Cardno ENTRIX

Shaping the Future

Economic Analysis of the Proposed Federal Numeric Nutrient Criteria for Florida

November, 2010

Florida Numeric Nutrient Criteria No. 02953001.00

Prepared For

Florida Water Quality Coalition

Economic Analysis of the Proposed Numeric Nutrient Criteria for Florida

November 2010

Florida Numeric Nutrient Criteria No. 02953001.00

Prepared for
Florida Water Quality Coalition

Prepared by
Cardno ENTRIX
3141 John Humphries Wynd, Suite 265, Raleigh, NC 27612
Tel 919 239 8900 Fax 919 239 8913 Toll-free 800 368 7511
www.cardnoentrix.com

Table of Contents

Executive Summary ES-1

ES.1 Direct Compliance Costs of the Proposed Federal NNC Far Exceed the EPA Estimates ES-2

ES.2 There are Significant Distributional and Socioeconomic Impacts of EPA's Proposed Regulations ES-5

ES.3 Benefits Associated with EPA's New Water Quality Standards are Uncertain ES-6

Chapter 1 Introduction 1

1.1 Purpose and Scope of Analysis 1

1.2 Organization 2

Chapter 2 Methods for Estimating Compliance Costs 1

2.1 Use of Existing Data and Interviews 1

2.2 Baseline Conditions 2

2.3 Incorporation of Uncertainty 3

2.4 Costs by Class of Potentially Affected Water Body 4

2.4.1 Water Body Categories 4

2.4.2 Number of Affected Entities by Water Body Category 8

2.5 Summary of Per Unit Cost Ranges by Sector 9

Chapter 3 Compliance Cost Estimates 1

3.1 Total Cost Estimate Findings by Water Body Category 1

3.1.1 Potential Cost Savings by Water Body Category 2

3.2 Summary of Cost Ranges by Scenario 3

Chapter 4 Indirect and Distributional Costs 1

4.1 Distributional Effects 2

4.2 Effects by County/Region 2

4.3 Effects by Industry 8

Chapter 5 Uncertain Benefits 1

5.1 Little to No Benefit to 'Improve' Unimpaired Water Bodies 1

5.2 Methodological Concerns with EPA Approach 2

5.2.1 EPA Benefit Estimate 2

5.2.2 Benefits Cited by EPA 3

Chapter 6 References 1

Tables

Table 2-1 Water Bodies Covered by Proposed Federal NNC by Impairment Category 6

Table 2-2 Potentially Affected Dischargers by Water Body Category 8

Table 2-3 Per Unit Average Annual Compliance Costs – BMP and LOT Requirement 11

Table 2-4 Per Unit Average Annual Compliance Costs – End of Pipe Requirement 11

Table 3-1 Annual Cost of Compliance by Water Body Category Assuming All Dischargers Affected by Proposed Federal NNC (Millions $) – BMP and LOT Requirement 2

Table 3-2 Annual Cost of Compliance by Water Body Category Assuming All Dischargers Affected by Proposed Federal NNC (Millions $) – End-of-Pipe Requirement 2

Table 3-3 Annual Compliance Costs by Enforcement Scenario (Millions $) 3

Table 4-2 Affected Industries and Expected Direction and Magnitude of Ripple Effect 9

Table A-1 Total Cost and Poverty Rate by County (in millions) 1

Table B-1 End of Pipe Requirement, All Water Bodies Costs (Millions $) 1

Figures

Figure ES-1 Financial Risk – End-of-Pipe Requirement Annual Cost 4

Figure ES-2 Financial Risk – BMP and LOT Requirement Annual Cost 4

Figure ES-3 Direct Annual Compliance Costs by Scenario and Sector 5

Figure ES-4 Distribution of Annual Compliance Cost by Water Body Category 7

Figure 5-1 Distribution of Annual Compliance by Water Body Category 2

Maps

Map 1 Categorization of Florida Inland Water Bodies by Impairment Status 2-7

Map 2 Cost by County of End of Pipe Requirement 4-3

Map 3 Cost by County of BMP and LOT Requirement 4-4

Map 4 End of Pipe Compliance Cost as a Percent of Total County Earnings 4-7

Executive Summary

Florida currently has a narrative nutrient standard to guide the management and protection of its waters. In January 2010, the Environmental Protection Agency (EPA) published proposed "Water Quality Standards for the State of Florida's Lakes and Flowing Waters" which details numeric nutrient criteria (federal proposed NNC). Estuarine, marine, and canal criteria will be the subject of a subsequent phase of rule-making and are not considered in this report. EPA provided an assessment (i.e. "EPA Economic Analysis") of the potential benefits and costs of its proposed federal NNC, along with an assessment of the economics associated with the draft NNC rule from the Florida Department of Environmental Protection (FDEP).[1] Per unit compliance costs from the EPA Economic Analysis differed widely from estimates provided by other entities, including FDEP.

On behalf of the Florida Water Quality Coalition, Cardno ENTRIX has conducted an independent study of compliance costs using the EPA Economic Analysis, the economic studies conducted by the regulated community, public comments, and information gathered from interviews of many Florida entities that will be affected by the proposed rule. In contrast to many previous analyses, this study considers the impact of uncertainty about the stringency with which the NNC would be applied, the compliance costs for different types of water bodies compared to the benefits, and the indirect costs on the Florida economy. This study provides a summary of findings regarding the relative magnitude of the direct and indirect costs of the proposed federal NNC, as well as a review of EPA's benefit estimating methodology and findings. The major findings of the study are:

- The costs of the proposed federal NNC regulations far exceed the EPA estimates. The EPA has inadequately accounted for existing baseline conditions, failed to address all direct costs, and did not considered all indirect costs to businesses and the public including the costs of uncertainty. If the EPA enforces "end-of-pipe" criteria (requiring all discharger effluent levels to be at or below the NNC), the total annual costs could range from $3.1 to $8.4 billion (based on the estimated fifth and ninety-fifth percentile of costs). Even if EPA enforces criteria to a less strict Best Management Practices (BMPs) and Limit of Technology (LOT) standard in which effluent is not at or below the federal proposed NNC, then the annual costs could range from $1.0 to $3.2 billion (based on the estimated fifth and ninety-fifth percentile of costs in this scenario).[2] These annual costs include operation and maintenance costs a well as capital costs annualized over a 30-year period; estimated annual costs may extend indefinitely past the 30-year period as new capital costs may be required.

---

1 Environmental Protection Agency, 2010, "Preliminary estimate of Potential Compliance Costs and Benefits Associated with EPA's Proposed Numeric Nutrient Criteria for Florida".

2 Even assuming, as the EPA Economic Analysis does, that the direct compliance costs of the proposed federal NNC are limited to implementing BMP's and LOT for dischargers located only on impaired water bodies ($481 million annually), this analysis still estimates that the direct compliance costs are 45 times greater than the upper end of EPA costs ($10.6 million). It is important to note that the FDEP disagreed with EPA's characterization of LOT and the assumption that implementation of BMPs would be sufficient to comply with the proposed federal NNC.

- There are significant distributional and socioeconomic impacts of EPA's proposed regulations. There will be high costs to economically distressed areas as well as substantial economic costs and dislocation impacts on certain economic sectors in the state. Over 20 counties in Florida have poverty rates that exceed 20 percent (the national average is 14 percent); annual compliance costs in these high poverty counties are expected to total $256 to $647 million annually. While some industries such as construction may benefit from the criteria, many industries such as housing and retail trade are expected to suffer.
- The benefits associated with EPA's new water quality standards are uncertain. There is little quantifiable benefit demonstrated with respect to improving water quality in healthy water bodies that will now be considered "impaired" under EPA regulations. For example, with 90 percent certainty, the annual end-of-pipe compliance costs for these "newly" impaired water bodies are estimated in this study to range from $0.8 to $2.1 billion, with an average estimated cost of $1.3 billion.

ES.1 Direct Compliance Costs of the Proposed Federal NNC Far Exceed the EPA Estimates

The EPA cost estimates fail to consider the impact of uncertainty and therefore underestimate the overall cost of the proposed federal NNC regulation. There are two factors driving the uncertainty about the direct compliance costs:

1. Uncertainty in the level of treatment that will be required of affected entities (i.e., expected increased per unit treatment cost to dischargers), and;

2. Uncertainty in the number of affected entities (i.e., expected number of dischargers needing new or additional treatment).

The EPA Economic Analysis estimates costs of implementing BMPs and upgrading current technology, but notes "it may be infeasible to meet the criteria instream due to technology limitations (p. 6)". The EPA states that regulatory relief may need to be considered, including lakes criteria adjustment procedures, site-specific alternative criteria (SSAC), restoration standards, variances, or use attainability analyses (together referred to as "variances" hereafter). In its economic analysis, the EPA did not address the feasibility or costs of utilizing these provisions. The EPA asserts that it does not know the extent of the use of these variances and therefore it cannot estimate compliance costs. A more reasonable approach would be to estimate the costs of using alternative technologies (such as reverse osmosis) that may be required for dischargers to meet the actual federal criteria and estimate the uncertainty that end-of-pipe criteria may be required for all water bodies. The Cardno ENTRIX study uses this latter approach. The study synthesizes the results of several existing cost estimates to provide a clearer picture of the costs and uncertainties associated with the proposed federal NNC. The study uses standard statistical techniques for estimating costs under uncertainty and different enforcement scenarios about compliance levels for the proposed federal NNC.

Compliance costs were estimated for two treatment level scenarios: 1) an End-of-Pipe Requirement that assumes that the proposed federal NNC will require all dischargers on affected water bodies to reduce their effluent levels to at or below the NNC; and 2) a less strict requirement that assumes that compliance will be achieved using standard BMPs and reaching LOT of existing technology. Effluent levels under the standard BMP and LOT Requirement will not achieve the criteria, and

actual nutrient reductions required to comply with the proposed federal NNC will be specific to each water body. According to the EPA, to an unknown degree, variances from strict compliance with the criteria may be granted for specific water bodies. We could find no information about the likelihood that variances would be granted although members of the public filed comments regarding the lack of perceived feasibility of pursuing and receiving widespread variances from the rule. Also, EPA's reliance on variance provisions raises a more fundamental issue regarding the reasonableness of analyzing the economic impact of the proposed federal NNC in the context of regulators granting an unknown and potentially limitless number of exceptions to the standards. Due to the uncertainty regarding both variances and the treatment requirement, we include implementation of standard BMPs and LOT as an alternative scenario to the End-of-Pipe Requirement. This scenario does not include the costs of conducting studies in attempts to obtain variances.

Additionally, the study estimates compliance costs using different numbers of affected entities based on varying assumptions regarding the application of the proposed federal NNC to different water body types (i.e., currently impaired, newly impaired due to NNC, and unimpaired under NNC). The EPA Economic Analysis assumes that increased treatment costs occur only for newly impaired water bodies; our analysis estimates costs for newly impaired, currently impaired, and unimpaired water bodies. Under all scenarios, compliance cost estimates use Florida's current water quality standard as the baseline. Furthermore, under all scenarios, compliance cost estimate are based on current costs of water treatment and do not anticipate changes in cost structures due to advances in technology.

The figures below summarize the results. Figure ES-1 and Figure ES-2 show the potential range of annual compliance costs associated with the two principal scenarios we evaluated.

Figure ES-1 shows that there is a 90 percent chance that total annual costs will (potentially indefinitely) range from $3.1 to $8.4 billion (in 2010 dollars) assuming an End-of-Pipe Requirement for complying with the proposed federal NNC for all inland water bodies, excluding South Florida. Figure ES-2 shows there is a 90 percent chance that annual costs for affected entities under the BMP and LOT Requirement scenario on all water bodies will range from $1.0 to $3.3 billion. Much of this cost is upfront capital cost that likely would be incurred in the first few years of implementing the NNC. Cost estimates are based on the assumption that capital costs are paid back during a 30-year time period; however the estimated annual costs may extend indefinitely past the 30-year period as operation and maintenance and, potentially, new capital costs will be required. Again, it is important to note that, under both scenarios, these costs would be in addition to current or currently anticipated costs for compliance under Florida's existing water quality standards and associated regulations.

