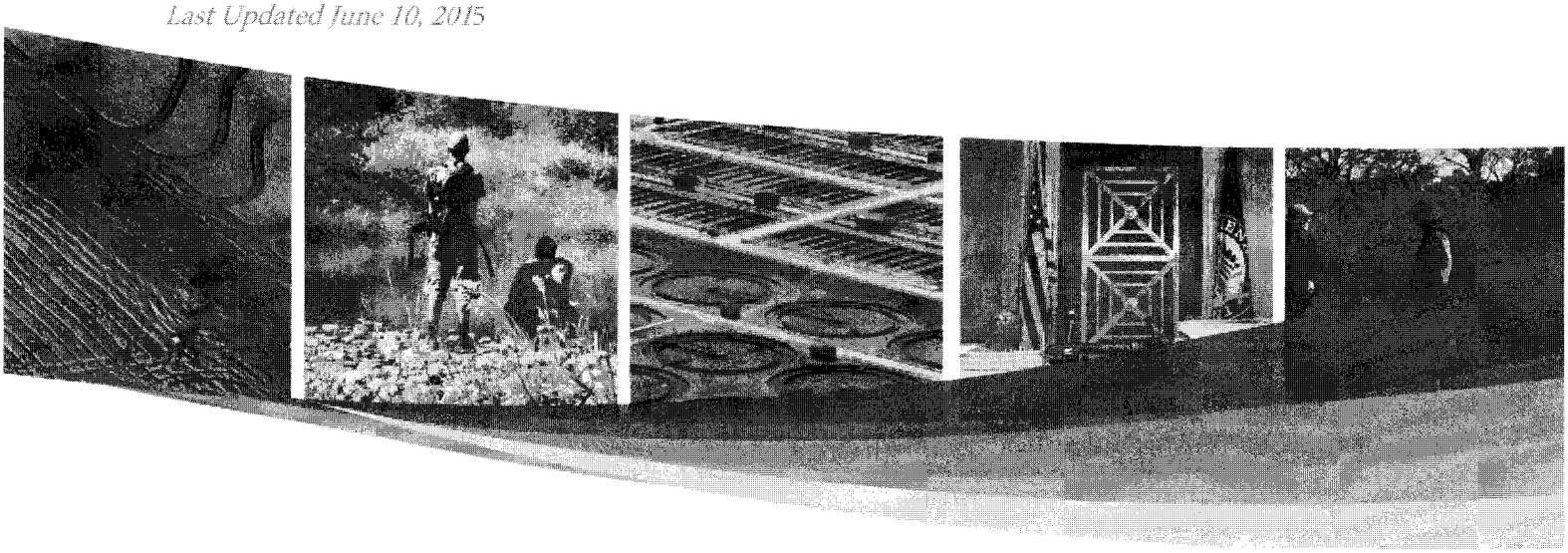
OVERVIEW:

National Network on Water Quality Trading

Last Updated June 10, 2015



Why a National Network on Water Quality Trading?

Water quality trading (WQT) programs continue to emerge across the country as permittees seek cost-effective compliance alternatives and interested stakeholders seek to accelerate the pace and scale of water quality improvements to meet the goals of the Clean Water Act. WQT programs are still developing, but a considerable base of experience has been assembled on how to build trading programs that are effective and gain support from multiple stakeholders. Successful WQT programs maintain transparency in their methods, ensure real and verifiable pollutant reductions, track and verify projects and credits throughout their lifecycle, rely on sound science, and establish clear lines of responsibility.

Purpose:
The purpose of the National Network ("Network") is to establish a national dialogue on how water quality trading can best contribute to clean water goals. That includes providing options and recommendations to improve consistency, innovation, and integrity in water quality trading.

Establishing a national community of WQT practitioners to articulate shared principles, core trading program design elements, recommendations for implementing and operating trading programs, and lessons learned from experience, will improve consistency and integrity across WQT programs. [1] The information will make it easier to establish WQT programs, provide greater transparency about what WQT programs hope to accomplish, and help WQT programs meet their clean water goals.

[1] The Network has chosen to focus first on point-nonpoint trades. The Network will discuss trades with urban stormwater (MS4, industrial, and construction) and NPDES-permitted wastewater facilities. Trades include both offsets for future growth and crediting against current discharges. Future effort may turn to point-point or other forms of trading.

What does the Network do?

The Network is structured as a facilitated dialogue between those stakeholders who are central to making WQT programs work (agriculture, permitted point sources, state water quality agencies, environmental groups, and practitioners). The Network dialogue was designed to accomplish the following:

- Articulate shared principles for guiding the development and operation of WQT programs;
- Define a range of reasonable options for each program element needed to support a successful WQT program; and
- Capture the debate and diversity of viewpoints around each program element to provide new and evolving programs with the pros and cons associated with different choices they might face.

Ultimately, approval of trading programs and their elements is up to the stakeholders engaged in those programs and the relevant state and federal regulatory agencies. The Network provides insights and support tools to aid in the development of successful WQT programs.

Who is currently involved in and coordinating the Network?

The Network's strength is derived in part from its diversity of experience and viewpoints. Thus, all Network participants are free to maintain their own individual positions on any issues or documents discussed or published by the Network as a whole. The following organizations are currently contributing as Network participants:

Network Participants	
American Farmland Trust	National Association of Clean Water Agencies
Association of Clean Water Administrators	National Association of Conservation Districts
Chesapeake Bay Foundation	National Milk Producers Federation
Electric Power Research Institute	The Freshwater Trust
Environmental Defense Fund	The Ohio Farm Bureau Federation
Kieser & Associates, LLC	Troutman Sanders
Maryland Department of Agriculture	US Water Alliance
Mississippi River Water Quality Collaborative	
Technical Advisor	
US Department of Agriculture	
Coordinators	
Willamette Partnership	World Resources Institute

Willamette Partnership and World Resources Institute act as the Network coordinators by organizing meetings, facilitating discussions, and documenting options and best practices. The US Department of Agriculture (USDA) and US Environmental Protection Agency (EPA) serve as technical advisors to the Network.

