existing requirements and so would potentially have impacts. The extrapolated results were re-arranged into the five categories of impacts:

Table III.5-4
Potential Permit Impacts to All Freshwater POTWs (n=275)

Permits	Projected Permit Impacts
210	No impact – continued 'no requirements' or 'Monitor Only'
9	Minor impact –marginal 'reasonable potential'
41	Significant impact – new or different limits, clear 'reasonable potential'
6	Less stringent – revert to 'Monitor Only'
9	Indefinite impact – need additional data
275	**Total**

The Division estimated that 56 of the 275 permits may be impacted by the proposed changes to the metals standards: 50 will potentially receive more stringent limits for cadmium, lead, &/or nickel (9 + 41) and six will receive less stringent requirements.

Design capacity is often a key factor in determining the cost of treatment plant improvements. Permitted flows are a reasonable measure of design capacity and were used for this purpose. Table III.5-5 shows the total and average permitted flows of the freshwater POTWs.

Table III.5-5
Permitted Flows – Freshwater POTWs

# Permits	Subsets	Total Flow	Average Flow
125	Continued 'No metals requirements'	226 MGD	1.81 MGD
85	Continued 'Monitoring Only'	590 MGD	6.9 MGD
56	Potentially impacted	341 MGD	6.82 MGD
9	Indefinite impact	61 MGD	6.81 MGD
275	**Total**		

The key value here is the 6.82 MGD average for the impacted POTWs. The Division assumed this to represent an 'average' freshwater POTW and used it where unit costs for compliance actions were based on design flows. The other flow values served no further purpose but are shown for comparison.

Action Level Metals – Freshwater: The 57 freshwater POTWs the Division evaluated include eight freshwater POTWs that are currently subject to limits for copper, silver, and/or zinc under the action level provisions of15A NCAC 02B .0211 and .0220. RPAs indicate that four of the eight clearly show reasonable potential to exceed one or more of these standards and, having already established toxicity in the effluent, would receive limits for them. However, the results for copper, in particular, were sensitive to differences in combined hardness, increasing the uncertainty of the results. As a result, the Division made the conservative assumption that six of the eight permits (rather than four) will maintain one or more action level limits. Of the remaining permits, one is projected to revert to 'monitor only' status, and one evaluation was inconclusive.

(b) POTWs Discharging to Saltwater

The Division followed the same general approach to evaluate four permits for POTWs discharging to saltwater. None of the four have limits for cadmium, lead, or nickel, but all monitor for one or more of these metals. The POTWs were grouped as show in Table III.5-6

Table III.5-6
Saltwater POTW Permits Evaluated (n=17)

Permits	Existing Requirements for Affected Metals
0	Have no requirements (limits or monitoring) for any of the affected metals
4	Have monitoring requirements only for one or more of the affected metals
0	Have one or more existing limits for cadmium, lead, &/or nickel (Cd, Pb, &/or Ni)
4	**Total**

The results of updated RPAs indicated that, while lead and nickel remain the metals of most concern, the proposed standards are not likely to result in changes in the metals requirements in these permits. The results were extrapolated to the 17 POTWs as follow as shown in Table III.5-7.

Table III.5-7
Potential Permit Impacts to All Saltwater POTWs (n=17)

Permits	Projected Impacts
8 of 8	(100%) With no requirements for affected metals will continue as such
9 of 9	(100%) With 'Monitoring Only' for affected metals will not change
17 of 17	

Action Level Metals – Saltwater: None of the saltwater POTWs have limits for action level metals, and none are expected to be impacted by the proposed standards.

Evaluation of Pretreatment Programs

Once their permits are renewed and their metals requirements updated, affected POTWs with pretreatment programs will have to re-evaluate their Allowable Headworks Loadings (AHLs) and their Maximum Allowable Headworks Loadings (MAHLs). Thus, new metals requirements for the POTWs may, in turn, result in new requirements for their significant industrial users (SIUs).

In evaluating the potential impacts to local pretreatment programs and their significant industrial users, the Division chose 28 freshwater POTWs and 4 saltwater POTWs from the 61evaluated to represent POTWs with pretreatment programs across the state. The impacts of the proposed metals standards to the pretreatment programs were evaluated using the water quality-based metals limits already calculated for the POTWs' assessments. Again, the evaluation focused on cadmium, lead, and nickel. The main steps in evaluating the impacts included:

- Recalculating the new Maximum Allowable Headworks Loadings (MAHLs) for cadmium, lead, and nickel at each POTW based on NPDES water quality effluent permit limits developed using the proposed water quality standards and the most recent Headworks Analysis (HWA) data available,
- Identifying potential courses of action for complying with the new MAHLs,
- Identifying impacts to Pretreatment Programs associated with the development, and implementation of the new MAHLs.

The analyses of the 28 freshwater POTWs with pretreatment programs indicated that a facility's size and Instream Wastewater Concentration (IWC) are not reliable predictors of permit impacts. The analyses showed that essentially all MAHLs and, hence, the Maximum Allowable Industrial Loadings (MAILs) for cadmium and lead would decrease in response to more stringent limits for these metals in the POTW's permit. However, MAHLs and MAILs for nickel decreased in only 40% of the POTWs due to the fact that headworks loadings for this metal are often controlled by considerations of residuals disposal, process inhibition or, in the case of Water Supply-classified waters, protection of human health.

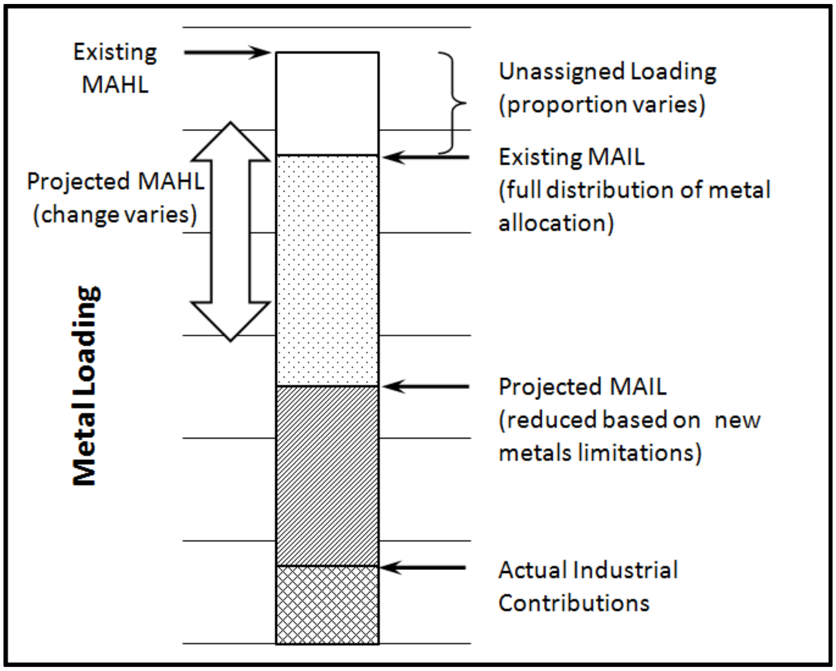
The actual uncontrollable loading and the allocated industrial loading established by each of the POTWs were compared to the newly calculated MAHLs. If the uncontrollable loading plus the allocated industrial loadings were less than the new MAHL, the Division concluded that the POTW would be in compliance with its new metals limits and not have to impose more stringent requirements on its SIUs. If the uncontrollable loading plus the allocated industrial loadings were greater than the new MAHL, the Division compared the allocated loadings to the SIUs' actual discharge loadings in the POTW's annual pretreatment report data.

The Division determined that the SIU permit reductions that would result from the POTWs' new metals limits would not require metals loadings reductions by the SIUs. A recalculation of the new MAHLs (and MAILs) for all 28 freshwater POTWs showed that 20 (71%) would not have to reduce current SIU permitted allocations for metals to comply with the revised MAIL. The remaining POTWs would have to reduce one or more SIU permitted allocations, but the reduced allocations could be at least 3 to 5 times greater than the individual SIU's actual current loads and the POTW would still comply with its revised MAIL.

Historically, pretreatment POTWs in North Carolina have often distributed a significant portion of the MAIL among their SIUs, setting metals limits for the SIUs much higher than the industries' actual discharge contributions. Not all SIUs contribute significant amounts of metals, but this approach (1) provides a margin of safety for the SIUs in meeting their local limits,(2) allows extra loadings for an industrial facility not operating at full capacity, and (3) allows additional loading necessary for a facility to expand in the future. In many cases, local limits could be reduced substantially without compromising any of these factors or requiring additional control measures by the SIU.

Figure III.5-1 illustrates the relative magnitude of actual and allowable loadings observed in many POTWs.

Figure III.5-1
Comparison of Existing and Projected MAILs with Actual Industrial Loadings Commonly Observed with Pretreatment POTWs



In evaluating pretreatment impacts, the Division revised a few of the uncontrollable loadings values originally selected for the HWA. Where those values seemed unusually restrictive, a mass-balance-based uncontrollable value was used. The alternate loading was determined by subtracting the SIUs' actual average metal loading value from the actual average influent metal loading at the POTW. Those uncontrollable loading values will be reviewed and, as necessary, revised as part of the next HWA.

HWA calculations are based on current average conditions. When 50% or more of the data are below the Practical Quantitation Limit (PQL), removal rates, inhibition values, or uncontrollable concentrations are based upon literature values rather than calculated values. In 10% of the POTWs evaluated, the revised HWA showed the MAIL plus the uncontrollable load to be less than the MAHL even though the actual POTW effluent data indicated a potential for NPDES water quality-based effluent limit violations for cadmium and/or lead. Some of these POTW's do not have SIU's discharging the affected metals, and causes of the potential effluent violations will have to be evaluated. Also, some POTWs do not currently report effluent data from laboratory results at the PQL, and the reported results are not sensitive enough to determine compliance with permit limits. It was assumed that, after conducting more suitable metals analyses, a certain number of these would receive new metals limits and take appropriate action to comply. Without additional source analysis, there is not sufficient data to conclude if the SIUs are the source of the metals. In addition, it should be noted that the Division's evaluation of NPDES permits determines reasonable potential by comparing daily maximum effluent values (individual samples) to monthly average water quality-based limits as proposed by the rules. In this light, the analysis was conservative and, recognizing this, POTWs may choose to increase metals monitoring so such daily variations do not result in a monthly violation.

The four pretreatment POTWs discharging to saltwater did not show any pretreatment program impacts at this time. The proposed saltwater standards for lead, applied in a permit and assuming 100% IWC (that is, no dilution in tidal waters), will reduce the monthly average effluent limits from 25 µg/L to 8.1 µg/L based on the proposed chronic standard and result in a 210 µg/L daily maximum limit based on the proposed acute standard. Currently, one of the four POTWs is showing that it will be able to comply with its new lead limit, and the other three facilities are consistently discharging less than 10 µg/L. This level of quantitation demonstrates compliance with current water quality standards. However, these facilities will have to report the results of their metals analyses nearer to the Practical Quantitation Limit (PQL) for lead (~ 2 µg/L) in order to assess compliance with permit limits based on the proposed standards.

The Division evaluated the potential impacts of the proposed metals standards on these POTWs' significant industrial users and found none.

Twenty-five of the 28 freshwater POTWs reported total chromium effluent results at <5 or <10 µg/L, indicating that none of these samples would exceed the minimum proposed limits for chromium III or chromium VI (180 µg/L and 11 µg/L, respectively, based on the chronic standard and assuming allowing for zero dilution). The other three POTWs reported maximum total chrome effluent values of 11, 15, and 22 µg/L. In two of these cases, the maximum observed values were less than the estimated daily maximum and monthly average limitations for chromium III or VI as determined under the proposed rules using the combined hardness for each POTW and its receiving stream. In the remaining POTW, the maximum observed value was less than the estimated daily maximum limit, but more than the monthly average limit for the chromium VI proposed standards. For POTWs showing total chromium effluent data exceeding the more stringent proposed chromium VI limits the POTW would be required to have analysis performed to differentiate the species of chromium and demonstrate compliance with the individual limits using the best available methodologies, consistent with EPA regulations (40 CFR Part 136). Given that not enough data exists to determine the size of the impact, the effect of the chromium rule change was not analyzed further.

Until recently, decreases in the MAHLs for some metals could have meant that many more facilities would be classified as significant industrial users. The previous definition of the term included any industrial user contributing 5% or more of *any* pollutant of concern, and more industrial users could have exceeded the threshold as the revised standards lead to reductions in metals MAHLs. North Carolina revised its pretreatment rules in 2011, in part to make them more consistent with the federal rules. As a result, the SIU definition has been revised so that the '5% of total loading' threshold for SIU designation no longer applies to metals but to organic loadings only.