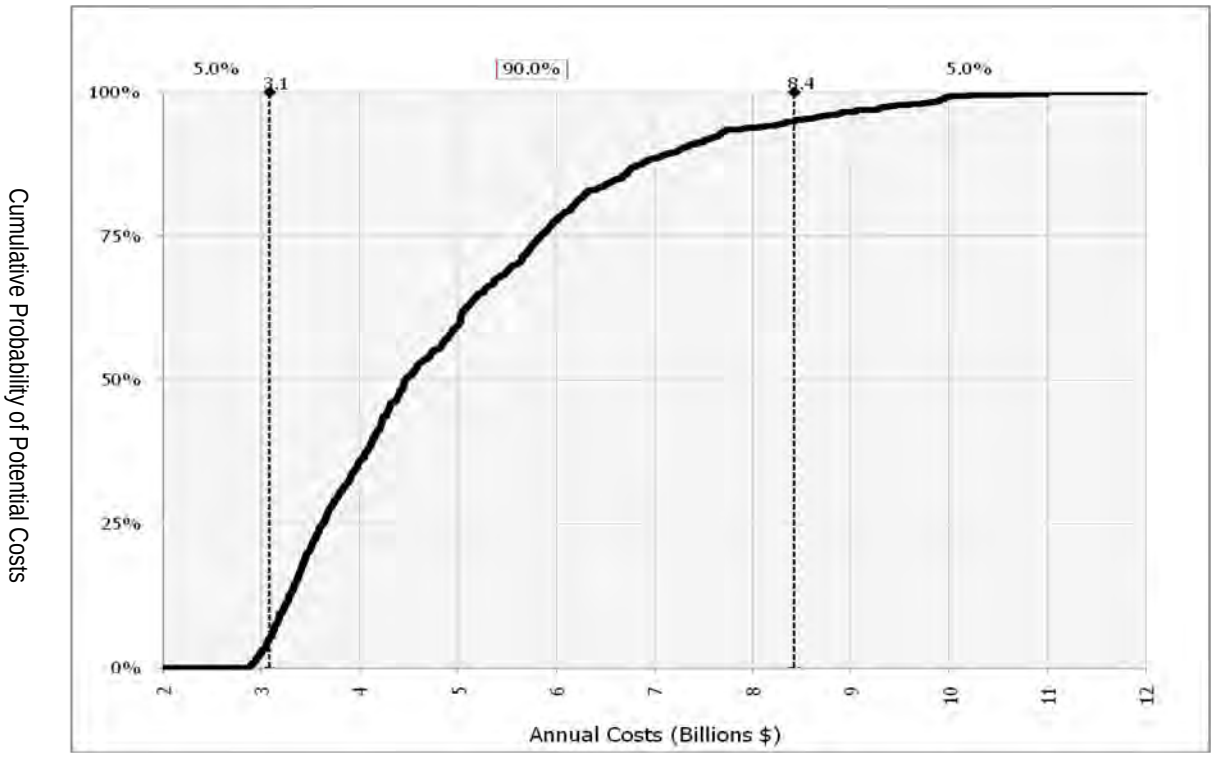


Figure ES-1 Financial Risk – End-of-Pipe Requirement Annual Cost

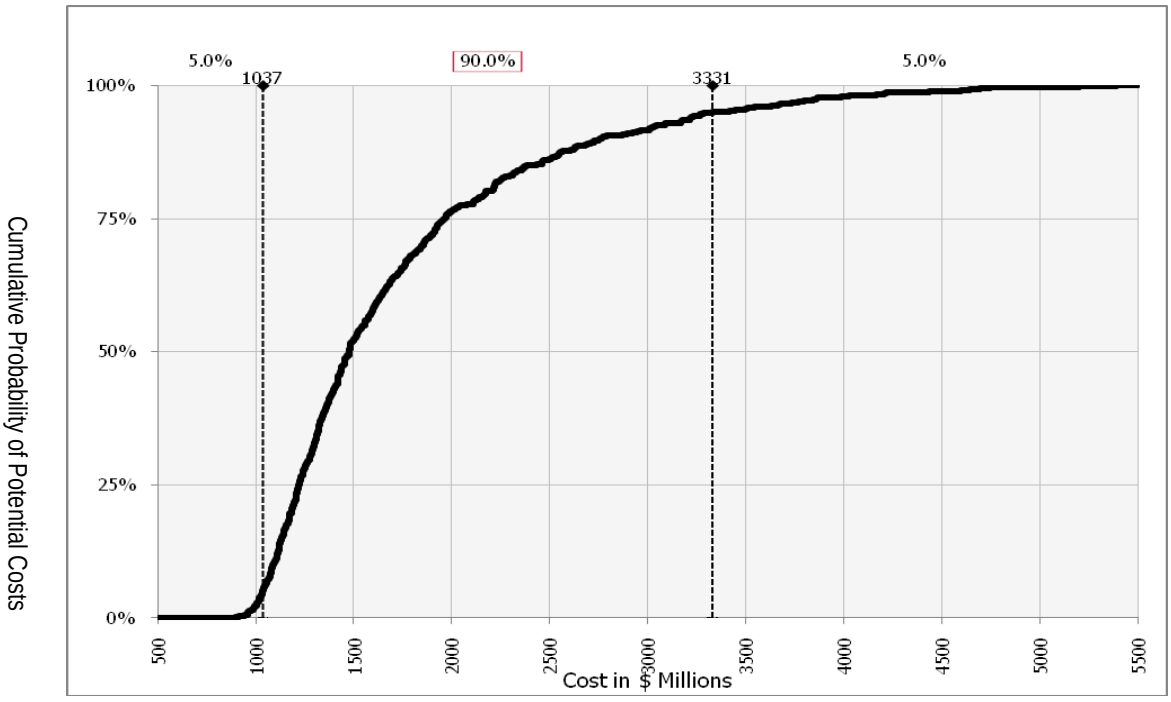


Figure ES-2 Financial Risk – BMP and LOT Requirement Annual Cost

Figure ES-3 shows the estimated annual direct compliance costs to the six sectors analyzed: agriculture, municipal wastewater treatment plants (WWTPs), industry, urban stormwater, septic

tanks, and state agencies (for development and enforcement of 'Total Maximum Daily Load' or TMDL limits). It shows that average expected annual costs are significant for all sectors, ranging from $240 million for septic tanks and over $2.1 billion for stormwater, based on the End-of-Pipe Requirement in all inland waters (these costs change to $41 million to $783 million based on the BMP and LOT Requirement). As indicated in Figure ES-3, stormwater costs in particular rise dramatically if enforcement of the proposed federal NNC is to meet the End-of-Pipe Requirement and applies to all inland water bodies. Stormwater and municipal WWTP costs are largely borne by local city and county governments, and thus are passed on to rate payers or tax payers. Together with the cost to state agencies of implementing and developing TMDLs, total costs to the public sector are expected to account for approximately 60 percent of total costs.

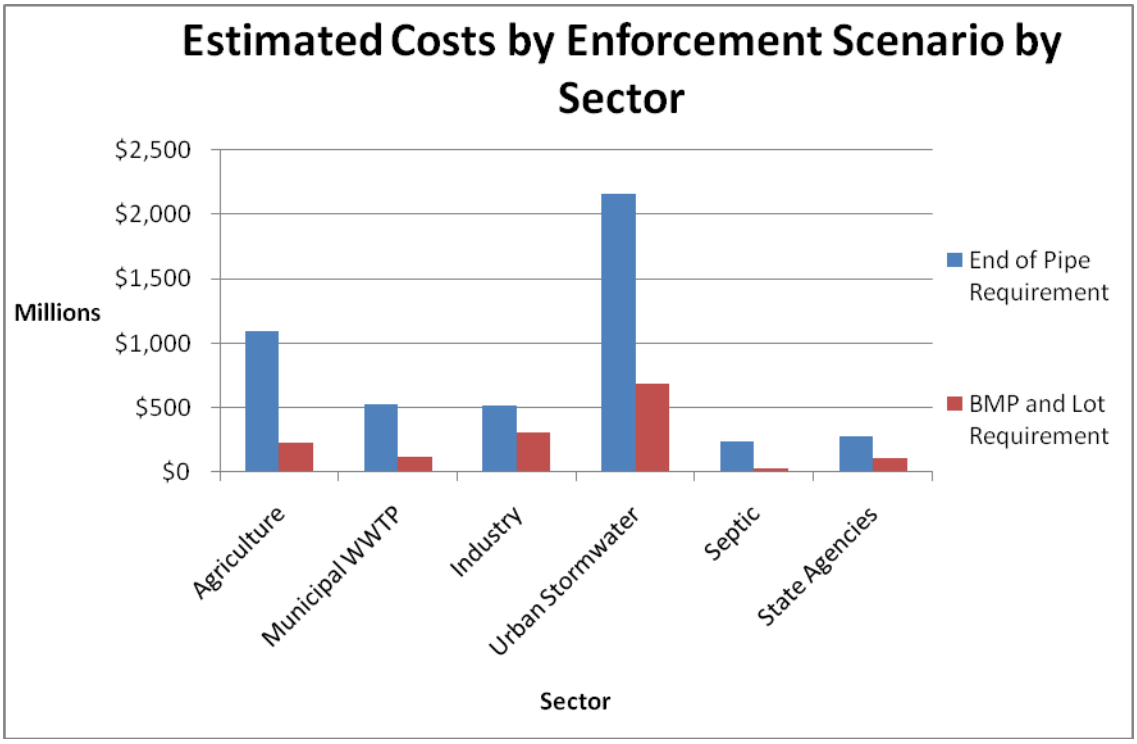


Figure ES-3 Direct Annual Compliance Costs by Scenario and Sector

ES.2 There are Significant Distributional and Socioeconomic Impacts of EPA's Proposed Regulations

There will be high costs to economically distressed areas as well as substantial economic costs and dislocation impacts on certain economic sectors in the state. Many counties already experiencing severe socioeconomic conditions will feel the impacts of the proposed federal NNC. Over 20 counties in Florida have poverty rates that exceed 20 percent (the national average is 14 percent); annual compliance costs in these counties are expected to total $256 to $647 million. Complying with the proposed federal NNC will cause significantly higher costs on a per capita and per income basis in counties with poverty rates exceeding 20 percent. Under the End-of-Pipe Requirement scenario, the average cost of compliance per person ($1,342) is three and a half times greater in these counties than in counties with poverty rates under 20 percent. Further, in this scenario, the cost per dollar earned (4 percent) is 300 percent higher in these counties indicating that a larger proportion of

each dollar earned will be used to pay for the proposed federal NNC compliance. For example, in Hamilton County, the cost per person of End of Pipe Requirement scenario compliance is projected to be over $11,700, or 467 percent of total county earnings.

Further impacts may include increases in utility costs, which can also depress housing prices and further depress the retail and commercial development industry. Implementation of the proposed federal NNC could increase the cost of owning a home, and therefore decrease the value of a home; it can also divert spending from the service and retail sectors to spending on utilities.

ES.3 Benefits Associated with EPA's New Water Quality Standards are Uncertain

Benefits identified in the EPA Economic Analysis are highly uncertain. Many believe that the benefits from vastly increasing the number of water bodies listed as impaired fail to justify the costs. Florida water quality experts review Florida surface waters for nutrient impairment in accordance with Florida's existing Impaired Waters Rule (IWR), and these experts believe that the vast majority of Florida lakes and flowing waters with existing water quality problems are already identified as impaired water bodies. As such, most of the estimated 2,174 water bodies that may be newly listed as impaired under the proposed federal criteria likely do not merit being listed as impaired in light of the established Designated Uses for Florida waters and will not benefit from imposing the proposed federal NNC. This study shows that the potential compliance costs for "newly" impaired water bodies account for more than 25 percent of total costs (Figure ES-4). Listing water bodies with acceptable ecological and human health conditions as impaired would allocate state resources unnecessarily to develop TMDLs, create "restoration" programs and create or increase treatment costs for discharges to these water bodies. Experts in Florida water resource management feel these limited resources would be better spent improving the water quality of those waters already listed as impaired for nutrients under the current IWR.

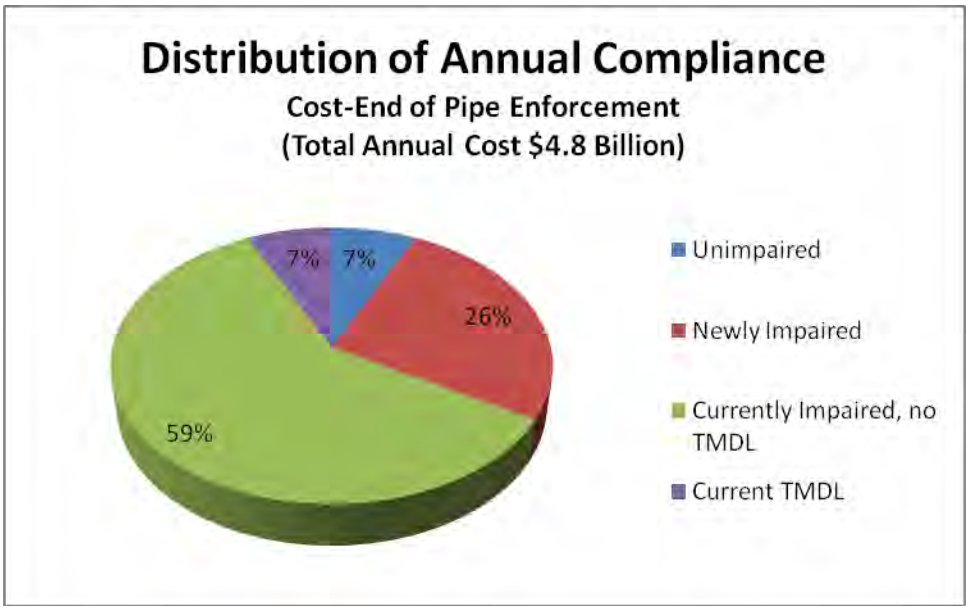


Figure ES-4 Distribution of Annual Compliance Cost by Water Body Category

In addition, the EPA's estimate of benefits is highly uncertain, and it is reasonable to assume that the benefits from the proposed federal NNC should be large enough to equal or outweigh the costs. EPA points to the potential economic value of improved water quality in both its preamble and in a separate Technical Support Document. Both discussions have the same two flaws. First, information and validation showing that specific locations will benefit in meaningful, measurable ways from imposing the criteria are lacking. As a general matter, economic benefits arising from these types of actions are site-specific and EPA's benefits assessment provides no information about the potential site-specific benefits (and their relationship to costs). In this sense, problems with EPA's economic benefits estimates mirror the flaws with several aspects of the technical approach to setting the proposed federal NNC (i.e., lack of clear connection between the required nutrient reduction and the anticipated ecological response). Secondly, even when focusing on "generic" rather than site-specific benefits, the studies cited by the EPA do not provide reliable estimates of water quality improvements.