Outcomes from the National Network

The Network identified a need to consolidate information on WQT programs into a form that new and evolving programs could leverage to reduce start-up costs and inform ongoing management decisions. Over the course of 18 months, participants engaged in a series of dialogues to identify key trading program components and distill experiences from existing programs into a range of options for designing, operating, and improving WQT programs over time. The results of this dialogue include published two documents, released June 2015:

- ***Building a Water Quality Trading Program: Options & Considerations.*** This robust reference walks through guiding principles and the 11 key elements considered in trading program design, with examples, options, and clear pros and cons to help stakeholders evaluate if WQT is the right fit for a particular watershed and meet the scientific, social, and ecological realities of their local watershed. It captures several decades of experience in trading programs from the standpoint of broad stakeholder groups and reflects two years of conversations, workshops, surveys and line-for-line feedback from 18 participating organizations that make up the National Network.[2]

- **Executive Summary:** A concise summary of *Building a Water Quality Trading Program*, intended for decision makers and designed to encourage greater feedback and discussion from broader stakeholder groups.

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[2] The contributors to the National Network engaged in an extensive dialogue to develop this publication as a comprehensive, contextual, balanced, and robust collection of information on different, representative water quality trading programs. Practitioners from new and evolving water quality trading programs may look to this document as an important source of information as they build and update their trading programs.

This document does not, however, represent a consensus opinion, endorsement, or particular recommendation from any one National Network contributor. It covers the broad range of topics related to water quality trading to assist local stakeholders to develop and implement trading programs that meet local needs and conditions. It does not create any binding requirements or standards of practice. Ultimately, stakeholders, state regulators, and/or U.S. EPA will clarify those requirements that apply to any particular trading programs or trading program participants.

How is the Network funded?

The National Network is grateful for seed funding provided by the Electric Power Research Institute (EPRI) and USDA that covers the gathering of options and initial dialogue between the diverse network participant stakeholders. Additional funders are welcome and would enable a broader engagement of stakeholders in conversation about what WQT trading programs might look like and the range of options that not only fosters consistency and integrity, but also embraces flexibility and innovation.

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Building a Water Quality Trading Program

Summary of Contents

The National Network publication, *Building a Water Quality Trading: Options & Considerations*, is organized around a set of common water quality trading program elements. The contents of these sections include:

➢ Introduction, Vision, & Guiding Principles

This Section introduces the National Network on Water Quality Trading, provides a common vision and goals of water quality trading programs, and lays out a set of guiding principles to anchor water quality trading program decisions.

➢ Section 1: Policy & Regulatory Instruments to Support Trading

Water quality trading programs linked to Clean Water Act compliance, need to be incorporated into relevant federal and state regulatory instruments. Those regulatory instruments, often a National Pollution Discharge Elimination System (NPDES) permit, need to be clear and enforceable and provide opportunities for the public to review and comment on the details of a trading program.

➢ Section 2: Trading Basics: Who, Where, What, & How

This section describes the basic elements that must be identified in a trading program to define who may participate, where trades can occur, what can be traded, and the actions that can generate credits (how).

➢ Section 3: Trading Eligibility

This Section explains the basic eligibility requirements that credit Buyers and credit Sellers need to meet, and discusses how programs can set baseline levels of pollution reduction and other ways to demonstrate additional water quality benefit that states and water quality trading programs must address.

➢ Section 4: Quantifying Water Quality Benefits

There are several approaches and several scales for quantifying water quality benefits. This Section explores the three main approaches to quantifying water quality benefits: modeling, pre-determined rates, and direct monitoring. Quantifying water quality at the field, reach, and watershed scales is also discussed.

➢ Section 5: Managing Risk & Uncertainty

Managing risk and uncertainty is an important part of many trading program design decisions. This Section focuses on one of the most common risk management tools—trading ratios, but also discusses other ways to manage risk and incorporate risk management throughout a trading program.

➢ Section 6: Credit Characteristics

This Section discusses the essential characteristics of a credit in a water quality trading program, including how long a credit is good for (credit life); the property rights, accounting, and tax treatment of credits; and other financial considerations.

➢ Section 7: Project Implementation & Assurance

Trading participants need to be confident that when implemented, credit-generating projects deliver their anticipated water quality benefits. This Section describes mechanisms to screen projects for eligibility (project site screening), provide design, construction, and maintenance quality standards (BMP guidelines), articulate project design and management plans, and document pre and post project site conditions. This Section also provides options for ensuring a project is maintained (project stewardship) and protected (legal protection) for the life of the project.

➢ Section 8: Project Review, Certification, & Tracking

Trading programs need a way to confirm projects are performing as promised. This Section discusses how a program can confirm a credit-generating project is implemented, credits have been calculated accurately, and performance expectations are being met. This Section also discusses the process for certifying, issuing, and tracking credits from their generation through credit sales and usage.

➢ Section 9: Compliance & Enforcement

Since many water quality trading programs are used as part of compliance with the Clean Water Act, this Section discusses options for ensuring compliance and enforcing obligations in a water quality trading program.

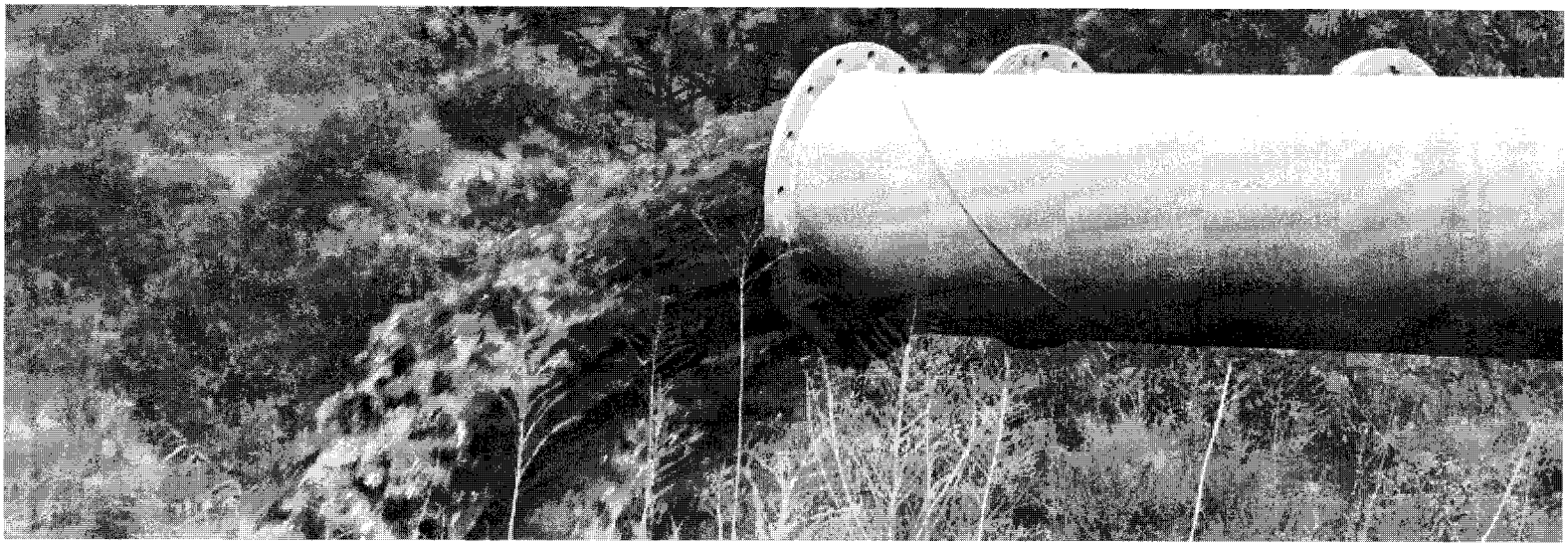
➢ Section 10: Program Improvement & Tracking