The contribution from these non-SIU facilities is accounted for in the uncontrollable portion of the influent wastestreams. Fourteen percent (14%) of the POTWs have uncontrollable contributions accounting for more than 50% of the allowable influent loading for at least one of the target metals. POTWs investigating source controls may look at these facilities to determine if their contribution is significant enough to require SIU designation or some other form of local controls. If each of these POTWs found one additional SIU, it would represent only a 2% increase in the number of industrial users classified as SIUs across the state.

Combined Results – Municipal WWTPs

The results from evaluation of the 61 POTWs were extrapolated to estimate impacts to the full set of municipal permits. Figure III.5-2 summarizes the projected regulatory (permit) impacts of the proposed metals standards to the state's POTWs.

Fifty facilities are expected to receive WQBELs for metals under the proposed standards. The results for nine facilities were indefinite. Six POTWs will likely revert to monitoring only, and the remaining 210 plants are not expected to be impacted.

Figure III.5-2
Projected Permit Impacts, Metals Standards Municipal WWTPs

Subcategory	Permits	Evaluated
Freshwater	275	57
Saltwater	17	4
Totals	*292*	*61*

Count	Projected Impacts	Projected # Permits		
		More Stringent	Less Stringent	No Impact
23 of 57	New or Cont'd WQBELs *	50		
4 of 57	Revert to 'Mon. Only'		6	
26 of 57	Cont'd 'Mon. Only' or 'No Req'ts'			210
4 of 57	Indefinite - need added data	9		
4 of 4	Cont'd 'Mon. Only' or 'No Req'ts'			17
61 of 61	*Subtotals*	*59*	*6*	*227*
			Total	*292*

Based on its analyses of the 32 pretreatment POTWs, the Division does not anticipate that the proposed metals standards will result in additional costs to municipal WWTPs and their pretreatment programs beyond those already identified; nor does it anticipate impacts to their SIUs.

Return to:

Chapter B. Wastewater Dischargers
B1. Summary of Findings
B2. Background: NPDES Permit and Pretreatment Programs
B3. Evaluation of Impacts: Metals Standards
(a2) Projected Regulatory Impacts – NPDES Wastewater Permits
(b) Existing Metals Requirements – NPDES Wastewater Permits
(h1) Wastewater Dischargers – Municipal WWTPs

Appendix III.6: Evaluation of Industrial Wastewater Treatment Plant Permits

This appendix provides additional details of the methodology used to estimate the number of industrial dischargers that would be impacted by the proposed changes to surface water quality standards for metals.

Evaluation of Industrial Permits

The Division focused its evaluation of industrial dischargers on the 85 permits that currently contain limitations or monitoring requirements for one or more of the affected metals. The Division evaluated a subset of these permits and then extrapolated the results to determine the number of permits that may be affected by the proposed changes. This appendix presents the methodology employed.

Most of the permits likely to be impacted fall into one of four industrial groups, which account for 53 of the 85 industrial permits with requirements for the affected metals.

- Metals forming or finishing: 5 facilities with cadmium, lead, and/or nickel requirements,
- Steam electric power generation (excluding hydropower and nuclear power): 24,
- Chemicals manufacturing: 13, and
- Textiles manufacturing: 11.

The Division also added to the evaluation other facilities of various types with requirements for these metals. A complete list of all facilities evaluated is included in *Appendix III.4: Wastewater Discharges – List of Permits Evaluated*.

Results by Subcategory

<u>(a) Metals Forming/ Finishing – 5 facilities</u>

Each of the five facilities already subject to cadmium, lead, and/or nickel requirements has technology-based effluent limitations (TBELs) in its permit for at least four of the affected metals. Three permits have TBELs only, for cadmium, lead, and/or nickel, and two have WQBELs for lead (daily maximum) and TBELs for other metals.

The Division evaluated four of the five facilities. The results indicate that the two facilities with WQBELs for lead will likely receive revised WQBELs if the proposed standards are adopted. One facility with TBELs only (which has an IWC > 50%) will receive one or more new WQBELs based upon the proposed metals standards. The other facility with TBELs only (which has an IWC <1%) will continue to receive TBELs only. The Division screened the fifth facility but did not conduct a new RPA; this facility has TBELs only and an IWC <1%, so the Division assumes it will also continue to receive TBELs only.

All of the potentially affected facilities are privately owned.

Projected permit impacts are as follows:

Table III.6-1
Potential Impacts to Metals Forming/Finishing Facilities

Item	#	Impact
Number of facilities in group:	5	
Existing Cd, Pb, &/or Ni requirements:	2 3	with WQBELs & TBELs with TBELs only
Subset evaluated:	4	of 5
Results of evaluations:	2 1 1	with WQBELs – continued WQBELs with TBELs – new WQBELs with TBELs – continued TBELs
Projected impacts to full group:	2 1 2	with WQBELs – continued WQBELs for target metals with TBELs – new WQBELs for target metals with TBELs – continued TBELs
In summary:	3 of 5 2 of 5	New or Revised WQBELs (60%) No Impact (40%)

(b) Steam Electric – 24 facilities

Of the 24 current permits for steam electric facilities with affected metals requirements, seven include TBELs for total chromium, 13 for iron, and 14 for copper. These are the only metals regulated by US EPA's Effluent Guidelines for this industry. Two of 24 current permits include WQBELs for cadmium, lead, and/or nickel. The Division evaluated a subset of six facilities: the two with existing WQBELs for cadmium, lead, and/or nickel and four others with lesser metals requirements.

The Division estimates that the most likely impact to the steam electric group will be lower WQBELs for the two facilities with existing WQBELs for total recoverable cadmium, lead, and/or nickel.

Since the beginning of the Division's evaluation, one of the two facilities has committed to spending more than $100 million to eliminate the discharge from its flue gas desulfurization scrubber system; therefore, it will not be impacted by the proposed standards. For the purposes of this fiscal note, the Division assumes that the other facility will install chemical precipitation and clarification to comply with new metals limits.

Both of the potentially affected facilities are privately owned. Most facilities' permits in the steam electric category include iron requirements as well; since these are based on federal Effluent Guidelines, the Division assumes the requirements will remain in place despite the proposed deletion of the iron standard.

Projected permit impacts are as follows:

Table III.6-2
Potential Impacts to Steam Electric Facilities

Item	#	Impact
Number of facilities in group:	24	
Existing Cd, Pb, &/or Ni requirements:	2 6 16	with WQBELs with Monitoring Only with no requirements
Subset evaluated:	6	of 24
Results of evaluations:	1 3 2	with WQBELs – continued WQBELs with Monitoring Only – continued Monitoring Only with no requirements – continued 'no requirements'
Projected impacts to full group:	1 7 16	with WQBELs – continued WQBELs with Monitoring Only – continued Monitoring Only with no requirements – continued 'no requirements'
In summary:	1 of 24 23 of 24	New or Revised WQBELs (4%) No Impact (96%)

(c) Chemicals Manufacturing – 13 facilities

Of the 13 current permits for chemicals manufacturing facilities with affected metals requirements, four contain TBELs for lead and total chromium, three for nickel, copper, and zinc, and one for silver. One has a WQBEL for copper based on the National Recommended Acute Water Quality Criterion. The Division evaluated a subset of four facilities.

The Division estimates that none of the chemicals manufacturing facilities is likely to receive more stringent metals limitations upon adoption of the proposed standards. One facility is likely to switch to 'monitoring only' status; this would result in minor savings as the result of reduced monitoring frequencies for non-limited metals.

All of the potentially affected facilities are privately owned. Projected permit impacts are as follows:

Table III.6-3
Potential Impacts to Chemicals Manufacturing Facilities

Item	#	Impact
Number of facilities in group:	13	
Existing Cd, Pb, &/or Ni requirements:	1 4 8	with WQBELs with TBELs with no requirements (including 2 inactive)
Subset evaluated:	4	of 13
Results of evaluations:	1 2 1	with WQBELs – dropped WQBELs, continue monitoring with TBELs – continued TBELs with no requirements – continued 'no requirements'
Projected impacts to full group:	1 4 8	with WQBELs – dropped WQBELs, continue monitoring with TBELs – assume all continue with TBELs with no requirements or inactive – assume no change
In summary:	1 of 13 12 of 13	Revert to Monitoring Only (8%) No Impact (92%)

(d) Textiles Manufacturing – 11 facilities

The Division estimates that none of these permits is likely to receive more stringent metals limitations under the proposed standards revisions. The evaluation did not address chromium, which is commonly associated with textile facilities. As noted earlier, the necessary data for the chromium III or chromium VI species of the metal are not available.

All of the potentially affected facilities are privately owned. Projected permit impacts are as follows:

Table III.6-4
Potential Impacts to Textile Manufacturing Facilities

Item	#	Impact
Number of facilities in group:	11	
Existing Cd, Pb, &/or Ni requirements	1 1 9	with WQBELs with Monitoring Only with no requirements
Subset evaluated:	3	of 11
Results of evaluations:	1 1 1	with WQBELs – dropped WQBELs, continue monitoring with Monitoring Only – continued Monitoring Only with no requirements – continued ‘no requirements’
Projected impacts to full group:	1 1 9	with WQBELs – dropped WQBELs, continue monitoring with Monitoring Only – continued Monitoring Only with no requirements – continued ‘no requirements’
In summary:	1 of 11 10 of 11	Revert to Monitoring Only (9%) No Impact (91%)

(e) Other Facilities with Cadmium, Lead, and/or Nickel Requirements – 12 facilities

Of the 12 remaining facilities with requirements for cadmium, lead, and/or nickel that do not fall in the four categories above, two have WQBELs of interest. The Division evaluated six facilities and extrapolated its findings to the other six.

The Division estimates that two of the 13 permits will receive one or more WQBELs for target metals, two will drop WQBELs and revert to monitoring only, and the other nine will not be impacted by the proposed metals standards.

Table III.6-5
Potential Impacts to Other Facilities with Cadmium, Lead, and/or Nickel Requirements

Item	#	Impact
Number of facilities in group:	12	
Existing Cd, Pb, &/or Ni requirements:	2 10	with WQBELs with Monitoring Only
Subset evaluated	6	of 12
Results of evaluations:	4 1 1	with Monitoring Only – continued Monitoring Only* with WQBELs – continued WQBELs with Monitoring Only – new WQBELs
Projected impacts to full group:	2 2 8	with WQBELs – continued WQBELs with Monitoring Only – new WQBELs with Monitoring Only – continued Monitoring Only
In summary:	2 of 12	New or Revised WQBELs (15%)

	10 of 12	No Impact (85%)

* Two of these five facilities had WQBELs in July 2011 that have since been dropped due to changes at the facilities.

(f) Other Facilities with No Cadmium, Lead, and/or Nickel Requirements – 20 facilities

There are 20 industrial permits that do not fall in any of the four categories based on type of business and contain no requirements for cadmium, lead, or nickel, but only monitoring requirements for other affected metals. Since these other metals have not been identified as parameters of concern at these facilities, which would warrant monitoring at the least, the Division assumes that none of these permits is likely to be impacted by the proposed metals standards.

Combined Results – Industrial Dischargers

The combined results of the evaluations (see Figure III.B-12) indicate that six of the 85 industrial facilities of interest will likely receive new or continued WQBELS as a result of the proposed metals standards. Two of the 85 are expected to revert to 'Monitoring Only' requirements, which would result in savings, and the remaining 57 facilities are not expected to be impacted. Together with the 140 facilities without affected metals requirement and 20 facilities with affected metal requirements that were screened, 217 facilities are estimated not impacted by the proposed rule change.

Figure III.6-1
Projected Permit Impacts, Metals Standards Industrial WWTPs

Subcategory	Permits	Evaluated
Metals Forming/Finishing	5	4
Steam Electric	24	6
Chemicals Mfg.	13	4
Textiles Mfg.	11	3
Others w/ Cd, Pb, Ni Req'ts	12	6
Others w/ No Cd, Pb, Ni Req'ts	20	(screened)
Others w/ No Aff. Metals Req'ts	140	(screened)
Totals	*225*	*23*

Subsets of Evaluated	Projected Impacts	Projected # Permits: More Stringent	Projected # Permits: Less Stringent	Projected # Permits: No Impact
3 of 4	New or continued WQBELs	3		
1 of 4	Continued TBELs			2
1 of 6	Continue WQBELs	1		
5 of 6	Cont. 'Mon. Only' or 'No Req'ts'			23
1 of 4	Revert to 'Mon. Only'		1	
3 of 4	No more stringent			12
1 of 3	Revert to 'Mon. Only'		1	
2 of 3	Cont. 'Mon. Only' or 'No Req'ts'			10
1 of 6	New or Cont'd WQBELs	2		
5 of 6	Continued 'Mon. Only'			10
(screened)	Continued 'No Req'ts'			20
(screened)	Continued 'No Req'ts'			140
23 of 23	*Subtotals*	*6*	*2*	*217*
			Total	*225*

Return to:

Chapter B. Wastewater Dischargers
B1. Summary of Findings
B2. Background: NPDES Permit and Pretreatment Programs
B3. Evaluation of Impacts: Metals Standards
(a2) Projected Regulatory Impacts – NPDES Wastewater Permits
(b) Existing Metals Requirements – NPDES Wastewater Permits
(h3) Wastewater Dischargers – Industrial WWTPs

Appendix III.7: Evaluation of Groundwater Remediation Permits

This appendix provides additional details of the methodology used to estimate the number of groundwater remediation dischargers that would be impacted by the proposed changes to surface water quality standards for metals.