Chapter 1

Introduction

Florida currently has a narrative nutrient standard to guide the management and protection of its waters. In January 2010, the Environmental Protection Agency (EPA) published proposed "Water Quality Standards for the State of Florida's Lakes and Flowing Waters" that detail numeric nutrient criteria (federal proposed NNC). EPA provided an assessment ("EPA Economic Analysis") of the potential benefits and costs of its proposed federal NNC, as well as an assessment of the economics of the draft NNC rule from the Florida Department of Environmental Protection (FDEP). During the public comment period, numerous Florida municipalities, industries, non-profit agencies, and state agencies (including the FDEP) provided comments on the proposed rule and the EPA Economic Analysis. Many of these comments disputed the methods and the findings of the EPA Economic Analysis.

1.1 Purpose and Scope of Analysis

On behalf of the Florida Water Quality Coalition, Cardno ENTRIX has conducted an independent review of the EPA Economic Analysis, the economic studies conducted by the regulated community, the public comments on the proposed federal NNC, and has also interviewed many Florida entities that will be affected by the proposed rule. This study provides a summary of findings regarding the relative magnitude of the direct and indirect costs of the proposed federal NNC. Similar to the EPA Economic Analysis, direct costs are estimated for five sectors: agriculture, municipal wastewater treatment plants (WWTPs), urban stormwater, industry, and septic tanks. Additionally, costs are estimated for state resource agencies to develop and implement TMDL thresholds for impaired water bodies. The purpose of this analysis was not to develop independent compliance cost estimates for each sector, but rather to utilize existing cost estimates to standardize estimates and incorporate uncertainty into total cost estimates.

This analysis provides estimates of direct compliance costs that reflect the best available information about the uncertainty of the costs and the impact of the proposed federal NNC. The geographic scope of the analysis is inland lakes and flowing water bodies, excluding South Florida, for which NNC establishment has been postponed. Estuarine, marine, and South Florida canal criteria will be the subject of a subsequent phase of rule-making and are not considered in this analysis. Furthermore, under all scenarios, compliance cost estimate are based on current costs of water treatment and do not anticipate changes in cost structures due to advances in technology.

While the EPA analysis estimated that the proposed federal NNC are applicable to 5,089 water bodies (as designated by water body identification numbers or WBIDs), this analysis identifies and estimates costs based on 5,147 water bodies. This study analyzes the potential impact of requiring additional water treatment by dischargers to all 5,147 water bodies. In contrast, the

EPA analysis assessed impacts only on the 190 streams that it classified as 'incrementally' impaired compared to the draft Florida NNC.

This analysis shows impacts by sector, by water body impairment status, and by county. It also provides a summary of the indirect impacts of the proposed federal NNC on the Florida economy and quality of life. Finally, the analysis includes a review of the benefits of the proposed federal NNC as estimated by the EPA.

1.2 Organization

This report is organized into five chapters. Following this introduction, Chapter 2 summarizes the methodology and data used to estimate direct costs, including the statistical methods used to incorporate uncertainty. Chapter 3 presents estimates of direct compliance costs by sector and water body impairment status. Chapter 4 discusses indirect and distributional impacts, while Chapter 5 reviews the methods and findings of EPA's estimated benefits.

Chapter 2

Methods for Estimating Compliance Costs

To estimate direct compliance costs, our methodology is based on the following primary steps:

1. Collect all existing cost estimates, and define ranges in all primary variables driving per unit costs (i.e. costs per acre, per septic tank, per million gallons treated daily (mgd), etc). Primary variables driving per unit costs include implementation rate, capital cost, existing level of technology, operation and maintenance cost, interest rate, and payment period.

2. Estimate per unit expected average compliance cost. To incorporate uncertainty, use low, high, and most likely cost estimates for each variable, and conduct Monte Carlo statistical analysis to estimate the most likely average per unit compliance cost across entities in Florida for each sector studied. Conduct several Monte Carlo analyses for each sector to account for different levels of potentially required treatment. Monte Carlo methods, described in more detail below, are commonly used for modeling costs when there is significant uncertainty in inputs

3. Collect spatial data on dischargers and on water body impairment status. Estimate the number of affected entities by sector by water body impairment status (water body category) and county, identifying characteristics that would affect the choice of per unit treatment cost (such as whether a municipal WWTP had existing LOT according to EPA and whether it was located in a county with deep well injection).

4. Multiply the number of units (acres, mgd, septic tanks) of affected entities in each water body category in each county by the relevant per unit cost to estimate total costs by water body category and by county.

This chapter describes the primary data sources, the definition of baseline conditions, how uncertainty was incorporated into the analysis, and how water body impairment status and the number of affected entities were estimated. Finally, per unit compliance costs estimated using Monte Carlo methods are presented.

2.1 Use of Existing Data and Interviews

All direct cost estimates in this study are derived from existing cost estimates, including those presented in EPA Economic Analysis, the FDEP Review of EPA's Economic Analysis (FDEP Economic Analysis), and reports submitted in the public comment process from municipalities, industries, and other affected entities. To thoroughly understand and document cost estimate assumptions, Cardno ENTRIX spoke with many authors of original cost estimate reports prepared in response to the proposed federal NNC. These sources of information were supplemented with numerous additional interviews with water quality professionals in Florida, including representatives from trade groups, industry, municipalities, FDEP, and other consulting

firms. Cardno ENTRIX spoke with organizations such as the Florida Water Environment Association (FWEA), FDEP, EPA, Florida Pulp and Paper Association, and Florida Stormwater Association (FSA) on the individual, regional, and industry specific impacts and costs associated with the proposed federal NNC. Engineering processes and costs were also discussed with engineers from multiple leading engineering firms with specialized experience in Florida and with the EPA proposal. These interviews were used to identify the key variables driving costs and to identify ranges in uncertainty according to these experts and report authors. It is important to note that each cost estimate provided to Cardno ENTRIX included its own assumptions and uncertainties that were not all independently evaluated in this study.

Spatial data was also gathered, including data on water body impairment status, National Pollution Discharge Elimination System (NPDES) permits, and land use and land cover data.

2.2 Baseline Conditions

In specifying a baseline for cost-benefit analysis, EPA guidance on cost-benefit analysis requires that all aspects of the baseline condition that are uncertain and all assumptions made in specifying the baseline should be clearly identified. The EPA Economic Analysis does not provide adequate information on this issue.[3]

The goal of economic analysis should be to provide an overall assessment of the potential benefits and costs of the proposed federal NNC. Because the total costs and benefits of the proposed rule are critical knowledge for the State of Florida and its residents, there is a reasonable expectation that EPA should use a baseline that considers total costs and benefits. The EPA asserts that, because the draft FDEP criteria are likely to be implemented in the absence of the proposed federal NNC, the FDEP criteria constitute a baseline. This is incorrect. The FDEP proposed criteria do not represent the current regulatory conditions, had not yet been formally proposed as criteria, and could have been changed by FDEP in response to public comments. In addition, when the EPA finalizes its proposed federal NNC, the FDEP criteria will never have been in force and the current narrative criteria would still constitute the baseline for comparison.

This analysis uses the narrative criteria currently in place in Florida as its baseline condition. Thus, it is important to acknowledge that the incremental effect of the proposed federal NNC is not known for some water bodies. For example, there are some water bodies that are currently impaired for which TMDLs have not yet been completed. As it is not known what would be required under the TMDL that would be created under the baseline condition, the incremental additional compliance that would be required by the proposed federal NNC is not known. Similarly, it is not known what additional compliance costs may be required of dischargers to water bodies with established TMDLs. In the absence of water body-specific information on how the proposed federal NNC would differ from the current narrative criteria, this analysis estimates potential additional compliance costs to all water body types, regardless of impairment status.

[3] According to the EPA's January 2010 Proposed Rule, the FDEP criteria used in the EPA Economic Analysis to describe a baseline condition differs from the draft FDEP criteria. Finally, the EPA does not use its actual proposed federal NNC in the EPA Economic Analysis.

2.3 Incorporation of Uncertainty

A primary driver in the wide variation in existing cost estimates regarding the proposed federal NNC is the treatment of uncertainty. In fact, it is the major reason that the EPA cost estimates are unrealistically low. The fundamental cause of the difference between the FDEP Economic Analysis estimates and the EPA estimates is that the EPA Economic Analysis estimates costs of implementing best management practices (BMPs) and upgrading current technology, but notes that "it may be infeasible to meet the criteria instream due to technology limitations (p. 6)". In contrast, the FDEP estimates are based on all sectors reducing discharges to the proposed federal NNC standards to the extent feasible under reverse osmosis and other technologies.

The EPA states that regulatory relief may need to be considered, including a proposed lakes criteria adjustment procedure, granting of site-specific alternative criteria (SSAC), use of restoration standards to extend the compliance period, variances, or Use Attainability Assessments (UAAs) (together referred to as "variances" hereafter). The EPA acknowledges that it does not know the extent of the use of these variances and therefore it cannot estimate compliance costs. Recognizing the inherent uncertainty in estimating compliance cost, this study has identified two factors driving uncertainty and has developed processes for incorporating this uncertainty into cost estimates.

Two primary factors driving uncertainty on direct compliance costs are:

1. Uncertainty in the level of treatment that will be required of affected entities (i.e., expected increased per unit treatment cost to dischargers), and;

2. Uncertainty in the number of affected entities (i.e., expected number of dischargers needing new or additional treatment).

For the first factor, our approach in this analysis is to incorporate uncertainty by looking at two levels of treatment that may be required: a lower level utilized by EPA in its cost analysis that relies on standard BMPs and upgrading existing technology to what EPA characterizes as the LOT, and a higher level that requires all dischargers (direct dischargers to surface water as well as septic tanks) to reduce effluent nutrient levels to the proposed federal NNC (i.e. an End-of-Pipe Requirement). Experts in Florida agree that in many cases, effluent levels under the standard BMP and LOT requirement will not be at or below the criteria, and actual nutrient reductions required to comply with the proposed federal NNC will be specific to each water body. However, as assumed in the EPA Economic Analysis, it is possible that standard BMPs and LOT, in conjunction with variances, may be sufficient to comply with certain criteria in at least some water bodies. According to the EPA, to an unknown degree, variances from strict compliance with the criteria may be granted for specific water bodies although members of the public filed comments regarding the lack of perceived feasibility of pursuing and receiving widespread variances from the rule. Also, EPA's reliance on variance provisions raises a more fundamental issue regarding the reasonableness of analyzing a standard's economic impact in the context of regulators granting an unknown and potentially limitless number of exceptions to the standards. Due to the uncertainty regarding both variances and the enforcement requirement, we include implementation of standard BMPs and LOT as an alternative scenario to the End-of-Pipe Requirement. Our evaluation does not include the costs of conducting studies in attempts to obtain variances.

Within these two levels of treatment, there is significant uncertainty regarding compliance costs for any given facility. To incorporate this uncertainty into our estimates, we collected a broad range of cost estimates at each treatment level for each sector and then developed a Monte Carlo simulation specific to each sector to estimate the most likely compliance costs for both the BMP and LOT Requirement and End-of-Pipe Requirement treatment levels.[4]

To address the second factor, as discussed above, this analysis presents all results by water body type and sector (the EPA Economic Analysis estimates costs only for water bodies that are newly listed as impaired under the proposed federal NNC). This method enables easy comparison of how costs differ based on which water bodies and which sectors must upgrade their water treatment due to the proposed federal NNC.

Finally, while not explicitly incorporated into cost estimates, it is important to acknowledge the cost of uncertainty itself. For example, a business would prefer to deal with a known cost of $2 million rather than a cost that ranges from $ 1 to $3 million, even though the expected cost is the same in both cases. The proposed federal NNC introduce considerable uncertainty in doing business in the following areas: the timing of implementation of the requirements, scheduling of the building of the technology, the likelihood of variances, and timing of the TMDL process. Further, much of the technology being discussed has not been implemented in many industries and there is a high level of uncertainty associated with the performance of the technology and possible costs resulting from poor performance.