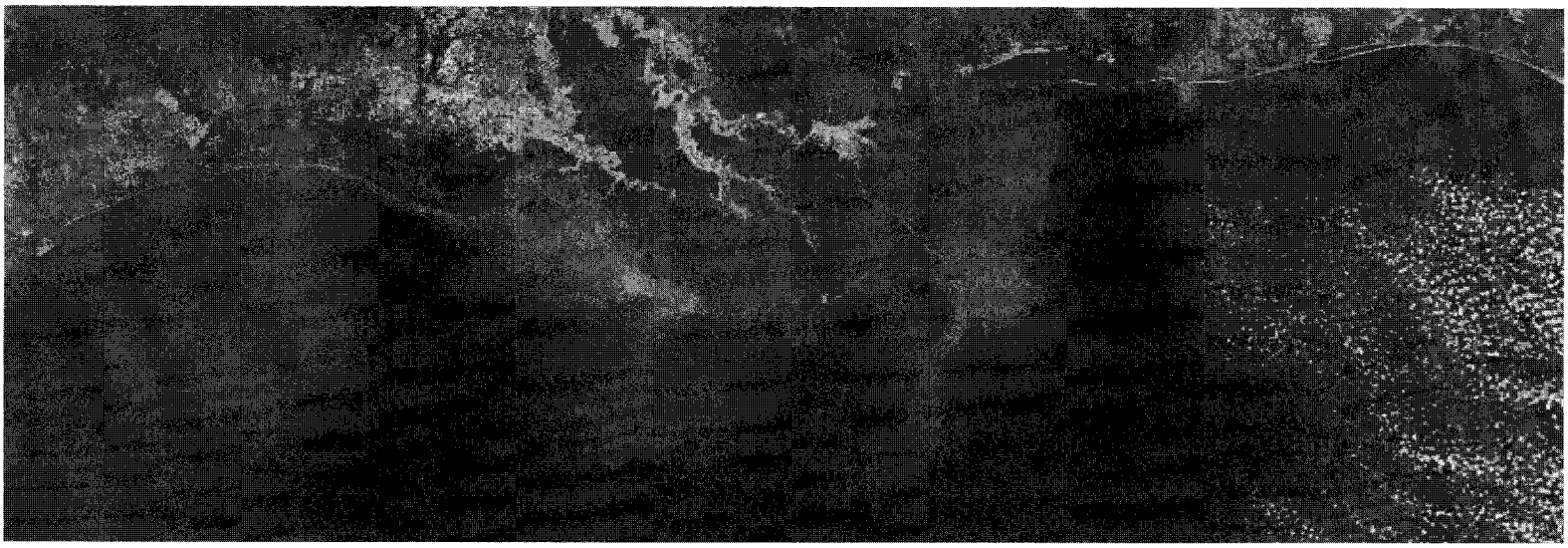
This Section discusses processes for improving the ability of a given trading program to meet its goals in an effective and efficient manner. New science and experience on the ground can help programs improve quickly, but buyers and sellers need predictable processes and timing for program improvement. This Section includes options for improving quantification methods, approving new BMPs, and evaluating overall program effectiveness.

➢ Section 11: Roles, Responsibilities, Transaction Models, & Public Participation

Trading programs provide an opportunity for regulatory agencies, permittees, and third parties to work together in administering different aspects of a trading program. This Section discusses roles, responsibilities, and skill sets needed to run different parts of a water quality trading program. The Section also explores different transaction models and some guidelines for involving the public in trading program design and operations.

WATER QUALITY TRADING





Polluting Public Waterways for Private Gain

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About Food & Water Watch

Food & Water Watch champions healthy food and clean water for all. We stand up to corporations that put profits before people, and advocate for a democracy that improves people's lives and protects our environment. We envision a healthy future for our families and for generations to come, a world where all people have the wholesome food, clean water and sustainable energy they need to thrive. We believe this will happen when people become involved in making democracy work and when people, not corporations, control the decisions that affect their lives and communities.

Food & Water Watch has state and regional offices across the country to help engage concerned citizens on the issues they care about. For the most up-to-date contact information for our field offices, visit *foodandwaterwatch.org*.

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WATER QUALITY TRADING

Polluting Public Waterways for Private Gain

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Glossary

Best Management Practices (BMPs) – Best Management Practices are agency-mandated processes that can avoid emissions or runoff to a body of water. Both point sources and non-point sources can implement BMPs to reduce their impact on the environment. In point sources, these can include scheduling maintenance or procedures to discharge the least amount of pollutants, when it will have the smallest impact on the environment. On farms, BMPs can include changing how the farm operates to sequester the pollutants in the ground, or planting buffers between the farm and the waterway to reduce the amount of pollution that runs off to the river or stream.

Best Available Technology (BAT/BATEA) – The CWA requires point sources to attain pollution discharge limits that result from the "Best Available Technology Economically Achievable," or BATEA. In practical terms, this means that industries are supposed to do the best they can, using the most advanced technologies available, to reduce their discharges of pollution to our waterways, while ensuring that chasing the last bit of reduction does not become cost prohibitive.

Clean Water Act (CWA or the Act) – Landmark 1972 (amended in 1977 and 1987) law that sets limits on discharges to America's waterways. The stated goal of the CWA is zero discharges to waterways.

Concentrated Animal Feeding Operations (CAFOs) – A CAFO confines animals in areas with no vegetation during the annual growing season. Most CAFOs are what we think of when we think of "factory farms." While CAFOs are theoretically controlled under the CWA, neither federal nor state environmental agencies actually provide the CWA oversight that they do with other pollution sources, leaving many CAFOs without permits (see NPDES permit) and largely unregulated.

National Pollutant Discharge Elimination System (NPDES) permit program – Under the CWA, the NPDES permit program regulates point sources that discharge pollutants into waterways. All point sources of pollution are required to obtain a permit stating the limits of what will be discharged and setting up monitoring for their discharges.