Evaluation of Groundwater Remediation Permits

The groundwater remediation facilities of interest in this fiscal note are those that pump and treat groundwater as part of a contaminated-site cleanup. Depending on the circumstances, these facilities can be subject to either an individual permit or a Certificate of Coverage under general permit NCG51. A complete list of all facilities evaluated is included in *Appendix III.4: Wastewater Discharges – List of Permits Evaluated*.

(a) Individual Permits:

Ten of the 38 facilities with individual NPDES permits have requirements for one or more of the target metals (cadmium, lead, nickel). The Division assumed these facilities would be the most likely to be impacted by the proposed standards and, to the extent that effluent data were available, evaluated all ten for the target metals.

The RPAs indicate that seven facilities will not be impacted, two facilities with monitoring only currently will receive new WQBELs for lead, and one facility with a WQBEL for nickel would receive a very slightly more stringent limit under the proposed standards (see Table III.7-1). Technology used to meet revised nickel limits based on the proposed nickel standard would be the same as that used under the current standard; therefore, the Division does not expect this one facility to be significantly impacted by the proposed standards.

One of the potentially impacted facilities is state-owned, and the other two are privately-owned.

Table III.7-1
Impacts to Groundwater Remediation Facilities – Individual Permits

Item	#	Impact
Number of facilities:	38	
Existing Cd, Pb, &/or Ni reqmt's: No Cd, Pb, &/or Ni requirements	10 28	(all are WQBELs, no TBELs)
Subset evaluated:	10	of 38
Projected impacts:	1 1 2 2 4	with WQBELs for Cd, Pb, &/or Ni – continued WQBELs with WQBELs for Cd, Pb, &/or Ni – monitor only with WQBELs for Cd, Pb, &/or Ni – cease monitoring with Cd, Pb, &/or Ni monitoring – new WQBELs with Cd, Pb, &/or Ni monitoring – cease monitoring
In summary:	3 of 38 7 of 38 28 of 38	New or Revised WQBELs (8%) Revert to Monitoring Only or No Metals Reqmt's (18%) No impact (74%)

(b) General Permit NCG51.

To assist the Division of Water Resources with its evaluation, the Division of Waste Management reviewed a subset of 23 of the 86 active facilities subject to the NCG51 general permit. DWM provided available data collected from varying locations at these sites, including recovery wells, monitoring wells, and treatment system influent and effluent. For the purposes of this fiscal note, data from recovery wells, monitoring wells and treatment system influent are referred to as “non-effluent” data.

The Division expects to modify the general permit after adoption of the proposed metals standards in order to include lead limitations based on the revised freshwater and saltwater standards. The lead limitation for dischargers to freshwater would be 3 μg/L, assuming worst-case conditions: no dilution in the receiving stream (IWC = 100%) and a minimum hardness value of 25 mg/L. The limit for discharges to saltwater would be 8.1 μg/L, again assuming no dilution (the saltwater standard is not hardness-dependent).

The Division evaluated the 13 facilities subject to COCs and whose effluent contains lead. The projected limit is calculated to ensure compliance with applicable lead standards in any surface water of the state, just as the existing limit protects the current lead standard. The available lead, flow, and effluent hardness data were not sufficient to determine an individual MAEC for each of these facilities. Instead, the Division compared the available lead data from the thirteen facilities to the proposed total recoverable lead limitation of 3 μg/L. The comparisons indicated varying degrees of impacts on the facilities. Table III.7-2 first shows the numbers of facilities and the various impacts projected for these facilities and then shows those results extrapolated from the 23 facilities originally selected to the full set of 86 facilities.

Table III.7-2
Extrapolation of Potential Impacts to Groundwater Remediation Facilities – General Permit NCG51

Sites Evaluated	Degree of Impact	Extrapolated to 86 COCs
10 (43% of 23)	No impact – no metals identified in effluent	40
1 (4%)	No impact – based on effluent data	
2 (9%)	Potential impact, effluent < 5 μg/L, proposed limitation = 3 μg/L total recoverable lead	8
8 (35%)	Potential impact, lead >3 μg/L at non-effluent sampling locations	30 (Assume 20 impacted, 10 not impacted)
2 (9%)	Impact, effluent lead > proposed limitation	8
23 (100%)	**< Totals >**	86

For facilities subject to the NCG51 permit, ‘Impacted’ facilities are those whose effluent was found to contain lead at total recoverable concentrations greater than the projected lead limitation of 3 μg/L. ‘Potentially impacted’ facilities are (1) those whose effluent contains lead at concentrations less than 5 μg/L and (2) those that had no effluent lead data but had found lead greater than 3 μg/L in non-effluent waters at the remediation site. For the purposes of this fiscal note, the Division conservatively assumed that all sites reporting results of ‘less than 5 μg/L’ would exceed the projected 3 μg/L permit limit for lead and that two thirds of those with non-effluent lead samples greater than 3 μg/L would be impacted by new WQBELs. The Division also assumed that those facilities whose data show significant concentrations of lead only in non-effluent samples will continue to conscientiously operate their existing treatment systems and will not require effluent limitations for lead.

One of the potentially impacted facilities is state-owned, one is federally owned, and the rest are privately owned.

Combined Results – Groundwater Remediation Dischargers

Table III.7-3 summarizes the projected impacts to all groundwater remediation facilities.

Table III.7-3
Potential Impacts to Groundwater Remediation Facilities

Permits/ COCs			Potential Impacts
Individual	**NCG51**	**Total**	
3	36	39	New or Revised WQBELs
7	0	7	Revert to Monitoring Only
28	50	78	No Impact
38	86	124	**Totals**

The Division estimates that ten facilities with individual permits and 36 facilities subject to the NCG51 general permit will be impacted by new permit requirements for metals. Of these, it is estimated that 39 facilities would be subject to more stringent requirements and seven would receive less stringent permit requirements. The remaining 78 facilities are not expected to be impacted.

Return to:

Chapter B. Wastewater Dischargers
B1. Summary of Findings
B2. Background: NPDES Permit and Pretreatment Programs
B3. Evaluation of Impacts: Metals Standards
(a2) Projected Regulatory Impacts – NPDES Wastewater Permits
(b) Existing Metals Requirements – NPDES Wastewater Permits
(h4) Wastewater Dischargers – Groundwater Remediation Facilities

Appendix III.8: Evaluation of Water Treatment Plant Permits

This appendix provides additional details of the methodology used to estimate the number of water treatment plant dischargers that would be impacted by the proposed changes to surface water quality standards for metals.

Evaluation of Water Treatment Plant (WTP) Permits

Forty-two WTPs – 15 discharging to freshwater and 27 discharging to saltwater – currently have monitoring requirements (37 plants) or limitations (5 plants) for cadmium, lead, and/or nickel, indicating that these metals are already parameters of concern. The Division assumed that these 42 WTPs would be the most likely to receive metals requirements in the future. A complete list of all facilities evaluated is included in *Appendix III.4: Wastewater Discharges – List of Permits Evaluated*.

(a) WTPs – Potable Water Sources and Purification Processes

Water Treatment Plants can utilize any of several processes to purify raw water for consumption. Different processes generate different types of wastewater with different characteristics; for example, filter backwash from conventional and green-sand systems, regeneration waters from ion exchange systems, or reject waters from reverse osmosis systems. Wastewaters can include significant concentrations of metals. The characteristics of each type of wastewater also vary from plant to plant, depending primarily on the characteristics of the raw water source. For permitting purposes, four types of water purification systems have been identified as having specific wastewater characteristics.

Conventional systems mix the raw water with a coagulant (typically, aluminum sulfate) to generate a floc that, upon settling, captures particulate materials, including metals to an extent. The clear supernatant from the settling tanks is routed to sand filters to remove additional solids and treated further prior to distribution to the community. Settled solids are withdrawn from the bottom of the settling tanks, and backwash waters from periodic cleaning of the sand filters are collected. The settled solids and backwash waters require further treatment prior to discharge. Metals of concern at conventional water treatment plants can include aluminum, copper, iron, manganese, and zinc.

Ion exchange systems use specially treated synthetic resins to selectively remove certain ions from water and thereby reduce the hardness of the water. (Hard water can result in mineral build-up in plumbing and water heater elements, lessen the effectiveness of certain cleaning agents (soap), and leave a metallic residue when it dries.) Water is passed through a bed of treated resin, where calcium, magnesium, and other cations in the water adsorb to the resin and displace sodium ions. The resin must be treated periodically with a concentrated solution of sodium chloride to regenerate the sorption sites. The regeneration process produces a concentrated wastewater carrying the cations, chlorides, and any metals captured by the resin. Metals of concern at ion exchange water treatment plants can include copper, lead, iron, manganese, and zinc.

Membrane and reverse osmosis systems are effective in removing contaminants found in surface, well, and briny waters. Membranes utilize micro-, ultra-, or nano-filtration to remove particles as small as 1.0 to 0.001 microns, respectively. The membranes must be routinely backwashed to clear them of the captured materials, and this concentrate is treated prior to discharge. Membranes do not remove salts like a reverse osmosis system. Reverse osmosis utilizes pressure to force water across an even finer membrane. Ions (e.g., Na+, Ca2+, Cl-) or larger molecules (e.g., glucose, urea, bacteria) remain behind while water passes through the membrane. The ions and molecules can be highly concentrated, and the resulting wastewaters can contain significant concentrations of metals. Metals of concern at membrane and reverse osmosis water treatment plants include arsenic, copper, iron, and zinc. The membrane and reverse osmosis units generally produce wastewaters with pollutants in the highest concentrations; however, this can vary depending on the level of contaminants in the source waters.

Greensand filters use specifically treated sand that easily bonds with iron and/or manganese. Filters are backwashed periodically to clean the greensand, and the resulting wastewaters contain the filtered materials. Metals of concern at greensand water treatment plants include iron, manganese, and zinc.

(b) Water Treatment Plants Discharging to Freshwater

The Division determined that three of the 15 WTPs discharging to freshwater have consistently exceeded an MAEC of 3 µg/L (assuming a combined hardness value of 25 mg/L) based on the proposed lead standard. These WTPs are ion exchange plants, and all discharge to zero low-flow streams (Instream Wastewater Concentration = 100%); thus, their effluent limitations for lead would also be 3 µg/L. To better assess the impacts on these facilities, the Division asked the facilities to measure actual effluent hardness. The operators reported the following results:

Plant 1: 400 mg/L, 179 mg/L, 499 mg/L, 242 mg/L, 277 mg/L, 611 mg/L, 590 mg/L
Plant 2: 187 mg/L, 170 mg/L, 340 mg/L, 204 mg/L
Plant 3: 200 mg/L, 160 mg/L, and 180 mg/L

To be conservative, the Division used the lowest of these values (160 mg/L) to calculate the *maximum allowable effluent concentration* (MAEC) for each WTP as described in the section B3. Evaluation of Impacts: Metals Standards (15A NCAC 02B .0211 & .0220) and Design Flows (02B .0206). Because all three plants have an IWC of 100%, the combined hardness value was the same as the effluent hardness, or 160 mg/L. The projected MAEC based on the proposed chronic standard was calculated to be 22.7 µg/L for the three facilities.

The Division performed a reasonable potential analysis for lead at each facility. The projected permit impacts are presented in Table III.8-1 below. One of the three discharges showed reasonable potential to exceed its estimated MAEC of 22.7 µg/L and would receive a new lead limit equal to that value. However, none of its effluent data exceeded the MAEC, so it is likely to be impacted only marginally by its lead limit. The other two did not exhibit reasonable potential and so would not receive a lead limit; however, their *maximum predicted effluent concentrations (MPEC)* were sufficient that they would be required to continue monitoring for lead.

(c) Water Treatment Plants Discharging to Saltwater

Twenty-seven WTPs that discharge to saltwater have monitoring requirements or limitations for cadmium, lead, and/or nickel in their NPDES permits. Of these, 21 have ion exchange systems, and the other six have membrane treatment systems. As with WTPs discharging to freshwater, lead appears to be the metal of most concern in these facilities.

Effluent data for these facilities were not sufficient to conduct RPAs (Reasonable Potential Analyses). Instead, the Division compared the available effluent data to the estimated MAEC and drew conclusions of potential impacts from those results.