2.4 Costs by Class of Potentially Affected Water Body

There are an estimated 5,147 water bodies that may be affected by the proposed federal NNC.[5] As the cost of compliance may vary depending on the impairment status of water bodies, this analysis classified four types of water body categories and assessed the number of potentially affected dischargers by water body category.

2.4.1 Water Body Categories

The four water body categories are:

- Category 1: Unimpaired: These water bodies are currently unimpaired and are expected to remain unimpaired under the proposed federal NNC. Entities discharging to these water bodies may be subject to increased water treatment costs if implementation of the proposed federal NNC requires all effluent levels to meet the criteria (end-of-pipe criteria), even if water body sampling indicates that ambient nutrient concentrations are below the proposed federal NNC.

[4] Monte Carlo is a statistical technique often used to simulate physical systems or any system involving a significant amount of risk. The uncertainty in cost estimates in this study is captured by the Monte Carlo simulations to generate estimates of most likely compliance costs for each affected sector.

[5] This number is based on an FDEP database, and differs slightly from the 5,089 number presented in the EPA Economic Analysis.

- Category 2: Newly Impaired: These water bodies are currently classified as unimpaired under the narrative criteria and are expected to become impaired under the proposed federal NNC. These water bodies are expected to be subject to increased water treatment costs under all implementation scenarios.
- Category 3: Currently Impaired, No TMDL: These water bodies are currently listed as impaired under the current narrative criteria but do not have an associated TMDL. Many TMDLs are in the development process and implementing the proposed federal NNC may require redevelopment of TMDLs.
- Category 4: Currently Impaired, TMDL: These water bodies are currently listed as impaired under the current narrative criteria and have a TMDL. It is not known if EPA will accept the TMDL as site-specific alternative criteria (SSAC), or if new TMDLs would need to be developed to comply with the proposed federal NNC.

The number of inland water bodies (excluding South Florida) in each category was estimated using a dataset developed by FDEP to analyze impairment status under the proposed NNC. Table 2-1 summarizes the number of water bodies (each with a distinct water body identification number, or WBID) in each of four categories.

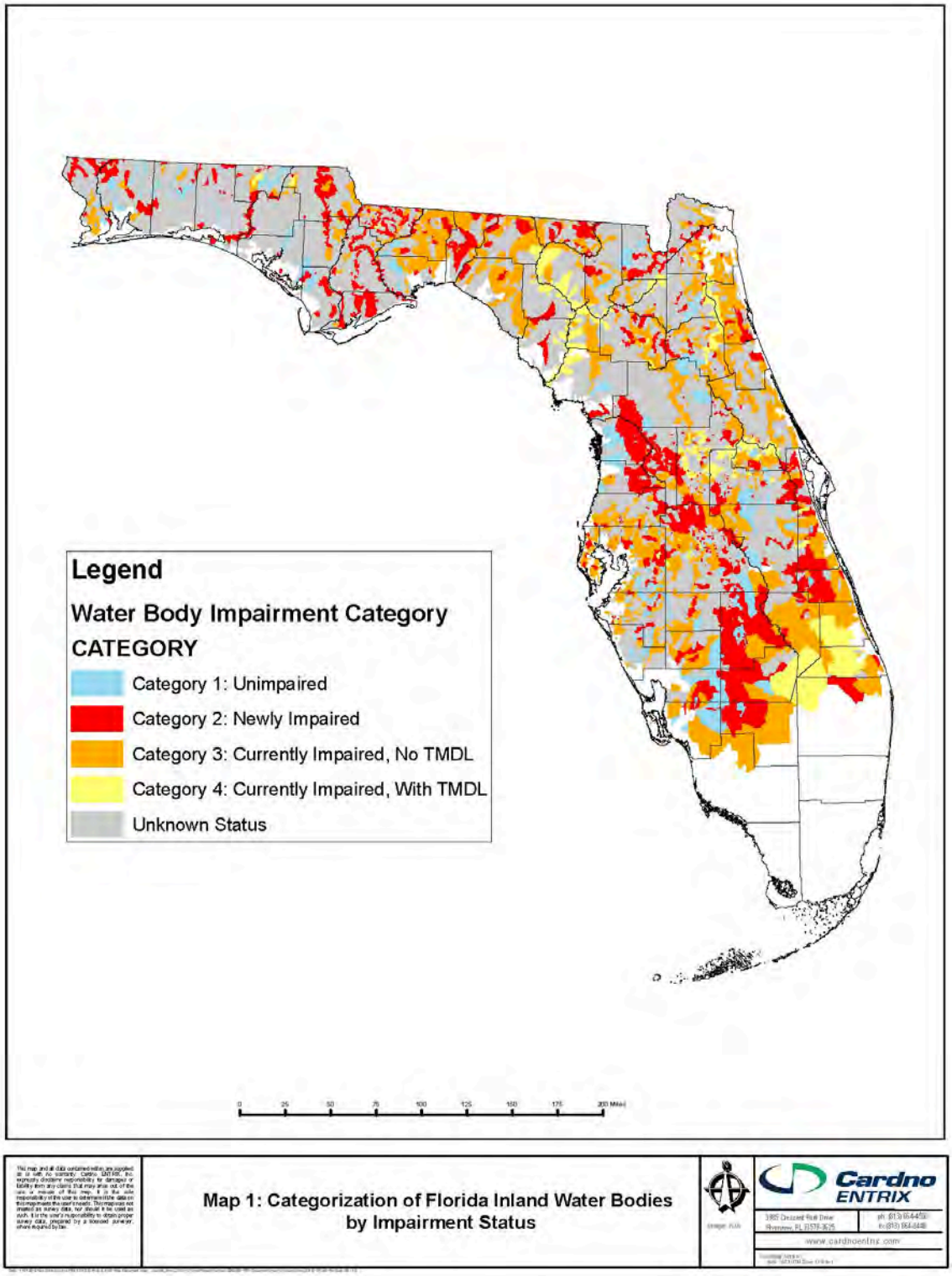
As indicated in the Table 2-1, there are 3,370 water bodies (66 percent of all WBIDs expected to be covered by the proposed federal NNC) for which there is not enough existing water quality data to classify their current or potential future impairment status. Of the water bodies with known impairment status, approximately 9 percent are in Category 1, not currently or newly impaired, 42 percent would become impaired under the proposed federal NNC (Category 2), and 50 percent are currently impaired (Categories 3 and 4). Assuming that the number of water bodies with unknown impairment status are similarly distributed results in the following number of water bodies in Categories 1, 2, 3, 4 (Table 2-1). (To account for uncertainty in the impairment status of these 3,370 water bodies, a range was utilized as indicated in italics in column five of Table 2-1).[6] There are also 39 water bodies that may become unimpaired as a result of the proposed federal NNC; these water bodies were not separately analyzed. Map 1 spatially presents impairment status by water body category.

[6] The range was calculated by allowing the percent allocation of unknown status water bodies to each category to vary by + / - 20 percent. For example, based on the current distribution, the number of newly impaired water bodies is 42 percent. The range applied to unknown water bodies was therefore 33.6% to 50.4% (0.8*42% and 1.2*42%).

Table 2-1 Water Bodies Covered by Proposed Federal NNC by Impairment Category

Water Body Type	Impairment Status: Current Narrative Criteria	Impairment Status: Proposed Federal NNC	Number of Water Bodies (WBID)	Total Known and Estimated Number of Water Bodies[1]	Dischargers Affected by NNC?
Category					
1: Unimpaired	Unimpaired	Unimpaired	154	442 *(Range: 388- 505)*	Yes, if criteria applied as end-of-pipe criteria
2: Newly Impaired	Unimpaired	Impaired	762	2,174 (Range: 1,921 – 2501)	Yes
3: Currently Impaired, no TMDL	Impaired without TMDL	Impaired	753	2,426 (Range: 2,058 – 2,711)	
4: Current TMDL	Impaired with TMDL	Impaired	105	105	Yes, if TMDL not accepted as SSAC
Unknown Status					
Insufficient Data to Classify			503		
Not Included in FDEP Database			2,870		
Total			5,147	5,147	

1. The number of water bodies in categories 1 through 4 based on redistributing water bodies of unknown status to categories 1, 2, and 3.



Map 1 Categorization of Florida Inland Water Bodies by Impairment Status

2.4.2 Number of Affected Entities by Water Body Category

Combining spatial data on the impairment status of each of the 5,147 waterbodies with spatial data on NPDES permits, agricultural acreage, acreage draining into each water body, and total acreage in each county, the number and size of potentially affected entities was estimated for each water body category. Table 2-2 provides the results of this analysis. Details regarding the analysis are summarized below.

Table 2-2 Potentially Affected Dischargers by Water Body Category

Sector	Units	1: Unimpaired	2: Newly Impaired	3: Currently Impaired, no TMDL	4: Current TMDL	Total
Agriculture Gross Acres	Acres	1,456,900	4,722,000	6,724,000	701,800	13,604,900
Agriculture Harvested Acres	Acres	1,292,000	4,198,000	5,669,100	468,200	11,626,900
Urban Stormwater (Estimated MS4 Service Area)	Acres	192,000	714,1000	1,926,000	177,000	3,009,000
Septic	# Tanks	237,800	714,400	1,067,400	170,200	2,189,800
Municipal Wastewater (NPDES permit capacity)	MGD	22.8	72.6	222.6	18.5	336.5
Existing Treatment Not at LOT	MGD	15.1	50.7	150.1	15.7	231.6
Access to Deep Well Injection	MGD	19.2	19.3	49.0	0.7	88
Industrial (NPDES permit capacity)[1]	MGD	13.7	42.1	163.0	29.6	284.4
Access to Deep Well Injection	MGD	0	0	27.0	0	27.0
State Agency	TMDL	0	1,087	0 – 1,213	0 - 53	1,087 – 2,353

1. In addition, there are 9 permits for phosphate fertilizer operations, with an estimated 4 billion gallons of wastewater per facility to dispose of at plant closure.

- Agriculture: Total acreage in each water body category was based on the 2007 Census data on harvested and gross acreage, and allocated to county and water body category using proportions based on data from the Florida Land Use Classification Code (FLUCC) for all agricultural lands (FLUCC 2000). Due to uncertainty regarding the proportion of total harvested and gross acreage that drains to inland waters as well as changes in acreage since 2007, a range of total agricultural acreage was utilized, equal to 85 to 105 percent of total 2007 acreage.
- Urban Stormwater: The GIS dataset on MS4 permits provided the number and location of stormwater permits discharging to the 5,147 inland water bodies, but did not provide the service area acreage. To estimate service area acreage by permit, permits were also classified by county. Based on the proportion of population in the county relative to other counties, and the total urban acreage draining to inland waters in Florida (3,000,900 acres as estimated in the FDEP Economic Analysis), acreage was allocated to each stormwater permit in each county. For example, Alachua County has two percent of the population of all counties with MS4 permits on inland water bodies. Therefore, it was assumed that there were 63,000 urban acres served by MS4s in Alachua County (two percent of 3,000,900 acres). As there are three MS4 permits in Alachua County, there are an estimated 21,000 acres in each stormwater permit. Based on this method, the average stormwater permit has a service area

of approximately 58,000 acres. This evaluation excludes all smaller urban and suburban areas that are not included in an MS4 permit.

- Septic: Data from the Florida Department of Health provided the number of septic systems in each county. These septic systems were allocated to each water body category based on the proportion of land in the county found in each water body category. For example, in Brevard County, three percent of land is estimated to be located in areas draining to Category 4 water bodies. It was therefore assumed that three percent of septic tanks in Brevard County are in Category 4 watersheds. It is possible that proportionately more septic tanks drain to impaired water bodies rather than unimpaired water bodies. As some acreage in many counties does not drain to inland water bodies, not all septic tanks in Florida are included in the analysis.
- Municipal Wastewater: 128 NPDES permits classified as 'sewerage' and 'water supply' that discharge to inland water bodies were identified. These permits were cross referenced with the 94 NPDES permit numbers for the WWTP dischargers reported in Appendix A of the EPA Economic Analysis. An additional 10 NPDES permits were identified in this process that were classified under different SIC codes (i.e., residential mobile home sites). Based on data from the EPA report, facilities were classified by whether their existing treatment was at LOT or not. In addition to classification by water body, WWTP were classified based on their current level of treatment and options for additional treatment. Based on WWTP facilities with data in the EPA report, approximately one-third of treatment capacity is at LOT treatment. It was assumed therefore for the facilities without a matching record in the EPA report, that one-third of capacity, on average, is currently at LOT treatment. Furthermore, data from the FDEP underground injection control program was utilized to identify which WWTP facilities are located in counties with existing Class 1 injection wells. It was assumed that all facilities in these counties, with the exception of Polk County,[7] would have access to sites for deep well injection (as opposed to reverse osmosis technology). Our evaluation does not include assessment of the economic value of water that would be "lost" from Florida's hydrologic cycle due to deep well injection.
- Industrial: Similar to municipal wastewater, the location and capacity of NPDES permits in industries with nutrient discharges (as identified by SIC in the FDEP Economic Analysis) was overlapped with the WBID boundaries to identify the total discharge capacity by water body category. Industrial facilities located in counties with existing Class 1 injection wells were also identified to determine potential treatment options.
- TMDL: Based on the number of WBIDs in each water body category, the number of TMDLs that may be required was estimated by assuming that two WBID are covered by one TMDL based on the current Florida average as cited in the EPA Economic Analysis.