Nonpoint sources – Nonpoint sources pollute waterways through runoff caused by rainfall or snowmelt moving over and through the ground to waterways. As the water moves, it picks up both natural and man-made pollutants. The pollutants are then deposited into lakes, rivers, wetlands, coastal waters and ground waters. Traditionally, row crops are not covered under the CWA, as they are considered nonpoint sources of pollution.

Nutrient pollution – While nutrients such as nitrogen and phosphorus contained in manure and other fertilizers are helpful for crop growth, excess application leads to runoff into waterways. The nutrients encourage the growth of algae, which blocks light, killing sea grasses below the surface. When the algae and the sea grasses die, their decomposition uses up the oxygen in the water, leading to hypoxia, or reduced oxygen levels — which, in turn, kills fish and other aquatic animals. These "dead zones" appear in many bodies of water. The second largest dead zone in the world occurs in the Gulf of Mexico every spring, due largely to nutrient pollution (see cover photo).

Point sources – Point source polluters discharge via man-made discrete conveyances, such as a pipe or man-made ditch, that allows runoff to flow into surface water. Factories, power stations and municipal wastewater and runoff treatment facilities fall under this category.

Total Maximum Daily Load – This is essentially a restriction on the amount of pollution that can flow into a waterway or watershed. If a watershed cannot achieve meaningful progress in water quality, the U.S. Environmental Protection Agency works with state agencies to set a total amount of pollution that the waterway can handle. Point sources then are limited further in total discharges.

Water Pollution Control Act (WPCA) – Predecessor to the CWA, the WPCA was first passed in 1948 and amended in 1965. There was no individual accountability for pollution, so there were no specific targets in even the most polluted waterways.

Executive Summary

A tidal wave of deregulation is sweeping across our nation's waterways. After over 40 years of effective Clean Water Act control of many of our biggest sources of pollution, industries have finally found a way to evade meaningful and enforceable limits on their discharges. Water pollution trading — or water quality trading, as proponents call it — is allowing polluters to opt out of installing pollution reduction technologies and, instead, to purchase pollution "credits" from other sources that may or may not be controlling their own discharges. This pay-to-pollute scheme is not only endangering our rivers, streams and lakes, but also threatening the very underpinnings of our successful water quality laws.

This report provides an in-depth examination of how water pollution trading is being implemented in two key states: Pennsylvania and Ohio. While this market-based approach to water pollution control is quietly being introduced throughout the country, its supporters, including many in the environmental movement, continue to focus on trading as an abstract concept full of promise. This report cuts through the theory and abstractions and establishes what water pollution trading really is: a regulatory avoidance scheme fraught with unaccountability that is destined to destroy waterways and communities.

Food & Water Watch filed Pennsylvania Right to Know Law requests for two trading participants in the state — Red Barn and Brunner Island — and received 942 documents. We also requested documents related to the Alpine Cheese trading program through Freedom of Information Act requests to the Ohio Environmental Protection Agency. The findings of this report are based on the analysis of these documents.

Key Findings:

- Water pollution trading seriously undermines the Clean Water Act, allowing previously accountable pollution dischargers to hide behind pollution credits and to discharge without any real limits:
  - Pennsylvania's Brunner Island coal-fired power plant now operates under a fictitious "net zero" nutrient discharge permit, whereby the facility is free to discharge as much nutrient pollution as it can purchase credits for. It was the third largest buyer of nitrogen credits in Pennsylvania in both 2013 and 2014, purchasing 87,000 credits in 2013 and 78,000 in 2014 — amounting to almost 10 percent of all credits purchased statewide in those years. With this new limitless discharge allowance, Brunner Island cannot be sued for polluting the local river.
  - In Ohio, chronic violators of our clean water laws are using pollution trading to continue their violations and to further destroy already impaired rivers. The Alpine Cheese Company was allowed to increase its phosphorous load to 972 pounds per year — a 200 percent increase from the stated target for the waterway — by increasing its phosphorous-containing wastewater discharge to 36.4 million gallons per year. This represents a 600 percent increase in wastewater discharge over what should have been allowed to protect local water quality. Between 1999 and 2014, Alpine Cheese had a combined total of some 928 limit violations and about 323 reporting violations, for a total of about 1,251 permit violations over the last 15 years. Tellingly, the bulk of these violations occurred between 2005 and 2011, while the nutrient trading pilot program was being developed and later implemented.

Excess application of manure and other fertilizers, high in nutrients such as nitrogen and phosphorus, leads to runoff in waterways, where these nutrients encourage the growth of light-blocking algae.

- Regulatory agencies that should be overseeing these practices and protecting our waterways are subjected to political interference, leaving them uninvolved while for-profit companies and pro-industry entities control our water quality future:
  - In Pennsylvania, all of the authority, verification and trading of water pollution credits has been placed in the hands of for-profit companies like Red Barn.
  - In Ohio, a then-state representative warned the state Environmental Protection Agency, which oversees trading, to stay off of farms where trading is being implemented. Meanwhile, a trading program in the state required 10 semi-annual status reports over the five-year trading program; state regulators only disclosed two of those reports.
- Pollution credits generated by agricultural operations for sale to other industry polluters are unverified and uncertain, and often are based on unsustainable practices that lead to likely increased pollution in our waterways.
  - In Pennsylvania, pollution credits are being generated by moving millions of pounds of animal manure from one impaired watershed to another, simply shifting the burden to other communities instead of solving the problem.
  - In Ohio, verification of agricultural pollution reductions consists of lax, infrequent visual inspections of pollution management practices at participating farms with weak attempts to actually quantify, through sampling, reductions in pollution loads to local waterways.

Recommendations

To hold polluters accountable and to protect our waterways, Food & Water Watch recommends that:

- Congress needs to reaffirm that the Clean Water Act does not allow for point source pollution trading by, among other things, defeating attempts to amend the Act to include a trading program and prohibiting states from spending any funds on implementing trading programs.
- Federal agencies, particularly the U.S. Department of Agriculture, need to stop spending taxpayers' dollars to promote these pay-to-pollute schemes across the country.
- State and federal governments need to replace voluntary pollution control approaches with mandatory measures in the nonpoint and agricultural source sector.
- Federal agencies must fund agricultural Best Management Practices without compromising current point source controls.
- The environmental community needs to wake up to the dangers of water pollution trading.
- Advocacy groups need to legally challenge water pollution as a violation of the Clean Water Act.