Table III.8-1
Projected Permit Impacts, Metals Standards Three WTPs Discharging to Freshwater

	Effluent Pb Concentrations (µg/L)		Proposed Pb Limits (µg/L)[1]		Potential Impact
	Average	Maximum	Chronic	Acute	
Plant 1	5	15	22.7	584	No impact – continued monitoring
Plant 2	4	21	22.7	584	More stringent - limits required
Plant 3	3	7	22.7	584	No impact – continued monitoring

[1] Calculated using effluent hardness value of 160 mg/L.

The proposed chronic saltwater standard for lead is 8.1 µg/L (dissolved). An IWC of 100% generally applies to discharges to saltwater (unless modeling shows otherwise), so dilution is not used to calculate the maximum allowable effluent concentration. Saltwater standards are not hardness-dependent, so hardness does not affect this value. For the purposes of this evaluation, the Division assumed a translator of 1.0. Thus, the estimated MAEC for lead is also 8.1 µg/L (total recoverable).

Comparison of the effluent data and MAEC for these 27 WTPs resulted in these findings:

- Eight of the 27 WTPs did not have effluent data for lead, because they do not currently discharge to surface waters (under construction, not active, etc.). The Division could not determine whether these facilities would be impacted by the proposed standards.
- Four of the 27 consistently report effluent lead concentrations below the estimated MAEC of 8.1 µg/L and mostly less than a PQL of 5 µg/L.
- Eight of the 27 consistently report effluent lead concentrations less than PQLs. Because each facility reported using a mix of PQLs (3, 5, or 10 µg/L), the Division could not determine whether these facilities would consistently meet the projected MAEC. Improved sampling clean techniques and/or more consistent reporting of analytical results to the expected PQLs will be necessary to assess the actual impact.
- Seven of the 27 facilities exceeded the projected MAEC for lead on one or two occasions but not consistently. Several of the exceedances reported by these seven facilities appeared to be ‘outlier’ values but were retained, to be conservative. Given the limited amount of effluent data, the Division reviewed the NPDES permit files and actual discharge locations for these seven in order to assess the possible impacts of the standards. These are explained in greater below.

Two of the seven facilities with occasional exceedances of the MAEC already have effluent diffusers. One was installed after the facility’s permit was last renewed, and effluent limitations in the facility’s permit do not yet reflect the change. This diffuser is designed to effectively reduce the IWC to 13%. A review of effluent data shows that, if the diffuser’s performance were considered in the RPA, the facility would not exhibit reasonable potential to exceed the proposed lead standard nor require improvements in order to comply with a new lead limit based on the proposed standard. This facility’s permit will be updated at the next renewal, and no impact is expected to result from adoption of the proposed standards.

The second WTP has installed a diffuser but does not know how much dilution it provides. This facility, too, will most likely not exhibit reasonable potential once the diffuser is taken into account. While plant improvements to conform to the proposed standards do not appear necessary, the discharger will have to perform a study to determine the amount of dilution provided by its diffuser.

The other five of the seven facilities do not have sufficient effluent data to determine potential impacts. It is possible that these five WTPs could comply with projected lead limits by implementing clean sampling techniques, reporting to accepted PQLs, and/or making changes in plants operations without having to install treatment for lead removal. The projected permit impacts are presented in Table III.8-1 below.

Table III.8-2
Extrapolation of Potential Impacts to WTPs

WTPs Evaluated		Degree of Impact	Totals
Discharge to Freshwater	Discharge to Saltwater		
1	-	Impact, effluent lead > proposed limitation	1
-	7	Potential impact, occasional exceedance of projected lead limits	Assume 5 mixed impacts, 1 w/ existing diffuser, 1 outfall study
-	8	Potential impact, inconclusive based on limited or ambiguous data	Assume 4 mixed impacts, 4 no impact
2	-	No impact – based on RPA	2
12	12	No impact – based on effluent data or lack of data	24
160	19	Screened out - Cd, Pb, Ni are not metals of concern	179
175	46	**< Totals >**	221

Combined Results – Water Treatment Plants Dischargers

The interim results of the freshwater and saltwater evaluations are re-arranged in Table III.8-3, below. The Division estimates that 11 WTPs will be impacted by new or continued metals limits or will likely take other action as the result of the revised metals standards. The remaining 210 facilities are not expected to be impacted.

Table III.8-3
Summary of Potential Impacts to WTPs

Discharge to Freshwater	Discharge to Saltwater	Totals	Projected Impacts
1	10	11	New or Continued WQBELs, or action required
-	-	-	Revert to Monitoring Only
14	17	31	No impact based on review of effluent data
160	19	179	No impact - Cd, Pb, Ni are not metals of concern
175	46	221	Totals

Return to:

Chapter B. Wastewater Dischargers
B1. Summary of Findings
B2. Background: NPDES Permit and Pretreatment Programs
B3. Evaluation of Impacts: Metals Standards
(a2) Projected Regulatory Impacts – NPDES Wastewater Permits
(b) Existing Metals Requirements – NPDES Wastewater Permits
(h4) Wastewater Dischargers – Groundwater Remediation Facilities

Appendix III.9: Wastewater Discharges – Cost Information

Unit Costs and Cost Equations

Cost estimates of metals controls for wastewater dischargers are based on a variety of sources as well as assumptions made by the Division of Water Resources. The following is a summary of these sources, organized primarily by the wastewater category to which they are applied.

Annual operating costs were adjusted to 2014 values in the course of the calculations by applying the assumed inflation rate of 2% per annum, which yields slightly higher costs than by applying the CCIs. Capital costs were adjusted by applying the Engineering News Record's Construction Cost Index (CCI)[121] for the appropriate year, as follows:

Year	CCI
1989	4406
2000	6225
2006	7721
2010	8858
2012	9176
2014	9796

Net present values were calculated using a discount rate of 7% as prescribed in North Carolina statutes, and the inflation rate of 2% recommended by the OSBM.[122]

Some costs for municipal WWTPs employ the designated average flow per facility of 6.82MGD.

General

Clean-Sampling Improvements:

Capital Cost = $3,500 — New sampler and related equipment; derived from cost estimates developed by Town of Cary, letter to Connie Brower, 9/7/2010, p. 6 of 8: $10,335 initial setup costs and training for 3 POTWs (combined permitted capacity of 48 MGD) = $3,445/WWTP; use $3,500/WWTP.

Annual Costs = $7,000 — Derived from same Town of Cary estimates: $20,864/year for the 3 POTWs, assuming monthly sampling = $6,955/year per WWTP; use $7,000/year.

Effluent Monitoring (Metals):

Annual Costs (add new limit) = $120/year per WWTP

Annual Costs (revert to Mon. Only) = $120/year per WWTP

Assume affected permits add or delete monitoring requirements for a single metal limit: Under current schedule, effluent monitoring frequency is 1/month (12/year) for metals with limits and 1/quarter (4/year) for those with

[121] Engineering News-Record. Economics. Current Costs. Construction Costs. http://enr.construction.com/economics/
[122] NCGS § 150B-2(8c) [SL2011-398] and 150B-21.4(b1) [SL2011-13], regarding cost estimates for fiscal notes.

monitoring only. This equates to an increase or decrease of 8 samples per year per facility as new metals limits are added or permit reverts to 'Monitor Only'.
Allow $15/ sample for cost of metals analysis (average <$15/sample) and minor differences in sample processing time. 8 samples/year x $15/sample = $120/year per WWTP that is reverting to 'Monitor Only' status.

Municipal WWTPs

Source Identification:

Initial Cost = $25,000 (Low) — For small POTWs, $15K for sampling survey + $10K for public outreach or other related efforts. For large or pretreatment POTWs, $25K sampling + minimal opportunity costs to municipal programs. Assumes total cost of staff or contractor time is $100/hr.

Initial Cost = $37,500 (Medium) — Assumed 150% of Low estimate.

Initial Cost = $50,000 (High) — Assumed 200% of Low estimate.

Evaluate Compliance/ Treatment Options:

Initial Assessment = $25,000+ — For evaluation of potential compliance alternatives. Additional $10,000 for each evaluation of more advanced treatment options (e.g., PAX + existing clarification, PAX + new clarification, etc.)

Conventional Chemical Precipitation (alum or ferric chloride) with Existing Secondary Clarification:

Capital Cost = $15,172 Q_{design} +$144,828 = $248,300 @ 6.82 MGD. Derived from *Nutrient Reduction Technology Cost Estimations for Point Sources in the Chesapeake Bay Watershed*, Chesapeake Bay Program, Nutrient Reduction Technology (NRT) Task Force, 2002. (2000 $)

Operations Costs = $979.46 Q_{design} + $7515.6 = $14,200/yr @ 6.82 MGD. For 1.5 < Q ≤ 10 MGD. (2000 $)

Chemical Costs = $1,484/yr/MGD capacity — Based on 3 mg/L dose of alum at average POTW flow of 6.82 MGD @ $325/ ton alum.

Electric Costs = $450/yr/MGD — Taken from NCLM cost estimates. (2010 $)

Added Sludge Disposal = $10,000/yr/MGD — (Same source)

Chemical Precipitation with Polyaluminum Chloride (PAX) and Existing Secondary Clarification:

Capital Cost = $80,000/MGD capacity — Taken from North Carolina League of Municipalities (NCLM) cost estimates, except for addition of 30% contingency rather than 38% used by NCLM. (2010 $)

Chemical Costs = $39,400/yr/MGD — Taken from NCLM cost estimates. (2010 $)

Electric Costs = $450/yr/MGD — (Same source)

Added Solids Handling (included in operation & maintenance costs) = $5,000/yr/MGD (Same source)

Added Sludge Disposal = $10,000/yr/MGD — (Same source)

Chemical Precipitation with Polyaluminum Chloride (PAX) and New Tertiary Clarification:

Capital Cost = $875,000/MGD capacity — Taken from NCLM cost estimates, except for addition of 30% contingency rather than 38% used by NCLM. (2010 $)

Chemical Costs = $39,400/yr/MGD — Taken from NCLM cost estimates. (2010 $)

Electric Costs = \$1,000/yr/MGD (Same source)

Added Solids Handling (included in O&M costs) = \$5,000/yr/MGD (Same source)

Added Sludge Disposal = \$10,000/yr/MGD (Same source)

Membrane Filtration:

Capital Cost = \$4,000,000/MGD capacity Taken from NCLM cost estimates, except for addition of 30% contingency rather than 38% used by NCLM. (2010 \$)

Electric Costs = \$195,000/yr/MGD Taken from NCLM cost estimates. (2010 \$)

Industrial WWTPs

Evaluate Compliance/ Treatment Options:

Initial Assessment = \$10,000/WWTP For evaluation of potential compliance alternatives.

Chemical Precipitation (Misc. Industrial Facilities):

Capital Cost = \$875,000/MGD capacity Taken from North Carolina League of Municipalities (NCLM) cost estimates for PAX + Existing Clarification. (2010 \$) Municipal systems and costs are not directly applicable to industrial facilities, but these estimates should offer a conservative estimate of costs.

Annual Costs Also taken from NCLM estimates for PAX + Existing Clarification.

Secondary Chemical Precipitation (Metals Forming/ Finishing Facilities):

Capital Cost = $\exp[13.829+0.544*\ln(Q_{design})+4.96*10^{6}*(\ln(Q_{design}))^{2}]$
Taken from US EPA *Development Document for Proposed Effluent limitations Guidelines and Standards for the Centralized Waste Treatment Industry (Volume I)*, Washington, DC, EPA 821-R-98-020, 1998. (1989 \$)

Operations Cost = $\exp[12.076+0.63456*\ln(Q_{design})+0.03678*(\ln(Q_{design}))^{2}]$ (Same source)

Clarification

Capital Cost = $\exp[11.552+0.409*\ln(Q_{design})+0.02*(\ln(Q_{design}))^{2}]$
Taken from US EPA *Development Document for Proposed Effluent limitations Guidelines and Standards for the Centralized Waste Treatment Industry (Volume I)*, Washington, DC, EPA 821-R-98-020, 1998. (1989 \$)

Operations Cost = $\exp[10.673+0.238*\ln(Q_{design})+0.013*(\ln(Q_{design}))^{2}]$ (Same source)

Multimedia Filtration (Metals Forming/ Finishing Facilities):

Capital Cost = $\exp[12.0126+0.48025*\ln(Q_{design})+0.04623*(\ln(Q_{design}))^{2}]$
Taken from US EPA *Development Document for Proposed Effluent limitations Guidelines and Standards for the Centralized Waste Treatment Industry (Volume I)*, Washington, DC, EPA 821-R-98-020, 1998. (1989 \$)

Operations Cost = $\exp[11.5039+0.72458*\ln(Q_{design})+0.09535*(\ln(Q_{design}))^{2}]$ (Same source)

Chemical Treatment for Flue Gas Desulfurization (FGD) Waters (Steam Electric):

Capital Cost = \$ 4,900,000 (Low) Based on EPA estimates for Merrimack Station in Bow, New Hampshire;

\$18,000,000 (High) Based on EPRI estimate for Merrimack Station;

	$11,500,000 (Midpoint)	Average of the Low and High estimates
Operations Cost = 430,000/yr (Low)	Based on EPA estimates for Merrimack Station in Bow, New Hampshire;	
	$1,000,000/yr (High)	Based on EPRI estimate for Merrimack Station;
	$ 720,000/yr (Midpoint)	Average of the Low and High estimates

Groundwater Remediation

Chemical Precipitation:

Capital Cost =	$ 5,000/site (Low)	Per Division of Waste Management.
	$10,000/site (High)	(Same source)
	$ 7,500/site (Midpoint)	Average of the Low and High estimates
Operations Cost =	$ 1,000/month/site (Low)	Per Division of Waste Management.
	$ 2,000/month/site (High)	(Same source)
	$ 1,500/month/site (Midpoint)	Average of the Low and High estimates

Water Treatment Plants

Evaluate Compliance/ Treatment Options:

Initial Assessment = $5,000	For evaluation of potential compliance alternatives, allowed for new diffuser and outfall extension projects.