2.5 Summary of Per Unit Cost Ranges by Sector

Cardno ENTRIX summarized and standardized costs using data provided from the EPA Economic Analysis, as well as from Florida municipalities, industries, non-profit agencies, and

[7] Polk County is not included in this assumption as the required depth of a municipal deep well in that area is not cost effective (FWEA Report). It is reasonable to assume the same may be true for other Florida counties.

state agencies (including the FDEP) provided during the public comment period. Per unit costs, whether on a per acre basis for agriculture, or a per million gallon day (mgd) capacity for wastewater treatment costs, differed widely by data source. Based on this variation, Cardno ENTRIX collected the range of reasonable cost estimates and then estimated the most likely per unit cost using Monte Carlo simulations for each affected sector.

Monte Carlo analysis is a statistical technique that systematically incorporates uncertainty into quantitative analysis to improve decision-making. It was first developed for the Manhattan Project and has been used for over 60 years to understand the impact of multiple sources of uncertainty. The EPA recognizes the value of Monte Carlo techniques for dealing with uncertainty. [8][9]

As much of the variation in cost estimates is based on differing assumptions regarding what will be required to comply with the proposed federal NNC, costs are estimated using Monte Carlo methods at two different levels:

- End-of-Pipe Requirement This level of compliance cost assumes that the proposed federal NNC are implemented as an end-of-pipe criteria, and will require all dischargers on water bodies subject to the EPA criteria to reduce their effluent levels to at or below the NNC. Experts in Florida NPDES permitting largely agree this is the most likely scenario for facilities seeking renewal of NPDES permits.
- BMP And LOT Requirement This level of compliance cost assumes that compliance will be achieved using standard BMPs and reaching LOTs. Assuming that the proposed federal NNC are not enforced as End of Pipe criteria, there is still great uncertainty regarding how much treatment will be required by each sector to achieve compliance. Additionally, there is uncertainty regarding the degree to which the EPA will grant variances, and the cost of obtaining these variances. Given these uncertainties, this level of per unit cost is intended to capture the range of costs that may result assuming that the federal proposed NNC are not implemented as End of Pipe criteria.

Tables 2-3 and 2-4 summarize unit compliance costs for the two scenarios. These per unit cost values represent the estimated average compliance cost across all potentially affected entities discharging to inland waters in Florida.

8 Environmental Protection Agency, ""Guiding Principles for Monte Carlo Analysis" (EPA/630/R-97/001)", accessed online at: http://www.epa.gov/ncea/pdfs/montcarl.pdf.

9 A simple example can be helpful. Suppose the annual BMP compliance costs for a specific crop range from $10 to $20 and the number of acres in a county could be between 5,000 and 20,000. A Monte Carlo model will randomly select a value from the price range and randomly select a value from the acre range and calculate an estimate of annual compliance costs. This process is repeated 1,000 times and provides 1,000 different estimates of compliance costs. The average of the 1,000 estimates is the expected or mean cost. The 1,000 estimates can be sorted from high to low to provide a confidence interval.

Table 2-3 Per Unit Average Annual Compliance Costs – BMP and LOT Requirement

Sector	Unit	Mean	BMP / LOT
Municipal WWTP	MGD	$590,000	Upgrade BNR to LOT
Municipal Stormwater (MS4)	Acre of Service Area	$260	Implement stormwater BMPs on 0 to 78% of urban lands[10]
Industry (NPDES Permits)	MGD	$1,500,000	Upgrade BNR to LOT
Agriculture	Acre	$23	Implement BMPs on Harvested Acreage
Septic Tanks	Septic Tank	$19	Repair Septic Tanks at a rate of 0.5 – 3% annually
State Resource Agencies	TMDL	$98,000	Develop and Implement TMDLs

Table 2-4 Per Unit Average Annual Compliance Costs – End of Pipe Requirement

Sector	Unit	Mean	End of Pipe Requirement
Municipal WWTP[11]			
Microfiltration – Reverse Osmosis	MGD	$1,870,000	Reverse Osmosis
Deep Well Injection	MGD	$750,000	Deep Well Injection
Municipal Stormwater (MS4)	Acre of Service Area	$718	Implement or Upgrade BMPs on 78 to 100% Acreage
Industry (NPDES Permits)			
Microfiltration – Reverse Osmosis	MGD	$1,870,000	Reverse Osmosis
Deep Well Injection	MGD	$750,000	Deep Well Injection
Phosphate Fertilizer	Facility	$5,200,000	Reverse Osmosis
Agriculture	Acre	$83	BMP Implementation on Harvested Acreage and On-Farm Retention/Treatment on Gross Acreage
Septic Tanks	Septic Tank	$110	Replace Septic Tanks at a Rate of 3-6% Annually
State Resource Agencies	TMDL	$98,500	Develop and Implement TMDLs

[10] Based on FDEP Economic Analysis estimate that 78 percent of urban lands in Florida were developed prior to the 1982 stormwater rule.

[11] Includes cost of deep well injection for the estimated 33 percent of dischargers located in counties where deep well injection is possible, and cost of reverse osmosis technology for all other dischargers.

Chapter 3

Compliance Cost Estimates

This chapter has two sections. The first summarizes the per unit costs of compliance for each sector at two different water treatment levels based on the cost results from the Monte Carlo simulations. The second combines the per unit cost information with the number of affected dischargers (presented above in Chapter 2) to estimate total compliance costs by sector and water body category. All annual costs presented in this Chapter include annualized capital costs (based on a 30-year period and a three to seven percent interest rate) as well as annual operation and maintenance costs. Annual cost estimates are based on the assumption that capital costs are paid back during a 30-year time period; however the estimated annual costs of $1.0 to $8.4 billion may extend indefinitely past the 30-year period.

3.1 Total Cost Estimate Findings by Water Body Category

To estimate total costs, per unit compliance costs presented in Tables 2-3 and 2-4 were combined with the total number of entities that discharge to Florida inland lakes and rivers (excluding the South Florida region). Total cost estimates assuming all dischargers to inland water bodies must comply are presented in Tables 3-1 and 3-2 for the two levels of per unit cost estimates (BMP/LOT Requirement and End of Pipe Requirement) for complying with the proposed federal NNC for all inland water bodies, excluding South Florida. Under the BMP and LOT Requirement, there is a 90 percent chance that total annual costs will (potentially indefinitely) range from $1.0 to $3.3 billion, with an average cost estimate of $1.71 billion. Under the End-of-Pipe Requirement, there is a 90 percent chance that annual costs for affected entities range from $3.1 to $8.4 billion, with an estimated average cost estimate of $4.82 billion. Of the total End of Pipe Requirement cost, an estimated 57 percent is annualized capital costs while the remaining 43 percent is annual operation and maintenance costs (see Appendix B).

While significantly higher than the estimates from the EPA Economic Analysis, these estimates are less than originally anticipated by certain sectors in Florida. This is primarily due to two factors. First, these cost estimates take into account uncertainty, including required implementation rates, capital costs, annual operation and maintenance costs, and geographic variation in available treatment methods. Second, these estimates exclude costs in South Florida that were included in several other reports.

Table 3-1 Annual Cost of Compliance by Water Body Category Assuming All Dischargers Affected by Proposed Federal NNC (Millions $) – BMP and LOT Requirement

	Water Body Category				
Sector	1: Unimpaired	2: Newly Impaired	3: Currently Impaired, no TMDL	4: Current TMDL	Total
Agriculture	$23	$81	$143	$25	$272
Municipal WWTP	$9	$30	$89	$9	$137
Industry	$21	$63	$244	$44	$372
Urban Stormwater	$50	$186	$501	$46	$783
Septic	$4	$13	$20	$3	$41
State Agencies	$0	$107	$0	$0	$107
Total	$107	$481	$997	$128	$1,712
Proportion	6%	28%	58%	7%	100%

These are the means of the Monte Carlo simulation assuming BMP and LOT criteria applied to all sectors and all water body categories.

Table 3-2 Annual Cost of Compliance by Water Body Category Assuming All Dischargers Affected by Proposed Federal NNC (Millions $) – End-of-Pipe Requirement

	Water Body Category				
Sector	1: Unimpaired	2: Newly Impaired	3: Currently Impaired, no TMDL	4: Current TMDL	Total
Agriculture	$103	$363	$552	$77	$1,095
Municipal WWTP	$21	$114	$361	$34	$530
Industry	$29	$93	$330	$70	$522
Urban Stormwater	$138	$513	$1,383	$127	$2,161
Septic	$26	$78	$117	$19	$240
State Agencies	$44	$107	$120	$5	$275
Total	$361	$1,269	$2,863	$332	$4,824
Proportion	7%	26%	59%	7%	100%

These are the means of the Monte Carlo simulation assuming end-of-pipe criteria applied to all sectors and all water body categories.

3.1.1 Potential Cost Savings by Water Body Category

Costs can vary not only by the level of water treatment implementation as shown in Tables 3-1 and 3-2, but also by the number of entities that are affected. If dischargers in all water body types are equally affected by the proposed federal NNC, then approximately 85 percent of costs are borne by Category 2 (newly impaired) and Category 3 (currently impaired with no TMDL) water bodies. However, while proportionately small, significant cost savings could be attained if no additional requirements are imposed from the proposed federal NNC on the remaining sectors:

- Cost Savings on Unimpaired Water Bodies: If there are no incremental costs due to the proposed federal NNC on water bodies that are unimpaired (Category 1), then six to seven percent of costs are saved, or from $107 million to $361 million annually.
- Cost Savings on Water Bodies with TMDLs: If all nutrient-related TMDLs are accepted as SSAC, and no additional nutrient reductions are required on these water bodies (beyond what already required by the TMDL and BMAP), then seven percent of costs are saved, or from $128 million to $332 million annually.

3.2 Summary of Cost Ranges by Scenario

Table 3-3 summarizes the range of costs estimated in this study, based on differing implementation requirements and different numbers of affected water bodies. Direct compliance costs are estimated to range from approximately $1.5 billion to $4.8 billion annually for 30 years or more. Costs of $1.5 billion correspond to the BMP and LOT Requirement on newly impaired (Category 2) and currently impaired water bodies lacking a TMDL (Category 3). Costs of $4.8 billion correspond to implementation of the End of Pipe Requirement on all water body categories. The present value of incurring $4.8 billion in compliance costs over 30 years (at a five percent discount rate) is $74.2 billion.

Table 3-3 Annual Compliance Costs by Enforcement Scenario (Millions $)

Sector	End of Pipe Requirement, All Water Bodies	End of Pipe Requirement, Impaired Water Bodies without TMDL (Category 2, 3 only)	BMP and LOT Requirement, Impaired Water Bodies without TMDL (Categories 2, 3 only)
Agriculture	$1,095	$915	$224
Municipal WWTP	$530	$476	$119
Industry	$522	$423	$307
Urban Stormwater	$2,161	$1,896	$687
Septic	$240	$196	$33
State Agencies	$275	$227	$107
Total	$4,824	$4,132	$1,477

These are based on the means of the Monte Carlo simulation.

Chapter 4

Indirect and Distributional Costs

The proposed federal NNC will have impacts far beyond the direct compliance costs. These indirect impacts can significantly affect the economy and quality of life in Florida. The proposed federal NNC will have an adverse impact on economic development activities and affect the ability of the state to attract new businesses. The proposed federal NNC would raise the cost of doing business in Florida and may make it harder for the state to attract and retain businesses and residents. For example, the pulp and paper industry estimates that water quality treatment upgrade required to comply with the federal proposed NNC may increase the cost of producing paper by $5 to $6 per ton, which is a two to three percent cost increase. Furthermore, many stormwater and wastewater utility experts have commented to EPA in recent public meetings that some of the criteria are not achievable at all using current technology, so the price of compliance shifts from water treatment costs to complete elimination of discharges or closing of facilities.