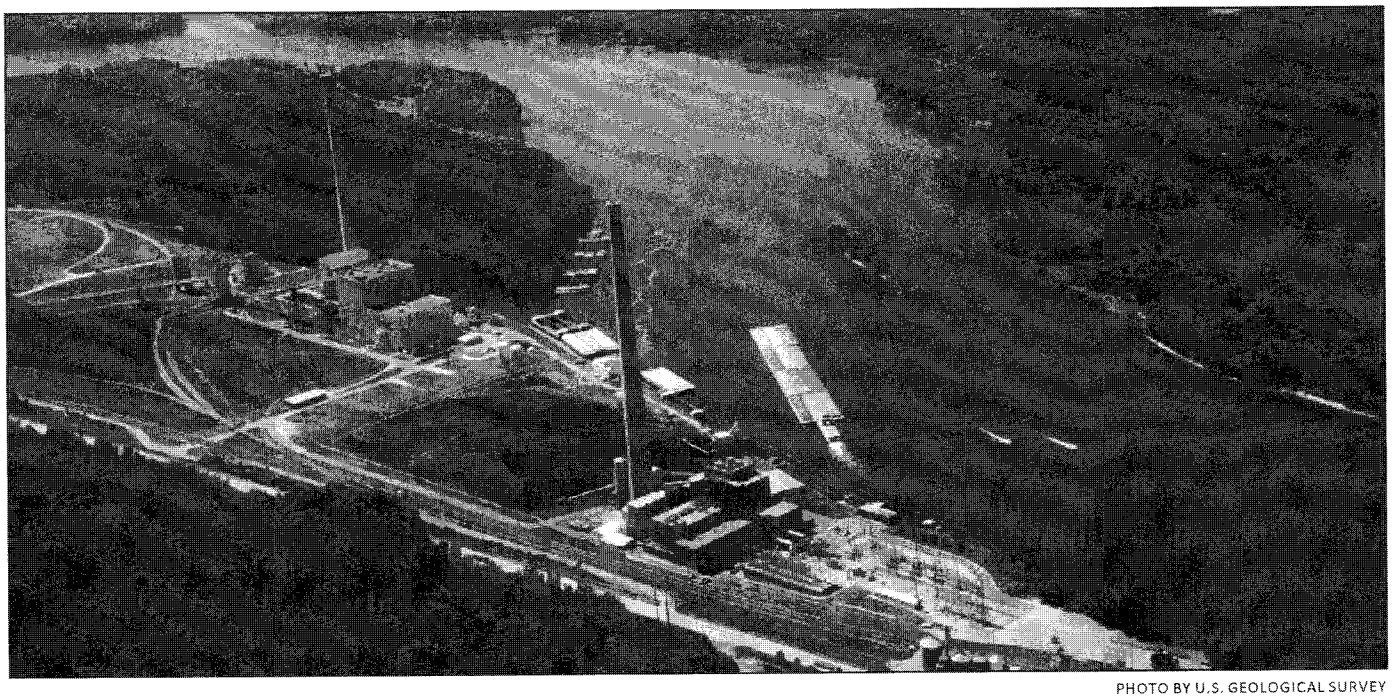


PHOTO BY U.S. GEOLOGICAL SURVEY

Introduction

Clean water is not only the most vital natural resource on Earth — it is also something that many people in the United States take for granted, since clean drinking water is readily available for most of our communities. However, as Toledo, Ohio experienced in the summer of 2014, there are no guarantees that clean water will always flow from our taps. As industries continue to pollute and use their increasing political influence to move away from the protective environmental policies that we now have in place, clean water will become even more scarce.[1]

Increasingly, corporations and governments that are charged with protecting their citizens are pushing for deregulation of pollution controls using market-based approaches.[2] In the United States, the marketplace is replacing our suite of environmental laws, such as the Clean Water Act (CWA, or Act). In the marketplace, pollution reduction is determined by profitability and attained through the purchase of pollution "credits" and offsets.[3] To date, pollution trading has focused mainly on air and climate problems, but we are witnessing an increasing effort to undo the CWA by creating a market for water pollution control. Regional water pollution trading programs are taking off in the Chesapeake Bay watershed and in the Ohio River Basin, currently covering nine states.[4] Water pollution trading also is being contemplated, either in active projects, pilot programs, regulations, policy or guidance, in locations like Arkansas, Colorado, Connecticut, the District of Columbia, Florida, Georgia, Idaho, Minnesota, Montana, North Carolina, Oregon, Utah, Wisconsin, and Washington.[5]

States Involved in Water Pollution Trading Programs

Arkansas	Kentucky	Pennsylvania
Colorado	Maryland	Utah
Connecticut	Minnesota	Virginia
Delaware	Montana	Washington
Florida	New York	West Virginia
Georgia	North Carolina	Wisconsin
Idaho	Ohio	
Indiana	Oregon	

These pay-to-pollute schemes are being quietly implemented with the active endorsement and funding of federal agencies like the U.S. Department of Agriculture (USDA) and the Environmental Protection Agency (EPA).[6] And while polluting industries are, as expected, actively pushing toward pollution trading over regulation, the country's environmental community has either openly embraced water pollution trading or sits on the sidelines, unaware or unengaged.[7]

Water pollution trading — or water quality trading, as it is called by proponents — is an overly complex and convoluted system of pollution control that is inherently subject to mismanagement, unaccountability and ineffectiveness, yet trading adherents continue to issue reports that make abstract promises, embracing make-believe ideals of accountability and verification.[8] Just this year, the National Network on Water Quality Trading (NNWQT)[a] put out a manual detailing its views on what it called "successful" pollution trading programs.[9]

The NNWQT report builds off a false foundation, stating that pollution trading is "guided by the same goals as those set out in the Clean Water Act."[10] However, pollution trading is inherently antithetical to the goals of the CWA; while the Act calls for the elimination of pollution from our waterways, water pollution trading sanctions acceptable discharges of pollution under a market scheme of credit swapping.

Even more disconcerting is the lack of polluter accountability built into water pollution trading. Individual polluter accountability is the hallmark of success of the CWA and its implementing regulations, while water pollution trading is designed and implemented so that polluters can evade responsibility for their discharges to our waterways. Some of the members of the NNWQT know first-hand how pollution trading destroys accountability and the rights of citizens to protect their waterways — another cornerstone of the Act — yet they still continue to promote the practice as the future of water quality control.[11]

This report exposes the problems with water pollution trading by looking closely at its implementation in both Pennsylvania and Ohio. This investigation reveals that water pollution trading is not a cost-effective fix to our ongoing water quality problems, as proponents claim.[12] Instead, it is a broken system of inherently unaccountable and highly questionable practices that will only pollute our waterways and threaten our communities.

a The NNWQT includes a number of industry, municipal and environmental groups. Although polluters trade pollution credits, proponents insist on euphemistically referring to the practice as Water Quality Trading. This report refers to the selling and purchasing of pollution credits more accurately as water pollution trading.