Dye Study for New or Existing Effluent Diffusers:

Study Cost = $20,000/WTP	Based on dye test for recent mussel survey which cost $7,500. Assume $20,000 per study.

Diffuser Installation

Capital Cost = $60,000/WTP	Per Division of Waste Management: $2,500 diffuser, $5,000 installation, $10,000 sundries (valves, etc.), $7,500 effluent pumps (3 @ 60 gpm, $2,500 each). Also allow $5,000 for initial assessment and assume 200 foot outfall extension @ $125/ft plus $10,000 installation, to be conservative.
Annual Costs = $1,200/year/WTP	Assume annual maintenance = 2% of capital cost.
Energy Cost = $229/year	Assumes that the 60hp effluent pump will use .746 kw/hr for 2 hours/day every day of the year at a price of $0.07/kw. Also assumes average flow of 0.1MGD.

Outfall Extension

Capital Cost = $505,000/WTP	Per Division of Waste Management: $125 per linear foot of outfall, assume 4,000-foot extension (2006$). This estimate includes $5,000 for initial assessment.
Annual Costs = $10,000/year/WTP	Assume annual maintenance = 2% of capital cost.

Energy Cost = $229/year	Assumes that the 60hp effluent pump will use .746 kw/hr for 2 hours/day every day of the year at a price of $0.07/kw. Also assumes average flow of 0.1MGD.

Cartridge Filtration

Capital Cost = $12,000/WTP	Per Division of Waste Resources: Fil-Trek cartridge filter housing (S6GL18-032-4-6F-150), rated for a flow of 640 gpm (peak). Made of 316SS, each skid-mounted housing holds thirty-two cartridge filters, each 2.5" OD by 40" long. The impacted WTPs are all of similar size (approx. 0.1 MGD discharge, or 70 gpm average), so these filter units are over-sized. Assume similar systems for all plus $125,000 installation and sundries (valves, etc.) per WTP. This estimate includes $5,000 for initial assessment.
Annual Costs = $4,000/year/WTP	Per Division of Waste Resources: Filters ($10-30 each) must be replaced every three to six months, depending on level of particulates in the concentrate. Assume quarterly replacement and $30/filter: $30/filter x 32 filters/housing x 4 changes/year = $3,840/year per WTP; use $4,000/year.

Chemical Precipitation with Polyaluminum Chloride (PAX) and New Tertiary Clarification:

Capital Cost = $4,375,000/MGD capacity	Based on North Carolina League of Municipalities cost estimates ($875,000/MGD capacity) and EPA cost curves, which show unit costs for 0.1 MGD system are 5 times those for 1.0 MGD system. (2010 $)
Annual Costs	Use NCLM cost estimates (see Municipal WWTPs, above). (2010 $)

For more details on the computation of the impact from the proposed rules, refer to the links in Appendix III.10: Wastewater Dischargers – Cost Calculations.

Return to:

B3. Evaluation of Impacts: Metals Standards
3. Impacts – Metals
(e) Cost Baseline
(d) Quantify Costs/ Savings
(e) Quantification Methods and Assumptions
(g) Data Sources – Wastewater Dischargers
(h1) Wastewater Dischargers – Municipal WWTPs
(h3) Wastewater Dischargers – Industrial WWTPs
(h4) Wastewater Dischargers – Groundwater Remediation Facilities
(h5) Wastewater Dischargers – Water Treatment Plant Discharges (WTPs)

Appendix III.10: Wastewater Dischargers – Cost Calculations

See '*triennial review fiscal note - ww cost calcs 20140908.xlsx*', worksheets listed below.

<u>Spreadsheets – Cost Estimates – Totals and Category Subtotals</u>

Worksheets: *'totals'*
'subtotals_muni'
'subtotals_indy'
'subtotals_gw'
'subtotals_wtp'

<u>Spreadsheets – Municipal WWTPs – Evaluations, Impact Assessment, and Cost Estimates</u>

Worksheets: *'extrap-muni'*
'axn_tree-muni'
'unit_costs-muni'
'30-year_costs-muni'

<u>Spreadsheets – Industrial WWTPs – Cost Estimates</u>

Worksheets: *'unit_costs-indy'*
'30-year_costs-indy'

<u>Spreadsheets – Groundwater Remediation WWTPs – Cost Estimates</u>

Worksheets: *'unit_costs-gw'*
'30-year_costs-gw'

<u>Spreadsheets – Water Treatment Plants – Cost Estimates</u>

Worksheets: *'unit_costs-wtp'*
'30-year_costs-wtp'

<u>Spreadsheets – Monitoring Costs – Cost & Savings Estimates</u>

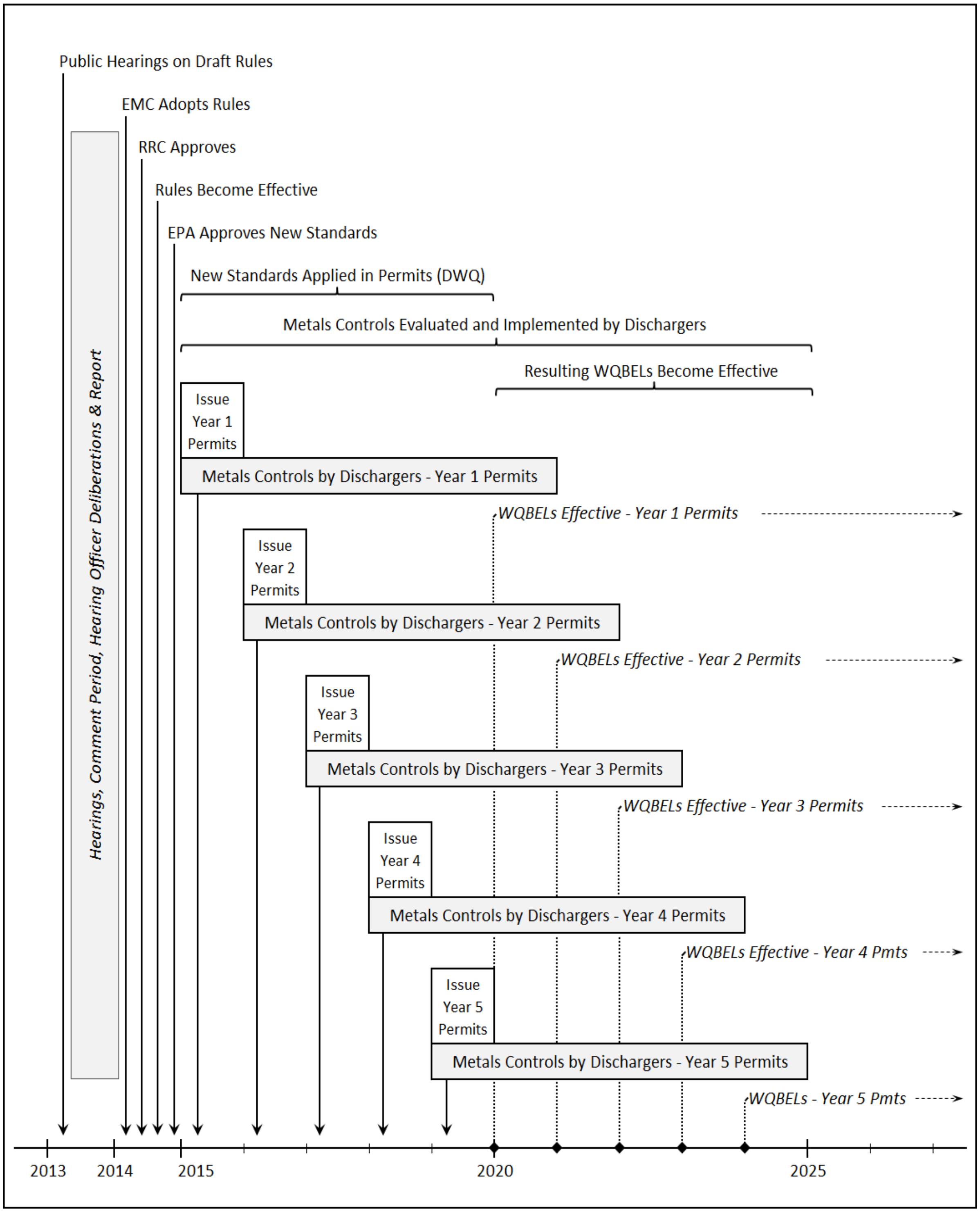
Worksheets: *'30-year_monit_costs'*
'subtot_monit_costs'
'30-year_monit_savings'
'subtot_monit_savings'

Return to:

Chapter B. Wastewater Dischargers
B3. Evaluation of Impacts: Metals Standards
3. Impacts – Metals
(d) Quantify Costs/ Savings
(h1) Wastewater Dischargers – Municipal WWTPs
(h2) Wastewater Dischargers – 100% Domestic WWTPs
(h3) Wastewater Dischargers – Industrial WWTPs
(h4) Wastewater Dischargers – Groundwater Remediation Facilities
(h5) Wastewater Dischargers – Water Treatment Plant Discharges (WTPs)

Appendix III.11: Projected Timeline for Implementation of Metals Standards Wastewater Dischargers

Figure III.11-1
Projected Timeline for Implementation of Metals Standards Wastewater Dischargers



Appendix VIII.1: Impact of Metal Contamination on Endangered Species

Two endangered NC aquatic organisms, sturgeon and freshwater mussels, are highlighted below to better reflect the negative impacts of metals pollution in NC waters and to illuminate the benefits that may be provided to species biodiversity from these rule proposals.

Sturgeon

Sturgeon are important species' contributing to the aquatic biodiversity in North Carolina. Besides their important ecological value, sturgeon has, in the past, provided direct economic benefits to the state from sturgeon fishery catches. In North Carolina, Atlantic sturgeon were historically abundant in most coastal rivers and estuaries, with the largest fisheries occurring in the Roanoke River/Albemarle Sound system and in the Cape Fear River.[123] [124]Sturgeon were harvested to be used as a food source and other non-edible parts of the fish were used to make various additional commercial products.[125] One of the most important commercial products was the sturgeon's eggs, which are made into high quality, valuable caviar.[126] Restoration of an abundant sturgeon population could still provide an economic benefit to fishermen in North Carolina. However, current sturgeon populations in North Carolina, as in most of the country, are not healthy enough to sustain a profitable fishery. There is currently a prohibition on the catch of sturgeon in NC waters based on their low population levels.

As noted previously, species in the sturgeon family are endangered and are a high priority for conservation in North Carolina.[127] Two sturgeon species are known to currently occur in North Carolina waters, the Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus)* and the Shortnose sturgeon (*Acipenser brevirostrum).* Both of these species are listed as endangered in North Carolina waters under the federal Endangered Species Act. The Shortnose sturgeon has been listed since 1967, while the North Carolina specific population of the Atlantic sturgeon was just recently listed in 2012. These species are dependent on both fresh and salt water environments, although to different degrees. Sturgeons spend most of their time in estuarine waters but travel into freshwater rivers in order to reproduce. This use of multiple aquatic habitats can make protection of sturgeon habitats and water quality specifically challenging.

There are many threats to the endangered sturgeon's recovery, such as habitat loss and water quality concerns. [128]The NC Coastal Habitat Protection Plan (CHPP) notes that sturgeon populations have not recovered in the state even though there has been a moratorium on their

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[123] Kahnle, A.W., Mckown, K.A., Shirley, C.A., Collins, M.R., Squiers Jr., T.S., and Savoy, T. (1998). Stock status of Atlantic sturgeon of the Atlantic Coast estuaries. Atlantic States Marine Fisheries Commission, Washington, D.C. 141pp.