As written, the proposed federal NNC may lead to significant price changes as many WWTPs, industrial point sources, and agricultural non-point sources that are required to implement modifications to meet the NNC. The push to comply may lead to price increases in the scarce resources needed to attain compliance. These include the demand for engineering, construction, machinery, technology, and labor that may drive up the price of these goods and services. In addition, the cost of compliance could be extensive enough to change prices and the cost of doing business in Florida. The EPA Economic Analysis should include descriptions of the potential price changes faced by consumers, the regulated industries, and their supply chains. Therefore, the federal NNC, as proposed, will likely lead to price increases by these providers, which will increase compliance costs above historically computed averages. Even a modest three percent increase in demand in this industry would increase total costs by 2 to 3 billion dollars in present value terms. Moreover, other industries in Florida that use these industries will also suffer price increases. Additionally some industries may be restricted from developing new locations or expanding existing businesses due to difficulty in obtaining new discharge permits on water bodies classified as impaired. This also can stunt growth and economic development.

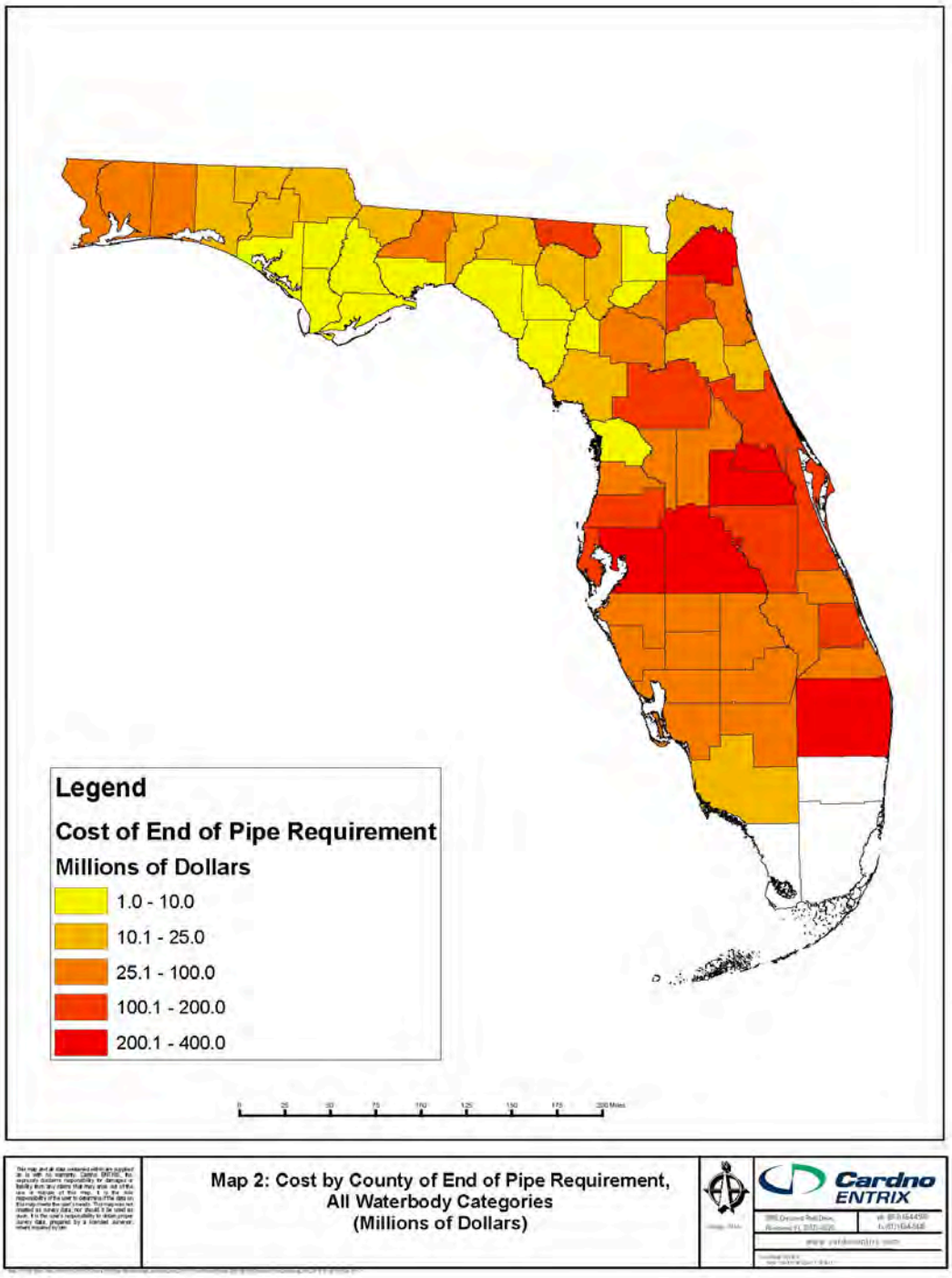
Finally, meeting the proposed federal NNC will affect air quality and green house gas emission. If reverse osmoses technologies are required, energy use will increase significantly, resulting in increased emissions of CO_2, SO_x, and NO_x in Florida. Upgrades for the phosphate industry alone are estimated by that industry to increase energy use by 159 million kilowatt-hours per year, a seven percent increase of total Florida energy use. In addition, the phosphate industry predicts that implementing reverse osmoses technology to comply with the proposed criteria will increase CO_2 emissions by 31,000 ton per year, SO_x emissions by 100 tons per year, and NO_x emissions by 50 tons per year. For the Florida pulp and paper industry, energy use could increase by 123 million kilowatt-hours per year.

4.1 Distributional Effects

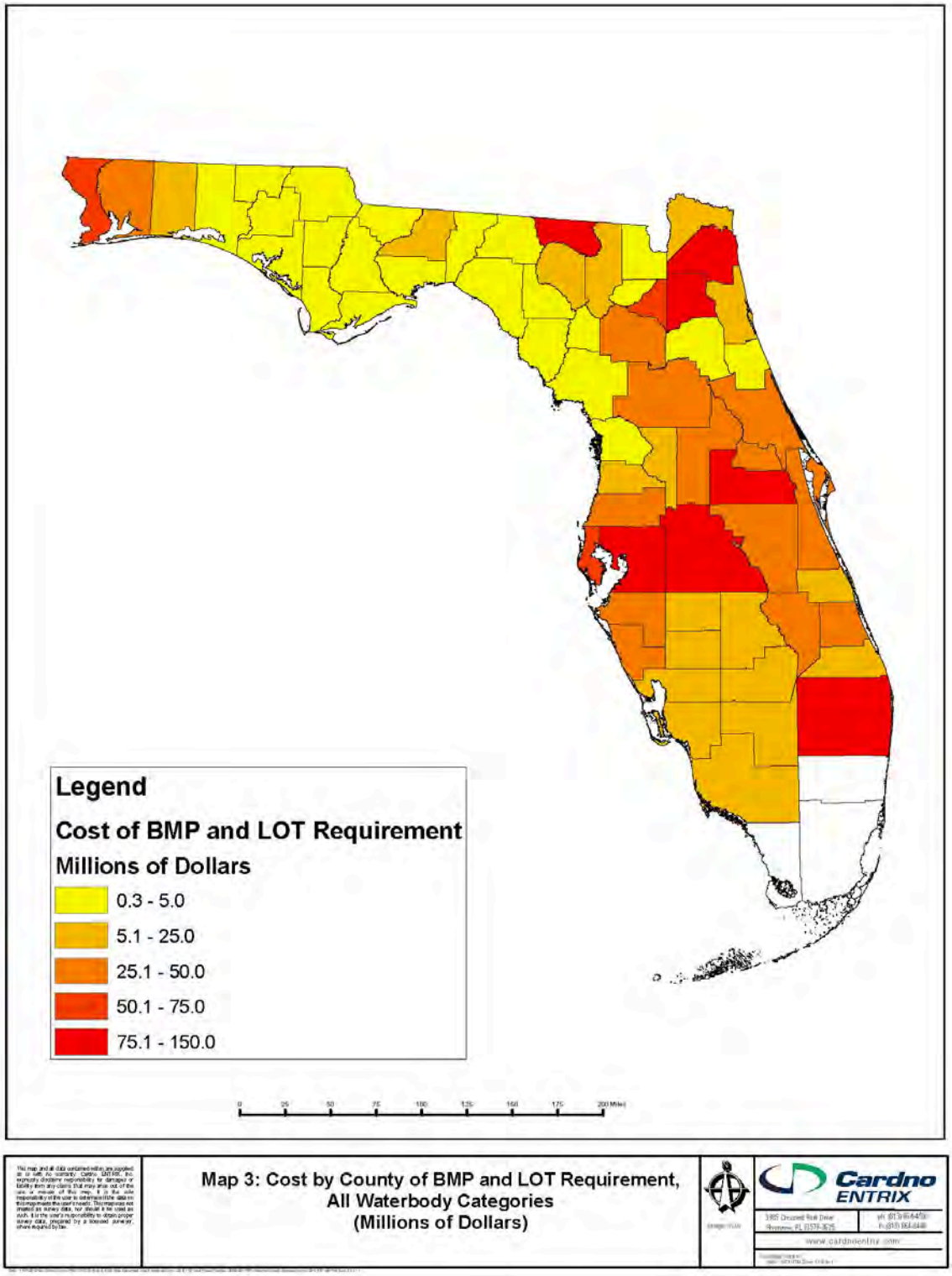
Federal guidance documents clearly state that the distributional impacts are an important component of an economic analysis. Most prominently, The Unfunded Mandates Reform Act of 1995 (UMRA) requires an examination of the potential disproportionate impacts on state, local, and tribal governments; urban or rural or other types of communities; or particular segments of the private sector. OMB Best Practices require that when distributional effects are thought to be important, the analysis should include their magnitude, likelihood, and incidence of effects on particular groups.

4.2 Effects by County/Region

Total direct compliance costs were estimated by county; cost findings from both the BMP and LOT Requirement Scenario and the End of Pipe Requirement Scenario, assuming all water bodies are affected, are presented in Maps 2 and 3. These costs exclude TMDL development costs, which are expected to occur at the state level rather than the local level.



Map 2 Cost by County of End of Pipe Requirement



Map 3 Cost by County of BMP and LOT Requirement

The economic burden of the proposed NNC may be greatest in areas that are already suffering from high unemployment or low income. Many counties already experiencing severe socioeconomic conditions will feel the impacts of the proposed federal NNC. Table 4-1 summarizes total estimated direct compliance costs for each county with poverty exceeding 20 percent in 2008, as reported and defined by the U.S. Census Bureau.[12] The impacts of these costs will be felt not only by local agricultural and industrial producers, but also by residents in the form of higher utility rates, and potentially, fewer employment opportunities. Increased utility rates to pay for capital upgrades to municipal WWTP and urban stormwater facilities may depress housing prices and further depress the retail and commercial development industry.

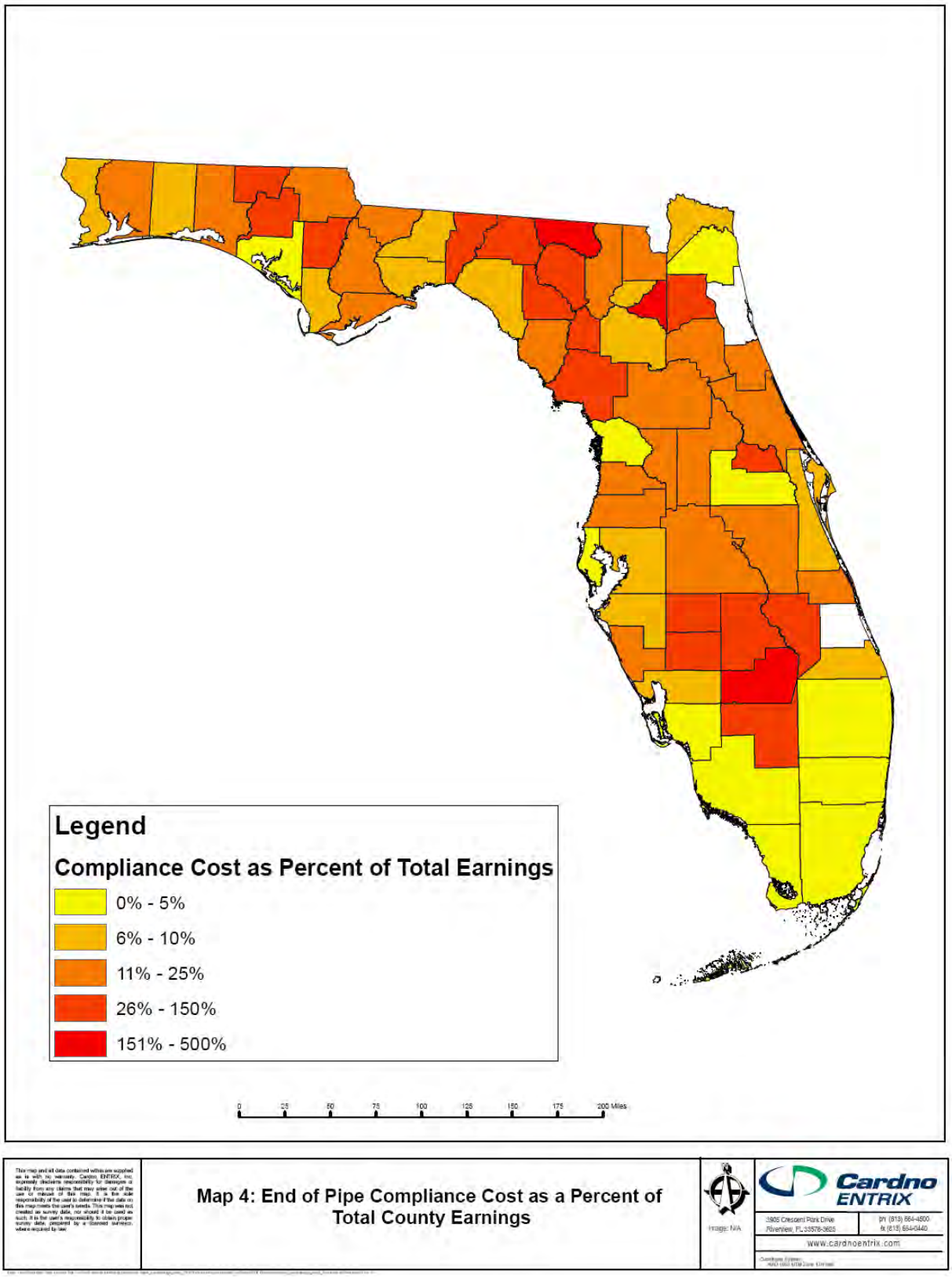
As shown in Table 4-1, complying with the proposed federal NNC will cause significantly higher costs on a per capita and per income basis in counties with poverty rates exceeding 20 percent. The average cost of compliance per person ($1,342) is three and a half times greater in these counties than in counties with poverty rates under 20 percent. Further, the cost per dollar earned (70 percent) is greater by a magnitude of three in these counties, indicating that a larger proportion of each dollar earned will be used to pay for the proposed federal NNC compliance (including costs to individuals in the form of increased utility rates and septic tank upgrades as well as increased costs to businesses). For example, in Hamilton County, the cost per person of End of Pipe Requirement compliance is over $11,700, or 467 percent of total county earnings.