Background on Water Pollution Control in the United States

Water Pollution Crisis: Declining U.S. Water Quality in the 1960s

By the beginning of the second half of the twentieth century, the increasing industrialization of the country had taken a dramatic toll on U.S. rivers and lakes. This water quality crisis is most often epitomized by the case of the Cuyahoga River in Cleveland, Ohio. By the 1960s, the stretch of river that ran through the city was so polluted with industrial waste that *Time* magazine said that it "oozes rather than flows."[13] The river also regularly caught fire.[14]

Although the Cuyahoga is perhaps the most famous example of declining U.S. water quality, it is certainly not the only one. By the late 1960s, Lake Erie was officially declared "dead" because of excess levels of nutrients,[15] prompting Dr. Seuss to include the following passage in the first printing of his 1971 book, *The Lorax*:

> *They'll walk on their fins and get woefully weary*
> *in search of some water that isn't so smeary.*
> *I hear things are just as bad up in Lake Erie.*[16]

The United States in the 1960s was not without water pollution laws. The Water Pollution Control Act of 1948 (WPCA) and its subsequent iterations all had minimal protections for water quality, but their biggest downfall was the lack of individual polluter accountability.[17] For example, while the 1965 WPCA Amendments provided for ambient water quality monitoring, there was no attempt to hold individual polluters responsible for their discharges.[18] That meant that even when waterways were found to be heavily polluted, there was no way to trace the problem back to the source and to remedy the problem.

The Clean Water Act and Source-by-Source Controls: 40+ Years Controlling Point Source Pollution

Congress responded to the emerging U.S. water quality crisis by enacting a set of environmental laws and creating the Environmental Protection Agency "to protect human health and the environment."[19] Perhaps most important among the new laws was the Clean Water Act, which was enacted in 1972 "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[20] The principal shift from earlier failed water pollution laws was that the CWA implemented a source-by-source accountability approach as part of its "national goal that the discharge of pollutants into the navigable waters be eliminated by 1985."[21]

Point Sources of Pollution

Under the CWA, each industrial facility that discharged pollutants into a waterway through a pipe or any other kind of "discrete conveyance" was required to get a discharge permit issued by the EPA or the state agency authorized to administer the program.[22] Importantly, these "point source" polluters also were required to monitor their discharges and to report the results to the EPA and to any member of the public who wanted this information.[23] This fundamental shift in clean water protection meant that when water quality problems were found, sources could easily be identified and remedied.

CWA-permitted facilities were expected to install state-of-the-art pollution reduction technologies to minimize their discharges.[24] For most industrial discharges, the standard of reduction is known as Best Available Technology, or BAT.[25] These permits are to be reviewed and reissued every five years to incorporate any new reduction technologies available, giving the Act its technology-driving approach needed to eliminate discharges.[26]

Other important aspects of the 1972 CWA were transparency and citizen empowerment. In recognition of the fact that federal and state environmental agencies would not always have the resources (or the will) to hold polluters liable for violating the terms of their permits, Congress wrote "citizen suit" provisions into many of our modern environmental laws, including the CWA.[27] These provisions allow any person to obtain copies of permits, discharge monitoring reports and all other records related to point sources of pollution, and to bring permit violators to court to seek injunctions against further violations.[28]

Although far from perfect, the CWA has proven to be a tremendous success.[29] In Lake Erie, catches of walleye, the dominant fish species in the lake, grew from 112,000 in 1975 to 4.1 million in 1985.[30] The largest polluters of our waterways — coal-fired power plants, wastewater treatment plants and manufacturing plants — now had to adhere to science-based pollution reductions and, when caught violating, had to immediately come into compliance and pay fines. But the CWA did not succeed in remedying all of our water quality problems. The EPA's latest water quality data show that over 580,000 miles of U.S. rivers and streams and over 13 million acres of lakes remain pollutant-impaired.[31] Fifty-four percent of assessed rivers and streams still suffer from excess pollution.[32]

Nonpoint Sources of Pollution

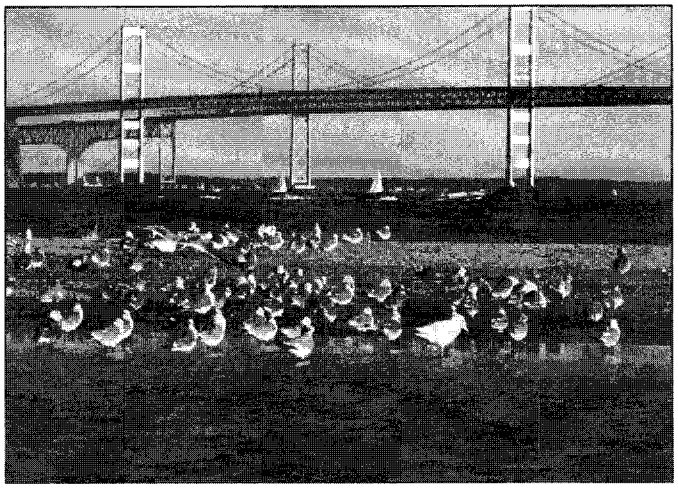
The biggest breakdown in CWA regulation has been with sources of pollution that are not considered point sources under the Act. These "nonpoint sources" include all of the diffuse runoff that is not associated with discrete, point source industrial pollution. Chief among these polluting sources is the agricultural sector, which, despite more than 40 years since the introduction of the CWA, remains largely unregulated.[b] Ironically, it is this refusal to properly regulate agricultural pollution that has, in part, spurred the growth of water pollution trading as yet another in a long line of attempts to get the industry to voluntarily clean up its discharges.

The Move to the Market in the Chesapeake Bay and the Ohio River Basin

In recent decades, water pollution trading has been introduced on a small scale in various states, typically to address nutrient-impaired waterways.[33] In recent years, however, there has been a renewed push by industries to replace the CWA source-by-source mandate with a market-based approach that allows point source facilities that do not want to pay to upgrade their pollution control technology to purchase credits in lieu of upgrades.[34] (See "The Story of Water Pollution Trading" on pages 14-15.)