[124] NOAA (1998). STATUS REVIEW OFATLANTIC STURGEON (*Acipenser oxyrinchus oxyrinchus*) http://www.nmfs.noaa.gov/pr/pdfs/statusreviews/atlanticsturgeon.pdf

[125] Williams, M.S. and Moser, M.L. 2000. Spawning of the Atlantic Sturgeon (*Acipenser oxyrhynchus*) in the Cape Fear River System, North Carolina.

[126] Williams, M.S. and Moser, M.L. 2000.

[127] North Carolina Wildlife Resources Commission. 2005. North Carolina Wildlife Action Plan. Raleigh, NC. http://www.ncwildlife.org/Portals/0/Conserving/documents/ActionPlan/WAP_complete.pdf

[128] Atlantic Sturgeon Status Review Team (ASSRT). 2007. Status review of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinch*us). Report to National Marine Fisheries Service, Northeast Regional Office on February 23, 2007.

harvest for over 10 years, and suggests that water quality or habitat issues are preventing their recovery.[129]

Research has looked into whether the potential exists to reintroduce the Shortnose sturgeon into select NC habitats with the goal of contributing to species recovery in the state and along the Atlantic Coast. For example, a recent study conducted by Cope *et al.* (2011)[130] focused on the suitability of the water quality in the Roanoke River, NC to support an introduced Shortnose sturgeon population. The Cope *et al.* (2011) study monitored the ability of juvenile sturgeon to survive when placed in cages in the river habitat, as well as monitored the overall health of the fish during their period of exposure to the river water. The results of this study indicated that water quality was not sufficient in the Roanoke River to support a juvenile Shortnose sturgeon population. The study authors indicated that metals and PAH (polynuclear aromatic hydrocarbons) data collected from the river water, when results for these individual chemicals were paired in almost any combination, were statistically significant when compared to sturgeon survival. This result implies that toxic combinations of different metals, rather than a single metal, could possibly be the, or one of the, contributing factors to the deaths of the test sturgeon.

Research has indicated that water quality is one of the areas that must be addressed in order to aid in the recovery of sturgeon species in North Carolina. The proposed changes to the state's current water quality standards are a step towards aiding in water quality improvements and ultimately species' recovery. Sturgeon species are thought to be highly sensitive to metal's toxicity, although limited aquatic toxicity testing has been done with this species to date.[131] Sturgeon toxicity data have not been included in previous water quality standards calculations, likely due to the scarcity of available data for these species when many of the NRWQC were originally derived. Vardy *et al.* (2011) [132]studied the toxicity of copper, cadmium and zinc to the White sturgeon (*Acipenser transmontanus*). This study found that early life stages of the White sturgeon are indeed sensitive to these metals, displaying sensitivities similar to trout and salmon. These results indicate that the NRWQC for copper, zinc and cadmium are likely to be protective of young White sturgeon when trout or salmon data is retained in the calculation.

Based on the above information, NC's current metals standards may not be stringent enough to provide adequate water quality protection or an accurate assessment of water quality in sturgeon habitat. Adoption of the EPA NRWQC for metals through the state's current rule proposals is anticipated to provide more protection for the sturgeon and be more representative of the environmental conditions needed to maintain a healthy sturgeon population.

Similar concerns relating to water quality limitations on recovery of other endangered species populations, such as the Cape Fear shiner, have been reported. For example, Howard (2003)[133]

[129] Deaton, A.S., W.S. Chappell, K. Hart, J. O'Neal, B. Boutin. 2010. North Carolina Coastal Habitat Protection Plan. North Carolina Department of Environment and Natural Resources. Division of Marine Fisheries, NC. 639 pp.

[130] Cope, W.G., Holliman, F.M., Kwak, T.J., Oakley, N.C., Lazaro, P.R., Shea, D., Augspurger, T., Law, J.M., Henne, J.P., and Ware, K.M. (2011). Assessing water quality suitability for shortnose sturgeon in the Roanoke River, North Carolina, USA with an *In situ* bioassay approach. *Journal of Applied Ichthyology* 27: 1-12.

[131] Dwyer, F J; Mayer, F L; Sappington, L C; Buckler, D R; Bridges, C M; Greer, I E; Hardesty, D K; Henke, C E; Ingersoll, C G; Kunz, J L; Whites, D W; Augspurger, T; Mount, D R; Hattala, K; Neuderfer, G N. (2005). Assessing Contaminant Sensitivity of Endangered and Threatened Aquatic Species: Part I. Acute Toxicity of Five Chemicals. *Archives of Environmental Contamination and Toxicology*. 48: 143-154.

[132] Vardy, D. W., Tompsett, A. R., Sigurdson, J. L., Doering, J. A., Zhang, X., Giesy, J. P. and Hecker, M. (2011), Effects of subchronic exposure of early life stages of white sturgeon (*Acipenser transmontanus*) to copper, cadmium, and zinc. Environmental Toxicology and Chemistry, 30: 2497–2505.

[133] Howard, Amanda K. (2003). Influence of Instream Physical Habitat and Water Quality on the Survival and Occurrence of the Endangered Cape Fear Shiner. (Masters Thesis). North Carolina State University, Raleigh, NC. Available from: http://www.fws.gov/raleigh/pdfs/howard_cape_fear_shiner_msthesis_2003.pdf

reported that Cape Fear Shiner populations in the Haw River are exposed to metals and organic pesticides at potentially toxic concentrations. An in situ toxicity study with Cape Fear Shiners conducted in the Haw River by the author found non-significant growth and significantly reduced survival as compared with the reference sites used in the study, providing support for the author's conclusion that water quality may be a limiting factor in the Haw River for this species recovery.

Freshwater Mussels

The United States is known for supporting extraordinary freshwater mussel diversity as compared to other countries. For example, Europe supports only 12 species, while nearly 300 freshwater mussel species live in US waters.[134] However, these animals may be the most threatened natural resource in this country. In the early 1990's, it was estimated that around 70 percent of North American freshwater mussels were endangered, threatened, or of special concern.[135] Most of the country's freshwater mussel diversity (91%) is located in the southeastern US, including North Carolina.[136] The NC Wildlife Resources Commission notes in the NC Wildlife Action Plan that this diversity of mollusks in the southeastern US is "globally unparalleled".[137] In North Carolina, state waters support at least 125 different species of freshwater mussels. An estimated 59 percent of these North Carolina species are imperiled.[138] Assessments of North Carolina freshwater mussel populations conducted in the 1990s discovered that 42 percent of the studied NC populations (n=147) were in "poor or very poor condition"[139] and that only 35 percent of the mussel populations were likely to continue to be viable populations during the following 30 years.[140]

This population decline is a concern because freshwater mussels perform many important functions in the environment and provide many benefits for both humans and aquatic ecosystems. Although generally not consumed by humans, freshwater mussels provide an important food source for both aquatic and terrestrial animals, including many popular sport fish. Mussels themselves are filter feeders, meaning they get their food supply by filtering it out of the water column. This provides an important benefit to the environment, and ultimately to the public, as mussel populations naturally improve water quality by filtering out suspended particles (sediment and algae) and other pollutants. A single large mussel can filter several gallons of water in a day making the water cleaner and more valuable for human uses.[141] Helfrich *et al.* (2009) indicated that mussels are especially helpful in removing algae and suspended particles from turbid, or muddy, and organically enriched waters near wastewater discharge facilities.

[134] US Fish and Wildlife Service (USFWS) website. 2012. http://www.fws.gov/news/mussels.html
[135] Williams, J.D., Warren, M.L, Jr., Cummings, K.S., Harris, J.L. and Neves, R.J. (1993). Conservation Status of Freshwater Mussels of the United States and Canada. *Fisheries* 18(9): 6-22.
[136] Neves, R. J., A. E. Bogan, J. D. Williams, S. A. Ahlstedt, and P. W. Hartfield. 1997. Status of aquatic mollusks in the southeastern United States: a downward spiral of diversity. Pages 43 –86 in G. W. Benz and D. E. Collins, editors. Aquatic fauna in peril: the southeastern perspective. Southeast Aquatic Research Institute, Decatur, GA.
[137] North Carolina Wildlife Resources Commission. 2005. North Carolina Wildlife Action Plan. Raleigh, NC. http://www.ncwildlife.org/Portals/0/Conserving/documents/ActionPlan/WAP_complete.pdf
[138] Neves, R. J., A. E. Bogan, J. D. Williams, S. A. Ahlstedt, and P. W. Hartfield. 1997.
[139] Rader, D. 1994. Programs to protect aquatic biodiversity in North Carolina. Pages 81–100, in D.S. Wilcove and M.J. Bean, editors. The big kill: Declining biodiversity in America's lakes and rivers. Environmental Defense Fund, Washington, D.C.
[140] Alderman, J.M., W.F. Adams, S. Hall, and C. McGrath. 1992. Status of North Carolina's state listed freshwater mussels. N.C. Wildlife Resources Commission, Raleigh, NC.
[141] Helfrich, L.A., Neves, R.J., and Chapman, H. 2009. Sustaining America's Aquatic Biodiversity - Freshwater Mussel Biodiversity and Conservation. http://pubs.ext.vt.edu/420/420-523/420-523.html.

This ability to naturally purify water is an important economic benefit to humans which could be increased if struggling mussel populations could be restored and enhanced. For example, in recent years, NC companies, local governments, and the state itself have invested large amounts of money to reduce nutrient pollution in enriched, algae choked freshwater environments. Healthy native mussel populations could aid in this effort by providing a natural method of filtering out and removing nutrients and algae from the system. Healthy mussel populations can also aid in the removal of bacteria that is harmful to humans thereby directly making the water safer for human use.

In addition to providing physical pollutant removal from an aquatic system, mussels are valuable indicators of an aquatic ecosystem's health. Mussels are very sensitive to many pollutants and to physical changes to their habitat. They can be used as "biological monitors" to indicate water quality conditions in rivers and lakes. A sudden die off of freshwater mussels can be an indication of toxic pollutants in waters and the gradual disappearance of freshwater mussels usually indicates chronic water pollution problems.[142]

Toxic pollution is likely to be a contributing factor in the steep decline of freshwater mussel populations and degraded water quality is also considered to be a factor limiting the mussel populations' ability to recover.[143] The sensitivity of mussels to metals pollution has been identified in the scientific literature and research is ongoing. Mussels can be exposed to metals both through metals dissolved in the water column and through particles ingested through filter feeding, exposing mussels to toxic metals in both the dissolved and/or particulate forms. This exposure to metals has been shown to cause mortality, disrupt enzyme efficiency, alter filtration rates, and reduce growth and change behavior of freshwater mussels.[144] Current metal concentrations in aquatic environments have been identified as a potential barrier to mussel recovery in North Carolina waters. For example, copper concentrations were found to exceed safe concentrations for both short and long term mussel exposures in 50 percent of samples taken by researchers from three NC streams.[145] Toxic impacts to freshwater mussels from some metals have been identified and are expected to occur at concentrations much lower than the current NC freshwater aquatic life water quality standards for these metals.

As freshwater mussel toxicity test data are currently not included in the NRWQC calculations, there are also concerns that implementation of NC's proposed rules for metals may still not provide mussels with enough protection from certain metals. Various studies are available in the peer reviewed literature that try to address this question by comparing freshwater mussel laboratory toxicity test data to the EPA's national recommended water quality criteria (NRWQC). Studies were found which addressed copper, cadmium, lead and zinc criteria. Wang *et al.* (2010)[146] indicates that, based on available toxicity test data, the current NRWQC for lead and cadmium are likely protective of freshwater mussels; however the current NRWQC for zinc are likely under protective of freshwater mussels. Various additional studies also have indicated that the hardness based 1996 NRWQC for copper and the 2007 Biotic Ligand Model (BLM) based

[142] Helfrich, L.A., Neves, R.J., and Chapman, H. 2009.

[143] Ward, S., Augspurger, T., Dwyer, F.J., Kane, C. and Ingersoll, C.G. (2007). Risk Assessment of Water Quality in Three North Carolina, USA, Streams Supporting Federally Endangered Freshwater Mussels (Unionidae). *Environmental Toxicology and Chemistry* 26(10): 2075-2085.

[144] Naimo, T.J. (1995). A review of the effects of heavy metals on freshwater mussels. *Ecotoxicology* 4:341-362.

[145] Ward, S., Augspurger, T., Dwyer, F.J., Kane, C. and Ingersoll, C.G. (2007). Risk Assessment of Water Quality in Three North Carolina, USA, Streams Supporting Federally Endangered Freshwater Mussels (Unionidae). *Environmental Toxicology and Chemistry* 26(10): 2075-2085.

[146] Wang, N., Ingersoll, C.G., Ivey, C.D., Hardesty, D.K., May, T.W., Augspurger, T., Roberts, A.D., Van Genderen, E. and Barnhart, M.C. (2010). Sensitivity of early life stages of freshwater mussels (Unionidae) to acute and chronic toxicity of lead, cadmium, and zinc in water. *Environmental Toxicology and Chemistry* 29(9): 2053-2063.