[12] The U.S. Census defines the poverty threshold for an under-65 household of two people and one child as $14,840.

Table 4-1 Compliance Costs for Counties with Poverty Rate at or Above 20 Percent

County	End of Pipe Requirement, All Water Body Categories ($millions)	Poverty Rate (Percent in 2008)	Annual Compliance Cost Burden per Person, End of Pipe	Compliance Cost Burden as % of Total Earnings, End of Pipe
HAMILTON	$172.6	29.3%	$11,750	467%
GADSDEN	$10.4	26.6%	$210	11%
LAFAYETTE	$5.3	25.6%	$610	48%
HENDRY	$76.4	23.8%	$1,870	94%
MADISON	$10.2	23.6%	$510	10%
UNION	$2.9	23.6%	$190	35%
WASHINGTON	$11.1	23.2%	$450	26%
FRANKLIN	$2.4	23.1%	$200	11%
HARDEE	$45.1	23.1%	$1,590	85%
PUTNAM	$16.3	23.1%	$220	11%
TAYLOR	$4.1	22.9%	$180	8%
DIXIE	$2.8	22.8%	$170	17%
DESOTO	$91.2	22.4%	$2,620	145%
GLADES	$27.9	21.8%	$2,583	204%
LIBERTY	$2.8	21.5%	$345	13%
GULF	$1.5	21.2%	$92	6%
HOLMES	$19.6	21%	$1,010	90%
CALHOUN	$6.2	20.9%	$430	31%
OKEECHOBEE	$60.3	20.8%	$1,510	79%
ALACHUA	$77.6	20%	$300	7%
Subtotal	$646.8	-	-	-
Average	$32.34	-	$1,340	70%
Remaining Counties, Average	$88.68	-	$390	21%

Map 4 illustrates the estimated end-of-pipe compliance cost burden by county relative to total county earnings. As indicated in the map, several counties face compliance costs that exceed 150 percent of 2010 total county earnings.



Map 4 End of Pipe Compliance Cost as a Percent of Total County Earnings

4.3 Effects by Industry

Imposing the federal NNC may have societal impacts on the economic welfare of Florida residents and businesses that are clearly not captured by the EPA Economic Analysis. Compliance costs of the magnitude contemplated by the proposed NNC will cause economic dislocations of an unknown magnitude. Employment in some sectors will suffer as agricultural and other businesses struggle with direct compliance costs as well as the increased cost of doing business as a result of increased water utility rates. For example, agricultural employment can be expected to decrease due to cropland conversion for BMPs such as forested buffers. Local and state governments will also suffer from reductions in tax revenue from the decreased value of agricultural land. Consumers will have less disposable income because of increased utility costs, which will adversely affect the retail industry and supply chain. Although increases in engineering and construction spending will provide benefits, the magnitude is unclear because firms supplying these resources may need to bring in out-of-state resources, which will result in "leakages" from the Florida economy.

The costs incurred to upgrade water treatment by WWTPs will be passed on to households in the form of higher utility rates. According to the November 18, 2009 FWEA report, sewer rates could increase by as much as $673 to $726 per household in areas where tertiary upgrades are needed. Further, as noted above, increased business costs may affect business viability and economic growth in Florida and further compound the economic hardship already being experienced in these communities.

Federal NNC will likely impose significant compliance costs on those Florida industries that have already been hardest hit by the recession. Since 2006, employment decreased in 98 of the 122 sectors recognized by the State of Florida current Employment Statistics resulting in more than 828,000 jobs lost. Moreover, approximately 38 percent of all jobs lost since 2006 were lost in the 10 sectors most likely to incur financial effects through implementation of proposed federal NNC (Table 4-2).

Manufacturing and mining industries will face particular challenges to growth under the burden of direct compliance costs. Pulp mills and paper manufacturing facilities, for example, reduced their employment base by 12 percent between 2006 and 2010. Similarly, mining – in particular phosphate mining— industries, which face disproportionately high costs of compliance, will be hard pressed to recover from a four year trend of downsizing and job loss (e.g. employment in mining is down 22 percent since 2006).

Federal NNC will also likely burden Florida's struggling retail sector, which decreased by 10 percent, or over 99,000 jobs, since 2006. Small businesses may not incur direct costs of compliance, but their cost of doing business may increase due to increased water utility rates. Furthermore, as consumers are expected to face higher sewer and water rates due to the federal proposed NNC, they will have less money to spend in retail and service industries. An increased cost of doing business coupled with elevated construction costs may also make Florida less attractive to new businesses and residents compared to nearby states, thereby further inhibiting long-term retail growth.

Although growth may be stunted in some sectors, it is important to recognize that the proposed federal NNC would also cause short-term redistribution of economic activity to other sectors. Some sectors, including construction, civil engineering and contracting, may benefit indirectly from Federal NNC as additional construction projects occur to implement BMPs and upgrade water treatment facilities. Approximately 300,000 construction jobs were lost in Florida between 2006 and 2010, including 75,000 in residential construction, 26,500 in heavy and civil engineering construction, and 57,500 in contracting. The construction sector may be negatively affected by proposed federal NNC to the extent that upfront compliance costs discourage growth, particularly in the residential housing market. In many cases, however, federal NNC could lead to new construction, engineering and contracting jobs where major upgrades are made to infrastructure and wastewater treatment.

Table 4-2 summarizes the industries that may be most significantly affected by the proposed federal NNC, together with the recent trends in employment, the expected direction of impact from NNC (positive or negative), and the magnitude of the industry's employment multiplier effect. The employment multiplier indicates how many jobs, in all sectors of the Florida economy, are supported for every $1 million in output from a particular industry. For example, residential construction has an employment multiplier of 20.6, indicating that 20.6 jobs are created in Florida for every $1 million in increased residential construction output.

Table 4-2 Affected Industries and Expected Direction and Magnitude of Ripple Effect

Industry	2006 – 2010 Change in Employment (#)	2006 – 2010 Change in Employment (%)	Expected Direction of NNC Impact	Employment Multiplier[1]
Residential Construction	-75,000	-53%	-	20.6
Building Equipment Contractors	-57,467	-35%	+ / -	20.6
Heavy and Civil Engineering Construction	-26,500	-33%	+	20.6
Architectural and Engineering Firms	-21,000	-23%	+	18.3
Retail Trade	-99,000	-10%	-	23.0
Agriculture	3,700	8%	-	10.5-24.1[2]
Real Estate, Rental, and Leasing	-33,100	-18%	-	1.5
Paper Manufacturing	-1,300	-12%	-	8.6 – 9.5
Chemical Manufacturing	-1,700	-8%	-	3.2 – 5.4[3]
Mining, Except Oil and Gas	-900	-22%	-	9.3
Total	-312,300			

[1] Number of jobs supported for every $1 million in output.

[2] Low estimate: Poultry and egg production; high estimate: Greenhouse, nursery, and floriculture production

[3] Low Estimate: Synthetic dye and pigment manufacturing; high estimate: fertilizer manufacturing

Chapter 5

Uncertain Benefits

Benefits identified in the EPA Economic Analysis are highly uncertain, both because of methodological issues in the EPA approach, and also because of potential for little benefit to be derived from vastly increasing the number of water bodies listed as impaired in Florida.

5.1 Little to No Benefit to 'Improve' Unimpaired Water Bodies

There are currently 858 water bodies that are impaired under existing water quality standards in Florida. An estimated 2,174 will be newly impaired under the proposed federal criteria. The proposed federal NNC will effectively increase fivefold the number of water bodies considered impaired in Florida, and will raise the proportion of impaired water bodies from five percent to 35 percent (based on 6,129 Florida water bodies—both freshwater and marine throughout all of Florida—designated by water body identification numbers).

Florida water quality experts generally agree that most Florida lakes and flowing waters with water quality problems have already been identified as impaired water bodies though the state's ongoing systematic evaluation of water body health in accordance with Florida's existing Impaired Waters Rule. As such, most of the 2,174 water bodies that will be newly impaired under the proposed federal criteria may not merit being listed as impaired and would not substantially benefit from imposing the NNC and thus the benefits received would be lower or non-existent. Listing water bodies with acceptable water quality as impaired allocates state resources unnecessarily to develop TMDLs and increase treatment costs for facilities discharging into these newly listed water bodies where the benefits gained are relatively low.

Benefits identified in the EPA Economic Analysis are highly uncertain. Many believe that the benefits from vastly increasing the number of impaired water bodies fail to justify the costs. Florida water quality experts believe that Florida lakes and flowing waters with water quality problems are already identified as impaired water bodies under the narrative criteria. As such, most of estimated 2,174 water bodies that may be newly impaired under the proposed federal criteria likely do not merit being listed as impaired and will not benefit from imposing the proposed federal NNC. This study shows that the potential compliance costs for "newly" impaired water bodies could account for more than 25 percent of total costs (Figure 5-1). Listing water bodies with good water quality as impaired will allocate state resources unnecessarily to develop TMDLs and increase treatment costs for facilities discharging into these water bodies.

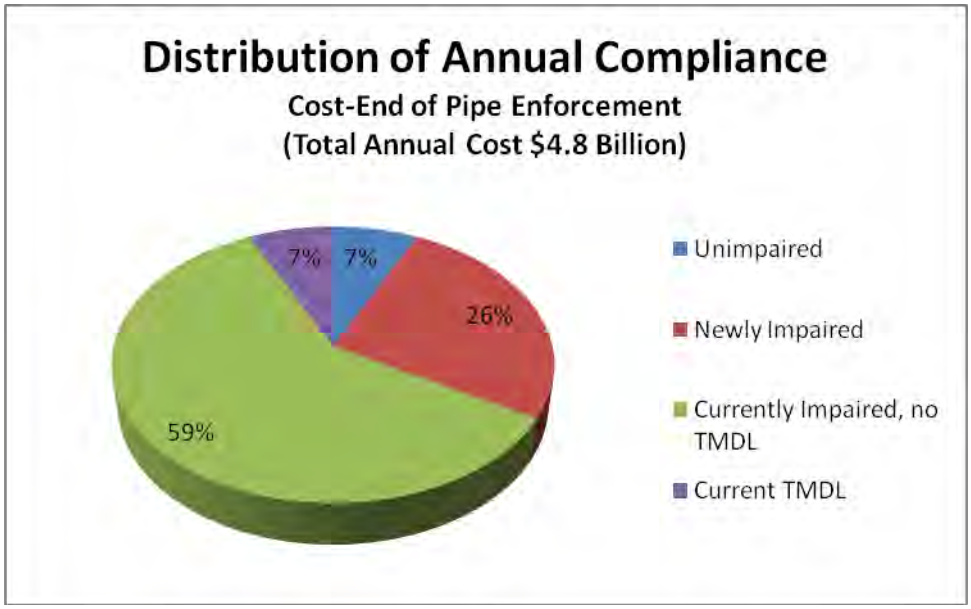


Figure 5-1 Distribution of Annual Compliance by Water Body Category

5.2 Methodological Concerns with EPA Approach

EPA points to the potential economic value of improved water quality in both its preamble and in a separate Technical Support Document. Both discussions have the same two flaws. First, information and validation showing that specific locations will benefit in meaningful, measurable ways from imposing the criteria are lacking. As a general matter, economic benefits arising from these types of actions are site specific and EPA's benefits assessment provides no information about the potential site specific benefits (and their relationship to costs). In this sense, problems with EPA's economic benefits estimates mirror the flaws with several aspects of the technical approach to setting the federal NNC (i.e., lack of clear connection between the required nutrient reduction and the anticipated ecological response). Second, even when focusing on "generic" rather than site-specific benefits, the studies cited by the EPA do not provide reliable estimates of water quality improvements.