Some of the early attempts at water pollution trading, such as Connecticut's Long Island Sound nitrogen program, involved placing a pollution cap on a number of point source facilities within the same industry sector and then allowing each facility some flexibility with permit compliance as long as the aggregate cap limit was met.[35] These types of point-to-point source programs, which are, in effect, a Clean Water Act "bubble permit" approach, have been replicated in Virginia's wastewater treatment industry and elsewhere.[36]

However, point-to-point source trading has not provided industry with the wide-scale solution that they really seek: a readily abundant and cheap way to avoid permit compliance, which point-to-point source trading simply cannot fulfill. Water pollution trading programs are increasingly nonpoint-to-point source trading programs, with industrial point sources looking to largely unregulated nonpoint agricultural sources as low-cost credit suppliers so that they can continue onsite discharges or even exceed permit limits. The biggest nonpoint-to-point source trading programs are being implemented in the Chesapeake Bay watershed and the Ohio River Basin.[37]



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Chesapeake Bay's Total Maximum Daily Load

"TMDLs" are the Total Maximum Daily Loads of pollutants that can be discharged and still allow a water body to meet water quality standards set by the states under the Clean Water Act.[38] These pollutants come from energy facilities, factories, factory farms (also known as concentrated animal feeding operations, or CAFOs) and wastewater treatment plants, as well as from harder-to-control nonpoint sources such as many of the Bay's agricultural operations.[39] In 1972, Congress required that TMDLs be adopted for all water bodies if, after the application of modern sewage and wastewater treatment technologies, the waters continued to violate quality standards.[40] The Chesapeake Bay TMDL was formally adopted by the EPA on December 29, 2010, after the Bay states, including Delaware, Maryland, New York, Pennsylvania, Virginia, West Virginia and the District of Columbia, avoided adopting TMDLs for decades.[41] The Bay TMDL focuses on some of the biggest threats to the Bay watershed: nutrients, namely nitrogen and phosphorus.[42]

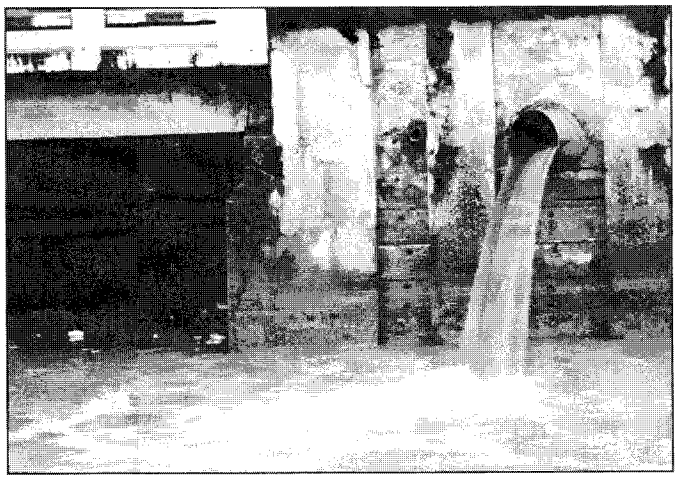
In the simplest sense, the TMDL is a rationing plan. It seeks to allocate pollution loads to waterways among the many sources of pollution in the Bay. To implement TMDLs, the EPA and the states must use their respective authority to ratchet down or restrict pollutant discharges through permits and other state regulatory programs. According to the EPA, the Bay TMDL should restore water quality in the Bay at some unspecified time after the year 2025.[43]

b Although crop operations are considered to be nonpoint sources under the Clean Water Act, concentrated animal feeding operations (CAFOs) are designated as point sources under the Act. However, the EPA and state agencies refuse to force CAFOs to adhere to the many protective provisions that other point sources must abide by. For example, CAFOs are not required to monitor and report their discharges of pollution.

One of the primary pollution problems facing the Chesapeake Bay is nutrients from agricultural operations.[44] Estimates from 2014 place agriculture's contributions to Bay nitrogen and phosphorus loads at 42 percent and 55 percent, respectively.[45] For decades, the Bay states and the federal government have plied the agricultural industry with taxpayer funds to implement voluntary practices, to little or no avail.[46] Although cost-share programs, manure storage sheds, cover crop initiatives and other "Best Management Practices" have been implemented to the tune of hundreds of millions of dollars, the health of the Bay continues to decline.[47]

However, the failure of voluntary approaches in agriculture-related restoration efforts did not stop the EPA from relying on yet another voluntary, incentive-based approach in the TMDL.[48] The EPA's Bay cleanup plan contemplates nutrient pollution trading as one of the main components of Bay restoration, and, instead of taking on any responsibility for overseeing and implementing this untested practice, the EPA is allowing the Bay states to come up with their own patchwork approach to pollution trading.[49]

One such Bay state-implemented water pollution trading program is in Pennsylvania (see page 9). Pennsylvania has the longest running trading program of any Bay state. In 2014 alone, credits for more than 1.6 million pounds of nitrogen and over 100,000 pounds of phosphorous were generated from agriculture-related operations that went to industrial point sources like wastewater treatment plants and coal-fired power plants.[50] This investigation of trading in Pennsylvania relies on public documents regarding a nutrient credit broker, Red Barn Trading Company, as well as on other state agency documents. Our inquiry shows a fundamentally broken and unaccountable system of credit swapping, whereby industries are free to pollute under a "sky's-the-limit" permitting system while manure from agricultural operations is trucked from one impaired watershed to another to generate credits.



Ohio River Basin's Industry-led Trading Program

Whereas state regulators are driving water pollution trading in the Bay region with the Bay TMDL, it is an industry-backed group, the Electric Power Research Institute (EPRI), that is working to bring the practice to the Ohio River Basin on behalf of its power plant membership.[51]

With the implementation of new Clean Air Act pollution control requirements, the coal-fired power plant industry found itself in a quandary. New air scrubbing technologies resulted in a dramatic increase in wastewater discharges of nitrogen and phosphorus from the plants directly into local rivers.[52]

The Ohio River Basin contributes significantly to the massive, nutrient-caused dead zone in the Gulf of Mexico each summer, accounting for 37 percent of nitrogen loads and 32 percent of phosphorus loads into the Mississippi River and then out into the Gulf.[53] The Basin is also home to 53 of these coal-fired power plants, and their impact on already nutrient-impaired waterways is significant.[54]

Faced with the burden of technology upgrades to reduce or eliminate these water nutrient discharges, the industry turned to EPRI to launch a water pollution trading pilot program in the Basin to relieve the industry of having to upgrade their facilities.[55] Funded in 2012 by $1 million in taxpayer money through a USDA grant, the EPRI Ohio River Basin two-year pilot project is slated to end in 2015, but EPRI has already gone on record as holding out several individual trading programs as indicative of success.[56] In a 2013 technical report entitled *Case Studies of Water Quality Trading Being Used for Compliance with National Pollutant Discharge Elimination System Permit Limits*, EPRI listed the Alpine Cheese Company in Ohio as an example of a successful nutrient trading program.[57]

Alpine Cheese has been used time and again by trading proponents as the poster child for water pollution trading, most notably by Richard H. Moore from Ohio State University, whose group at the university was paid by Alpine Cheese as part of the pilot.[58] Contrary to the representations made, the trading program is rife with a lack of accountability, ongoing permit violations and no attendant improvement in water quality. In fact, the Alpine Cheese case is a prime example of water pollution trading only in that it underscores all that is *wrong* with this reckless approach to water quality (see page 16).