NRWQC for copper may also not be adequately protective of freshwater mussels.[147] [148][149] The proposed rules would adopt the NRWQC for lead and a modified version of the national criteria for cadmium into NC regulations. Therefore the adoption of the rule proposals would provide better statewide protection for freshwater mussels and result in more accurate water quality assessments of their habitats. The NRWQC for both copper and zinc may need to be more stringent in order to provide full protection for freshwater mussels. However, adoption of the NRWQC for copper and zinc will be a step forward in providing a level of water quality more in line with the needs of these important organisms

[147] Wang, N., Ingersoll, C.G., Hardesty, D.K., Ivey, C.D., Kunz, J.L., May, T.W., Dwyer, F.J., Roberts, A.D., Augspurger, T., Kane, C.M., Neves, R.J. and Barnhart, M.C. (2007). Acute Toxicity of Copper, Ammonia, and Chlorine to Glochidia and Juveniles of Freshwater Mussels (Unionidae). *Environmental Toxicology and Chemistry* 26(10): 2036-2047.

[148] March, F.A., Dwyer, F.J., Augspurger, T., Ingersoll, C.G., Wang, N. and Mebane, C.A. (2007). An Evaluation of Freshwater Mussel Toxicity Data in the Derivation of Water Quality Guidance and Standards for Copper. *Environmental Toxicology and Chemistry* 26(10): 2066-2074.

[149] Wang, N., Mebane, C.A., Kunz, J.L., Ingersoll, C.G., May, T.W., Arnold, W.R., Santore, R.C., Augspurger, T., Dwyer, F.J. and Barnhart, M.C. (2009). Evaluation of Acute Copper Toxicity to Juvenile Freshwater Mussels (Fatmucket, *Lampsilis siliquoidea*) in Natural and Reconstituted Waters. *Environmental Toxicology and Chemistry* 28(11): 2367-2377.

Appendix VIII.2: Valuation of Water Quality Improvement - Model Summary

Table VIII.2-1
Variable List and Explanations for Water Quality Improvement Model

Variable	Description	Source
Log (Base Water Quality Level)	Percentage of waterbodies with good water quality before the policy	US EPA
Log (Starting Water Quality Tradeoff)	This is a variable associated with the survey questions and is set at a level where respondents were equally split in their answers to the first question in order to minimize any bias introduced by the survey itself	Value taken from original model survey data
Log (Income)	Average annual income	2010 American Community Survey
Years of education	Years of education (high school graduate = 12, college graduate = 16, etc.)	Organization for Economic Cooperation and Development (2004 value for US)
Age	Average age	US 2010 Census
Environmental Organization Membership	Membership in any of: Environmental Defense Fund, Greenpeace, National Audubon Society, National Wildlife Federation, Nature Conservancy, Natural Resources Defense Council, Sierra Club	Value taken from original model survey data
Visited a Lake or River, last 12 Months	Percent of people who visited a lake or river, determined by survey responses	Value taken from original model survey data
Race: Black	Percentage of residents who are Black	US 2010 Census
Race: Non-black, Non-white	Percentage of Non-Black, Non-White residents	US 2010 Census
Hispanic	Percentage of residents with Hispanic ethnicity	US 2010 Census
Gender: Female	Percent of residents who are female	US 2010 Census
Household Size	Average household size	US 2010 Census
Region: Northeast	Is the area improved in the Northeast	US EPA
Region: South	Is the area improved in the South	US EPA
Region: West	Is the area improved in the West	US EPA
State Lake Quality	Average lake quality in the state	US EPA
Lake Acres per State Square Mile	Average lake density in the state	US EPA and US Census

Table VIII.2-2
Household Value for One Percent Increase in Lakes and Rivers with Good Water Quality in North Carolina

Variable	Coefficients	NC Lake Data	NC River Data	Parameter Estimate Lakes	Parameter Estimate Rivers
Log (Base Water Quality Level)	-0.4263	-1.152013	-0.376877651	0.49110317	0.160662943
Log (Starting Water Quality Tradeoff)	0.5374	2.6755	2.6755	1.4378137	1.4378137
Log (Income)	0.1255	10.88	10.88	1.36544	1.36544
Years of education	0.0394	13.3	13.3	0.52402	0.52402
Age	0.0063	37.3	37.3	0.23499	0.23499
Environmental Organization Membership	0.5197	0.054	0.054	0.0280638	0.0280638
Visited a Lake or River, last 12 Months	0.1944	0.674	0.674	0.1310256	0.1310256
Race: Black	-0.1288	0.2148	0.2148	-0.02766624	-0.02766624
Race: Non-black, Non-white	0.0139	0.064	0.064	0.0008896	0.0008896
Hispanic	0.1108	0.0839	0.0839	0.00929612	0.00929612
Gender: Female	-0.0437	0.5128	0.5128	-0.02240936	-0.02240936
Household Size	-0.03	2.48	2.48	-0.0744	-0.0744
Region: Northeast	0.0289	0	0	0	0
Region: South	-0.0359	1	1	-0.0359	-0.0359
Region: West	-0.0155	0	0	0	0
State Lake Quality	0.0004	31.6	68.6	0.01264	0.02744
Lake Acres per State Square Mile	0.0044	6.4	6.4	0.02816	0.02816
INTERCEPT	-1.3463	1	1	-1.3463	-1.3463
			Sum	2.757	2.441
				Lake Value*	**River Value***
				$17.61	**$10.34**
Combined 2004 Value of a One Percent Increase in Lake and River Water Quality					**$28.96**
Combined 2014 Value of a One Percent Increase in Lake and River Water Quality					**$35.30**

* The logged variable is adjusted into a non-logged distribution after regression. If a logged distribution has mean M and variance S, then the mean of the un-logged distribution is e^(M+S/2). In this application, we took M and S to be the conditional means and variances given the regression. The variance is provided by Huber's model 3-3. So in this case, the lake value is calculated as e^(2.757+.7448) * 53.1%.

Appendix VIII.3: Alternative Method for Water Quality Valuation of Freshwater Streams

The model presented in Section VIII. Benefits, and detailed in Appendix VIII.2: Valuation of Water Quality Improvement - Model Summary, provides a general look at the value that North Carolina citizens place on healthy waters throughout the state. To test the validity of the monetary benefits that were calculated through the use of the generalized model, an alternate approach was performed using data obtained from this fiscal analysis and specifically related to the rule proposals.

This alternative benefit analysis estimates the direct benefits that are anticipated to the health of aquatic communities through money spent by impacted parties to comply with the proposed metals standards for freshwaters, as estimated in this fiscal analysis. This alternative analysis provides a monetary benefit range for a subset of the benefit estimates made using the Duke University economics model (aquatic life/habitat restoration).[150]

This fiscal analysis details potential costs that may be incurred as a result of the proposed regulations. Specific emphasis has been placed on potential impacts and costs to regulated parties, especially NPDES wastewater dischargers. An estimation of the number of potentially impacted NPDES dischargers has been identified through this analysis, along with accompanying estimates of potential costs (see Section III. Program Overview and Impacts, Chapter B. Wastewater Dischargers).

The costs incurred by impacted facilities provide a direct benefit to citizens of NC through improvement of metals degraded ambient waters or through better protection of ambient waters against further degradation in the future. This anticipated monetary benefit to the state that is expected to result from implementation of the proposed metals standards in NPDES permits has been estimated below.

Specifically this calculation includes the benefits associated with an improvement in the health of aquatic life populations and aquatic ecosystems. This benefit is expected to occur due to a reduction in metals entering an aquatic system or through better awareness and therefore control of metals concentrations in effluents prior to stream degradation. An improvement in the health of aquatic life and ecosystems also is assumed to eventually lead to increased recreational benefits for the state. This benefit calculation is not anticipated to reflect the total economic benefit to citizens of the state from the proposed regulations as not all benefit categories were quantified.

A waterbody can never be fully expected to provide a “healthy” or well-balanced aquatic habitat if water chemistry concerns are not addressed. The Clean Water Act (CWA) provides the structure for states to control toxicant inputs into state waters in order to prevent harm or to restore water chemistry. The NC DWR implements CWA regulations through a variety of programs, such as the development and adoption of protective water quality standards to define safe levels of toxics in natural waters.

The funds spent by public and private entities to comply with the proposed water quality standards regulations for metals would be expected to contribute to the chemical restoration of degraded waters in North Carolina and also may prevent waters from future degradation.

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[150] Huber, Joel, W. Kip Viscusi, and Jason Bell. 2006. “Economics of Environmental Improvement” EPA Cooperative Agreement CR823604 and Grant R827423 to Harvard University with the National Center for Environmental Economics. http://yosemite.epa.gov/ee/epa/eerm.nsf/vwAN/EE-0496-01.pdf/$file/EE-0496-01.pdf

Therefore, metals “degraded” waters were identified for this specific benefit analysis as the subset of waters likely to benefit directly from implementation of these rules.

Staff used facilities identified as impacted in the NPDES wastewater section (see Chapter B. Wastewater Dischargers for a more detailed discussion of how impacted is used and how the facilities were identified) for this analysis and they were assumed to be located on a metals degraded stream. Only facilities expected to see impacts more stringent than under current rules were included. The wastewater analysis recognized these facilities as impacted if the effluent discharge was expected to exceed or come close to exceeding the proposed instream water quality standard.

As the proposed water quality standards for metals define an acceptable condition for healthy aquatic life instream, it can be assumed that some level of aquatic life degradation has occurred or is imminent in the receiving streams if the proposed instream standards are not expected to be met.

For this specific benefits analysis, the total number of impacted facilities, and therefore metals degraded waters, was determined to be roughly 100 based on information gathered from Section III.B of this fiscal analysis (see Table III.B-8). This includes facilities in all discharger categories that are anticipated to see more stringent impacts due to the proposed rules.

The NPDES wastewater section of this fiscal note contains a range of anticipated monetary costs for these facilities. The costs were estimated to be $75 million (low), $158 million (average), and $270 million (high) over a ten-year period in Section III. Program Overview and Impacts, Chapter B. Wastewater Dischargers. Therefore, the average annual estimated costs are $7.5, $15.8, and $27 million for the low, medium, and high estimates, respectively.

From the peer reviewed literature, the US Fish and Wildlife Service (US FWS) has estimated that a healthy or fully restored stream is estimated to be worth about $102.83ft/year to the state.[151] The estimate was based on the US FWS’s work in stream restoration with a focus on instream restoration/enhancement to provide for aquatic habitat conservation and management (the mid-point value of $778 million for 1,433 miles of instream habitat). In recent decades, point source treatment capability has improved to the point where it is highly unlikely that a discharge would completely devalue a stream to $0ft/yr.

Nonpoint sources of pollution like stormwater or runoff also contribute metals to a waterbody; therefore not all metals degradation in a waterbody can be attributed to point sources. Monetary costs of reducing metals from non-permitted, nonpoint runoff could not be determined in this fiscal note and therefore are not considered in this benefit analysis. However, DENR needed to account for this discrepancy in the calculation. Variables representing the total stream distance degraded and the amount of stream value removed by metal pollutants were estimated as ranges to account for the high level of uncertainty around these estimates. Variable ranges were established as high, medium and low estimates.

The first variable range accounts for potential differences in the distance of stream degradation. The estimated linear footage of the stream degraded by effluent ranged from low impact (5,000 ft), medium impact (20,000 ft) and high impact (50,000ft). These ranges were assumptions made by DWR staff using their best judgment of plausible scenarios based on a thorough knowledge of water quality assessment in NC waters. It was necessary to make assumptions based on staff judgment as actual impacts are site-specific in nature and, therefore,

[151] Charbonneau and Caudill (2010). Conserving America’s Fisheries: An Assessment of Economic Contributions from Fisheries and Aquatic Resource Conservation. US Fish and Wildlife Service. September 2010. http://www.fws.gov/home/feature/2011/pdf/FisheriesEconomicReport.pdf

unattainable for this level of fiscal analysis. The second variable range accounts for the amount of monetary value removed from a stream attributable to point source discharges.

Low degradation, meaning the point-source discharger caused minimal metals degradation, is assumed to devalue the stream by $5.00ft/yr (therefore worth of degraded stream absent of non-point source contributions would be $97.83). Medium degradation was assumed to reduce water value by $20.00ft/yr (degraded stream worth of $82.83) and high degradation was assumed to devalue a waterbody by $40.00 ft/yr (degraded stream worth of $63.85). The high value for degradation used in this analysis assumes that discharges from point source dischargers (specific entities of interest for this analysis) are responsible for, at the most, 40 percent of metal's degradation in a waterbody. The remaining contributors, often considered to be non-point sources, would be valued with the remaining $62.83/ft/yr. These devaluation ranges were assumptions made by DWR staff using their best judgment of plausible scenarios based on a thorough knowledge of water quality assessment in NC waters. It was necessary to make assumptions based on staff judgment as the real world impact would be site specific in nature and therefore unattainable for this level of fiscal analysis.