5.2.1 EPA Benefit Estimate

EPA includes a rough benefits estimate of reducing nutrient loadings to Florida waters. Unfortunately, this estimate does not provide a reliable indicator of benefits. Most importantly, benefits are always site-specific. Without information about the change in water quality at a site and how people value those specific benefits, any quantification of values is highly uncertain.

Putting aside the need for site-specific value estimates, the EPA rough benefit estimate is problematic for the following reasons:

- EPA uses the changes in the water quality for rivers and applies those to all lakes as well. This was done in response to the availability of data on lake water quality improvements. This assumption may bias the results by an unknown magnitude.

- The water quality index used by the EPA is based on the average judgment of a panel of experts convened over 35 years ago. There is no reason to believe these weights reflect current science or are relevant to the water quality conditions in Florida.
- The change in the water quality index from imposing the criteria is trivial in magnitude. There is no reason to believe that minute changes in an index could result in a scientifically meaningful change in how people value and use the water body,
- EPA asserts that there are unquantified benefits from reductions in water treatment costs by municipalities and industrial users from imposing the criteria and improvements in agricultural production. However, if there were a positive net benefit from these, we would expect the EPA cost of compliance estimates to show a net savings; yet no such savings are estimated.
- If there were indeed net benefits, then the EPA should not have experienced the backlash of comments and critiques posted by all sectors regarding the proposed criteria.

5.2.2 Benefits Cited by EPA

EPA cites the results of Dodds et al. as an example of recreation and property value impacts from improved water quality. This study estimates the national value of these benefits at between $670 million and $4.0 billion annually. However, this study does not provide reliable estimates of the benefits. When estimating recreation benefits, the authors assume recreation use is evenly dispersed over land, which is highly unrealistic. The study also uses the wrong measure of economic value, expenditures, instead of consumer surplus. The property value estimates are also flawed. The study uses a "generic" baseline level of nutrient loading, and uses a single estimate of the property value increases from improved water quality to estimate nationwide benefits.

In short, EPA's study provides insufficient information about the economic value of the proposed federal NNC for Florida. Better information about benefits is clearly needed since annual costs could be as high as $8.4 billion for Florida, which is higher than the $4.0 billion in national benefits.

Chapter 6

References

Florida Water Quality Coalition (2010). Federal Water Quality Coalition Comments on EPA's Proposed Water Quality Standards for the State of Florida's Lakes and Flowing WatersDocket ID No. EPA–HQ–OW–2009–0596. EPA.

City of Palm Bay Florida, Utilities Department (2010). Summary of Impacts of Proposed Numeric Nutrient Criteria on the City of Palm Bay, Florida.

EPA (1997). "Guiding Principles for Monte Carlo Analysis." Retrieved EPA/630/R-97/001, 2010, from http://www.epa.gov/ncea/pdfs/montcarl.pdf.

EPA (1999). "Chapter 5: Description and Performance of Storm Water Best Management Practices." Preliminary Data Summary of Urban Stormwater Best Management Practices. EPA-821-E-99-012. , 2010, from http://water.epa.gov/scitech/wastetech/guide/stormwater/index.cfm.

EPA (1999). "Chapter 6: Costs and Benefits of Stormwater BMPs." Preliminary Data Summary of Urban Stormwater Best Management Practices. EPA-821-E-99-012., from http://water.epa.gov/scitech/wastetech/guide/stormwater/index.cfm.

EPA (2010). Preliminary estimate of Potential Compliance Costs and Benefits Associated with EPA's Proposed Numeric Nutrient Criteria for Florida.

FDEP (2003). "Class I injection Well Status." 2010, from http://www.dep.state.fl.us/water/uic/docs/Class_I_Table11_2003.pdf.

FDEP (2009). "Lake Jesup BMAP, Lower St. Johns Tributaries BMAP, and Long Branch BMAP." Basin Management Action Plans: New and Announcements., 2010, from http://www.dep.state.fl.us/water/watersheds/bmap.htm.

Florida Pulp and Paper Association Environmental Affairs, I. (2010). Docket ID No. EPA-HQ-OW-2009-0596 ("Docket"). US EPA.

Milk, S. (2010). Water Docket, U.S. Environmental Protection Agency. EPA.Mosaic Comments of the Mosaic Company on EPA's Proposed Rule on Water Quality Standards for the State of Florida's Lakes and Flowing Waters, Docket ID No. EPA HQ-OW-2009-0596. U. S. E. P. Agency.

Richard Budell, T. P., Holly Stone,James Clements,Alan W. Hodges, Thomas J. Stevens, Mohammad Rahmani, Tatiana Borisova, Del Bottcher. (2010). "Economic Impacts and Compliance Costs of Proposed EPA Numeric Nutrient Criteria for Florida Agriculture." from http://www.fl-counties.com/Docs/Legislative%20Division/Environmental/Economic%20impacts%20of%20EPA%20Numeric%20Criteria.pdf.

City of Gainesville (2010). Docket ID No. EPA-HQ-OW-2009-0596. Assessment of Financial Impact of Phosphate Mining and Mineral Processing: Complying with EPA's Proposed Nutrient Water Quality Standards for Florida. ENVIRON International Corporation. Prepared for The Florida Phosphate Industry. 4/2010.

Clay County Utility Authority's Comments on the United States Environmental Protection Agency's Proposed Rule. Rose, Sundstrom, & Bentley, LLP. Prepared for Clay County Utilities. 4/23/2010.

Gierach, David A, Moore, Paul. EPA's Proposed Numeric Nutrient Criteria Impact of Sanford System. City of Sanford. 4/27/2010.

Griswold, Richard F. Proposed NNC Mandate Comments. City of Destin. 4/27/2010.

Hanson, Raymond E. Numeric Nutrient Criteria Proposed for Fresh Surface Waters in Florida. Orange County Government Florida. 4/27/2010.

Levy, Kelli Hammer. Adoption of Numeric Nutrient Water Quality Standards for Florida. Pinellas County Watershed. 4/28/2010.

Littrell, Jeff. Public Comments Regarding EPA's Proposed Numeric Nutrient WQS for Florida. Okaloosa County Utilities. 4/27/2010.

Reardon, Rod. Costs to Comply with EPA Numeric Nutrient Criteria for Freshwater Dischargers. DRAFT. Prepared for FWEA. 11/7/2010.

Scott, Teresa. City of Gainesville Memo: Docket ID No. EPA-HQ-OW-2009-0596. City of Gainesville. Public Works Department. 4/21/2010.

Technologies to Meet Numeric Nutrient Criteria at Florida's Domestic Water Reclamation Facilities. Carollo. Prepared for FWEA. 11/18/2009.

Treatment Technologies Assessment for Removal of Nitrogen and Phosphorus in Pulp and Paper Wastewater. AWARE Environmental Inc. and AquAeTer Inc. Prepared for Florida Pulp and Paper Association. 4/2010.

Voyles, James K. Comments of the Mosaic Company on EPA's Proposed Rule on Water Quality Standards for the State for Florida's Lakes and Flowing Waters. The Mosaic Company. 4/23/2010.

Appendix A

Table of Annual Direct Compliance Costs

Table A-1 Total Cost and Poverty Rate by County (in millions)

County	Compliance Cost: BMP and LOT Requirement, All Water Bodies	Compliance Cost: End of Pipe Requirement, All Water Bodies	Poverty Rate (2008)
ALACHUA	$30.8	$77.57	20
BAKER	$1.3	$4.99	15.3
BAY	$0.5	$3.06	11.9
BRADFORD	$62.3	$89.90	19.3
BREVARD	$40.9	$123.48	10.7
CALHOUN	$1.3	$6.24	20.9
CHARLOTTE	$7.1	$29.53	10.3
CITRUS	$1.4	$8.75	15.8
CLAY	$83.3	$148.08	8.3
COLLIER	$6.5	$20.07	10.2
COLUMBIA	$6.9	$23.78	18
DESOTO	$16.5	$91.19	22.4
DIXIE	$0.6	$2.79	22.8
DUVAL	$75.6	$221.36	12.1
ESCAMBIA	$67.2	$94.55	16
FLAGLER	$4.7	$22.45	9.8
FRANKLIN	$0.7	$2.43	23.1
GADSDEN	$2.5	$10.37	26.6
GILCHRIST	$2.7	$9.71	16.8
GLADES	$6.2	$27.89	21.8
GULF	$0.3	$1.53	21.2
HAMILTON	$124.0	$172.58	29.3
HARDEE	$7.5	$45.08	23.1
HENDRY	$22.9	$76.44	23.8
HERNANDO	$11.4	$34.73	12.4
HIGHLANDS	$20.9	$89.39	16.7
HILLSBOROUGH	$110.7	$328.57	13.9
HOLMES	$3.4	$19.61	21
INDIANRIVER	$22.2	$62.43	12.4
JACKSON	$3.3	$22.02	19
JEFFERSON	$2.6	$10.38	18.5
LAFAYETTE	$1.7	$5.26	25.6
LAKE	$29.2	$88.51	10.3
LEE	$11.2	$29.69	10.6

LEON	$20.3	$65.46	18.6
LEVY	$3.0	$15.75	17.8
LIBERTY	$0.5	$2.82	21.5
MADISON	$2.4	$10.24	23.6
MANATEE	$26.9	$87.89	12.2
MARION	$29.6	$120.39	16
MARTIN	$13.6	$46.45	10.4
NASSAU	$7.2	$12.35	8.9
OKALOOSA	$13.5	$41.18	8.7
OKEECHOBEE	$25.8	$60.32	20.8
ORANGE	$80.7	$256.96	13.7
OSCEOLA	$27.0	$104.58	11.9
PALMBEACH	$91.8	$244.51	11.7
PASCO	$31.9	$101.39	13.2
PINELLAS	$60.1	$177.38	10.9
POLK	$144.5	$396.99	15.3
PUTNAM	$4.2	$16.29	23.1
SANTAROSA	$27.5	$79.44	9.9
SARASOTA	$27.0	$79.21	9.9
SEMINOLE	$42.0	$204.59	9.3
STJOHNS	$16.0	$49.83	7.9
STLUCIE	$46.8	$132.31	12.9
SUMTER	$8.2	$32.31	13.2
SUWANNEE	$6.7	$21.44	19.9
TAYLOR	$1.0	$4.14	22.9
UNION	$0.6	$2.94	23.6
VOLUSIA	$46.2	$145.61	12.9
WAKULLA	$1.4	$2.94	13
WALTON	$4.7	$17.72	14.9
WASHINGTON	$2.9	$11.07	23.2
Subtotal	$1,604.3	$4,548.9	
TMDL Cost	$107	$275	
Total	$1,711	$4,824	

Appendix B

End of Pipe Requirement Compliance Cost: Present Value, Annualized Capital, and Annual Operation and Maintenance Costs

Table B-1 presents the total estimate cost of the End of Pipe Requirement on an annual basis. As indicated in the table, annualized capital costs account for an estimated 57 percent of compliance cost, while annual operations and maintenance account for the remaining 43 percent. In total present value terms, calculated over 30 years using a five percent discount rate, total direct compliance costs are estimated at $74.2 billion.

Table B-1 End of Pipe Requirement, All Water Bodies Costs (Millions $)

	Annual Cost			
	O &M Cost	Capital Cost	Total Cost	Present Value of Costs Over 30 Years
Agriculture	$429.0	$665.8	$1,095	$16,830.1
Municipal WWTP	$215.6	$314.9	$530	$8,154.6
Industry	$222.0	$300.2	$522	$8,027.0
Urban Stormwater	$939.2	$1,221.9	$2,161	$33,221.5
Septic	$55.3	$185.1	$240	$3,694.8
State Agencies	$226.3	$48.9	$275	$4,232.0
Total	$2,087.4	$2,736.8	$4,824	$74,160.0
Proportion	43%	57%	100%	

Cardno ENTRIX

Shaping the Future

Down to Earth.

Down to Business.™

Toll-free 800 368 7511
www.cardnoentrix.com
www.cardno.com

Australia • Belgium • Canada • Ecuador • Indonesia • Kenya • New Zealand • Papua New Guinea
Peru • United Arab Emirates • United Kingdom • United States • Operations in 70 countries