Table VIII.3-1 includes the assumptions used in this calculation. Low, medium and high ranges were used for all variables (except the number of impacted facilities) to provide consistency.

Table VIII.3-1
Assumptions used in alternative aquatic life benefits calculation

Assumptions	Number of Potentially Impacted Facilities	Estimated Annual Costs of Compliance with proposed regulations	Potentially degraded stream distance (linear feet)	Metal degradation from discharge ($/ft/yr)	Value of Degraded Stream ($/ft/yr)
High	100	$27,090,000	50,000 ft	$40	$ 63
Medium	100	$15,810,000	20,000 ft	$20	$ 83
Low	100	$7,520,000	5,000 ft	$5	$ 98

The calculations were run using all potential combinations of the above variables, providing a total of 27 different possible impact scenarios. An example of calculations for one scenario follows:

Example for 1 benefit scenario

1. 5,000 ft (Potentially degraded linear feet -low) *100 (impacted facilities/waters) = 500,000 (total potentially degraded linear ft)
2. 500,000 * $102.85 (value of fully functioning stream) = $51,415,000 (value of full restoration)
3. 500,000 (total potentially degraded linear ft) * $63 (Value of degraded stream-high) = $31,415,000 (Current estimated value of degraded linear feet)
4. $51,415,000 (value of full restoration) - $31,415,000 (Current estimated value of degraded linear feet) = **$20,000,000 (Annual benefit after implementation)**
5. $75,200,000 (Estimated 10 year facility cost-low) / 10 = $7,500,000 (annual compliance cost)
6. $20,000,000 (Annual benefit after implementation) **-** $7,500,000 (annual compliance cost) = **$12,500,000 (Annual net benefit adjusted for annual compliance cost)**

An annual and a 30-year average benefit were calculated by including all of the results from each of the 27 different benefit scenarios. The average annual benefit to the health of aquatic life and aquatic ecosystems accounting for money spent by wastewater dischargers to comply with the proposed metals standards is estimated to be roughly $60.4 million dollars per year. Therefore, net present value of the average benefit over the 30-year implementation period for the proposed rules using this alternative methodology is estimated to be to be roughly $ 658 million dollars. This estimate may overstate the benefits because not every impacted discharger may be located on a river with metals degraded waters. In addition, there is substantial uncertainty around the feet of water that are impacted directly downstream from dischargers and the total amount of stream value that is lost to metals degradation.

Assumptions and Uncertainties Specific to the Above Alternate Methodology

There were multiple assumptions made in this analysis. Some important assumptions are as follows:

- This analysis considers direct improvements to aquatic life in receiving streams with point sources impacted by the proposed rules and does not consider other benefits that may occur from adoption of the proposed rules (such as identification of toxicity problems in waters without point source inputs and subsequent clean-up of these areas through other state, federal or local programs).
- Multiple assumptions made in this analysis were chosen based on the best professional judgment of DWR staff due to the inability of staff to visit every impacted site and make site specific determinations on values for these assumptions (such as feet of stream impacted). Staff chose estimates based on knowledge of point source impacts in NC waters and used a range of values in the analysis for each variable to help account for uncertainty.
- It is difficult to estimate the monetary value of an unpolluted stream. DENR has chosen an estimate from the literature that values a fully healthy or restored stream at $102.85 ft/year.
- Likewise, it is difficult to estimate how much of the monetary stream value is lost when the stream is contaminated with one or more metals. Some of the impacts, such as reduced biodiversity, are subtle and are difficult to quantify. The percentage lost will vary based on the nature and chemical and physical characteristics of the stream and of the discharge, and pollutant contributions from other sources in the immediate proximity to the discharge facility. A range of values and scenarios were considered to try to account for this uncertainty.

This analysis also assumes that NPDES point source dischargers will bear the entire compliance costs. We think this is unlikely because the federal and state governments have traditionally provided a portion of funding for wastewater treatment plants in recognition of the positive societal benefits such as improvements in human health that these facilities provide. According to the North Carolina Rural Center, state and federal governments provided approximately 22 percent of the funding for water and sewer improvement projects in North Carolina between 1995 and 2005.[152] Although this share of funding has been declining, some communities will continue to benefit from the grants and loans which defray the overall cost of sewer and water facilities and upgrades.

[152] North Carolina Rural Center "Trends in Water and Sewer Financing" Report 2 Water 2030 Initiative. Accessed May 2012. http://www.ncruralcenter.org/images/PDFs/Water2030/fundingtrends.pdf

Appendix VIII.4: Use Benefits – Secondary Impacts

Benefits to Human Health

Metals are persistent in the environment and do not degrade. Due in part to this characteristic, metals can bioaccumulate, or concentrate, in the tissues of aquatic organisms. This includes the fish and shellfish that humans often consume. The NC CHPP (2010) indicates that metals are of particular concern to the state with regard to oyster resources and the potential for associated human health issues.[153]

Metals accumulate in aquatic organisms through various different exposure routes, including through the water column, the organism's food sources and the sediments. Accumulation of metals in the tissues of aquatic organisms may cause human health problems if the organism is consumed and can also cause harm to the organism itself.

Researchers have published data indicating the potential for human health concerns based on metal concentrations in fish tissues in NC waters. For example, a recent study by Mallin *et al.* (2011) found that, on occasion, fish and shellfish in the lower Cape Fear river basin had levels of metals in their tissues above levels deemed by the US EPA to be safe for human consumption.[154] Two of these metals, cadmium and arsenic, are included in the proposed rules. Arsenic levels above the EPA's criteria for safe fish consumption have been found in the tissues of fish from other estuarine areas in NC.[155]

Any reduction in metals in both water and sediment that occurs as an outcome of the rule proposals could help to reduce bioaccumulation in fish tissue. This would provide a human health benefit to the state as a number of people in rural areas, including the lower Cape Fear, can be considered subsistence fisherman, meaning that they depend on NC fish as a food source rather than just for the recreational experience.[156] This benefit cannot be quantified due to the limited fish tissue data as well as the potentially significant time period required to see reductions in fish tissue metals concentrations due to reductions in loading.

Benefits to Economic Development

The changing future composition of North Carolina's economy, a growing population and changes in economic development strategies may affect the need for clean water. North Carolina has been undergoing a structural economic transformation from a traditional manufacturing economy to one based on services and knowledge-based industries and workers. Much of our past and present economic development efforts focus on attracting large manufacturing or industrial facilities that bring jobs and attract workers.

[153] Cope, Gord. "Pure Water, Semiconductors, and the Recession" *Global Water Intelligence* Vol. 10, No. 10. 2009
[154] Mallin, Michael A., McIver, Matthew R., Fulton, Michael, Wirth, Ed (2011). Elevated Levels of Metals and Organic Pollutants in Fish and Clams in the Cape Fear River Watershed. *Archives of Environmental Contamination and Toxicology* 61: 461-471.
[155] Cooksey C., Hyland J., Wirth, E., Balthis, W.L., Fulton, M., Whitall, D., et al. (2008). Support for integrated ecosystem assessments of NOAA's National Estuarine Research Reserves System (NERRS) vol II: assessment of ecological condition and stressor impacts in subtidal waters of the North Carolina NERRS. NOAA Technical
[156] Mallin, Michael A., McIver, Matthew R., Fulton, Michael, Wirth, Ed (2011). Elevated Levels of Metals and Organic Pollutants in Fish and Clams in the Cape Fear River Watershed. *Archives of Environmental Contamination and Toxicology* 61: 461-471.

However, research indicates that more people are making location decisions based on quality of life issues instead of work opportunities. Called people-first-jobs-follow, it materializes when workers and their families opt to locate in a community even though they have no immediate job prospects, instead basing their location decisions largely on the quality of life the community offers. To capitalize on this shift in personal preferences, relative ability to attract skilled workers relies heavily on being able to provide the amenities that highly-talented people value, including high environmental quality and a variety of passive water uses and water recreation.

Some people believe that local and regional economies that focus on creating, attracting, and retaining talented, high-knowledge workers will perform better than economies that do not make these efforts. As a regional development strategy, this means a fundamental shift from low cost to high quality — from attracting firms to generating, attracting, and retaining talent.

Richard Florida, the Heinz Professor of Regional Economic Development at Carnegie Mellon University[157] postulates that "(t)he rise of the new economy dramatically transforms the role of the environment and natural amenities — from a source of raw materials and a sink for waste disposal — to a critical component of the total package required to attract talent and, in doing so, generate economic growth."

In a national study that looked at the two different growth processes: jobs-first vs. people-first, it concluded that the two have roughly the same impact on job growth.[158] "More robust growth in jobs and income generally occurs in areas having resource-related amenities, such as outdoor recreational opportunities and high environmental quality, whereas areas with higher emissions of hazardous materials experience slower growth."[159] Some resource-related amenities have the greatest power to drive economic growth through their influence on the quality of life.[160]

North Carolinians have recognized this relationship between water quality and economic development. The Land of Sky Regional Council, which does strategic planning for the area around Asheville, considers protecting water quality and quantity as a high priority for its comprehensive economic development strategy for 2007-2012. Declining water quality may affect regional industries such as tourism, recreation and the retirement and second home products and services.[161]

A recent poll of registered North Carolina voters found very strong support for maintaining strong state protections for clean air and water and for funding the programs needed to enforce those protections. More than 80 percent of those polled believe that a clean environment is important to attracting new jobs to our state.[162] The North Carolina Department of Commerce on their Thrive in North Carolina website[163] lists quality of life as one of the reasons to live and work in North Carolina. Included in the reasons for exceptional quality life in North Carolina are

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[157] Florida, R. 2000. *Competing in the age of talent: environment, amenities and the new economy.* Report for the R.K. Mellon Foundation, Heinz Endowments, and Sustainable Pittsburgh, January 2000. Heinz School of Public Policy and Management, Pittsburgh., PA: Carnegie Mellon.

[158] Partridge, M. and D. Rickman. 2003. "The Waxing and Waning of Regional Economies: The Chicken – Egg Question of Jobs Versus People." Journal of Urban Economics 53: 76-97.

[159] Templet, P.H. 1993. "The Emissions-to-Jobs Ratio". Environmental Science & Technology 27: 810-812

[159] Partridge, M. and D. Rickman. 2003.

[160] Land of Sky Comprehensive Economic Development Strategy 2007-2010, revised September 2010, ftp://www.landofskygis.org/CEDS/2010%20Revised%20CEDS%20for%20EDA%20Final.pdf

[161] Land of Sky Comprehensive Economic Development Strategy 2007-2010, revised September 2010, ftp://www.landofskygis.org/CEDS/2010%20Revised%20CEDS%20for%20EDA%20Final.pdf

[162] Public Policy Polling "North Carolina Environmental Poll Survey Results" April 2011. http://www.publicpolicypolling.com/pdf/NCEnvironmentPoll411.pdf

[163] http://www.thrivenc.com/

recreational opportunities such as the state's beaches, national and state parks and mountains that offer boating, kayaking and fishing.

Industrial and manufacturing companies benefit from anti-degradation policies. Water quality standards may help North Carolina's existing and future companies that rely on stable sources of water with extremely low levels of contaminants such as metals. By providing cleaner source water, these industries spend less money on water processing. Industries that rely on clean water include:

Nanotechnology products	Semiconductor
Pharmaceutical	Alloy metal fabrication
Laboratory	Medical devices
Electronics	

In addition to the immediate benefits of clean water, some economists, including Michael Porter, an economist from Harvard University, have hypothesized that environmental regulation makes companies more globally competitive in the long term because it forces them to innovate and use resources more efficiently. The most successful companies are those that continually improve and innovate under shifting constraints.[164]

Companies can offset some of the cost of environmental regulation when re-examination of products and production processes yields higher resource productivity. This increased productivity may be in the form of higher process yields, savings from less materials (due to substitution, reuse or recycling of production inputs), better utilization of by-products, reduced material storage and handling costs, reduced waste disposal costs, or safer workplace conditions. These offsets may be interdependent, so that achieving one can lead to the realization of additional benefits.[165] While empirical evidence supports this position, [166]this view is not universally accepted.

[164] Porter, Michael E. and van der Linde, Claas. "Toward a New Conception of the Environment-Competitiveness Relationship" *The Journal of Economic Perspectives* Vol. 9, No. 4 (Autumn, 1995), pp. 97-118.
[165] *Ibid;* Minnesota Technical Assistance Program, University of Minnesota. "Cost Effective Pollution Prevention Strategies to Reduce Phosphorus in the Minnesota and Lower Mississippi River Basins". http://www.mntap.umn.edu/potw/resources/McKnight02.pdf
[166] Rassier, D. and Earnhart, D. "Short-run and Long-run Implications of Environmental Regulation on Financial Performance" *Contemporary Economic Policy*. Vol. 29 No. 3. July 2011, pp. 357-373.