The Theory of Water Pollution Trading

Simply put, nonpoint-to-point source water pollution trading rests on the belief that it is less costly to reduce nutrient pollution from agricultural sources than it is from industrial point sources like wastewater treatment plants. Adherents of trading, by focusing their attention on downstream receiving water bodies like the Chesapeake Bay or the Gulf of Mexico, take the position that a pound of upstream nutrient reduction is the same regardless of the source, and that a grass buffer filter on a farm is cheaper to install than a nutrient filter on a coal-fired power plant.[59] In addition to the point source cost-saving benefit, trading proponents also highlight the nonpoint-to-point source approach as one that will further incentivize agriculture, the largest source of nutrient pollution in U.S. waterways, to take steps to reduce their own loads (See "The Story of Water Pollution Trading" on pages 14–15).[60]

Point Source Control: Economic Cost Avoidance

The Clean Water Act generally requires industrial point sources to attain pollution discharge limits that result from the "Best Available Technology Economically Achievable," or BATEA.[61] In practical terms, this means that industries are supposed to do the best they can, using the most advanced technologies available, to reduce their discharges of pollution to our waterways. The "economically achievable" part means that at some point, further reductions simply do not become cost-efficient, but the hope is that further, affordable technological advances will make it possible to one day attain the Act's goal of eliminating pollution from our waterways.

Trading theorists suggest that it is these last, incremental reductions that industries should be able to meet through the purchase of agricultural credits, allowing industry to avoid additional reduction costs while still achieving downstream load reductions.[62] However, neither industry nor government has the same view of the limited utility of pollution credits. Instead, power plants are being permitted to use credits to cover their entire discharge of nutrient pollution into nutrient-impaired rivers — in the case of Brunner Island in Pennsylvania, for as much as 87,000 pounds of nitrogen in some years.[63] Also, the ability of industrial point sources to use pollution credits is destroying the individual accountability framework of the CWA, essentially returning us to the failed ambient water quality approach that resulted in the 1960s water crisis.

Nonpoint Source Control: Agriculture and Voluntary Incentive Programs

Trading supporters also claim that pollution trading creates financial incentives for industrial agriculture — the largest source of nutrient pollution in many of our nation's waters — to clean up its mess.[64] They say that trading represents the kind of out-of-the-box thinking that will help restore our many impaired waterways.[65] However, these financial incentives have existed for decades in an ongoing and failing effort to stop agricultural pollution.

The agricultural nutrient pollution problem does not stem from a lack of voluntary and financial incentives. Instead, it is a result of government's steadfast refusal to implement what has worked so well in the point source sector: individual accountability, discharge limits, monitoring and transparency. Yet, rather than bringing some of these successful point source control mechanisms to the agricultural sector, trading adherents are moving some of the failed nonpoint source approaches over to point source industries under the guise of water pollution trading.

Water Pollution Trading Case Studies: Where Reality Contradicts Theory

Red Barn and the Pennsylvania Program

Lack of Oversight and Independent Verification

Proponents who view water pollution trading as a way to improve water quality are all in agreement that there must be careful oversight of credit generating and purchasing, with verification and accountability built into trades. Yet oversight, verification and accountability are all, to a large degree, undefined concepts. Our review of Red Barn and the Pennsylvania program shows that the ideal trading that supporters might envision is far removed from the reality on the ground.

Pennsylvania is one of the biggest sources of nutrients to the Chesapeake Bay, in part because of a long history of ineffective regulation of agricultural operations. Starting in 2005, the state implemented its water pollution trading program as yet another incentive-based approach to agricultural pollution. The application process for agricultural credits includes steps for verifying the eligibility of a farm to generate the credits, checking the Best Management Practice (BMP) planned to generate the credits, a calculation of the amount of nutrient pollution avoided, and a verification plan.[66]

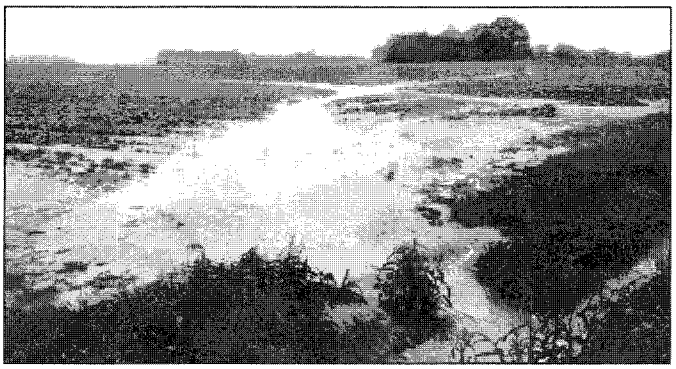
Because of the way that the Pennsylvania trading regulations are structured, the state Department of Environmental Protection (DEP) takes a virtually hands-off approach to water pollution trading, leaving the application and credit verification process largely in the hands of pollution credit broker services that have cropped up in the state. Red Barn Trading Company, located in Lancaster, Pennsylvania, is one such company. In 2014, Red Barn was the third largest source of verified nitrogen credits in the state.[67]

Given the degree of control that for-profit companies like Red Barn have over the credit trading program, Food & Water Watch decided to look at all the ways that Red Barn was working with farmers and state officials. We also wanted to look at the records for the largest non-municipal (and third largest overall) purchaser of credits, PPL Energy, the operator of the Brunner Island Power Plant. We filed Pennsylvania Right to Know Law requests for both Red Barn and Brunner Island and received 942 documents, all of which we analyzed. All references in this report to specific proposals, verification reports or sales in Pennsylvania's pollution trading scheme will refer either to documents received from those requests or to public documents.

The documents reveal that much of the trading process in Pennsylvania is outsourced to Red Barn. All of the authority, verification and trading, which should be under the auspices of employees of state environmental protection departments, has been placed in the hands of the company. Red Barn is a one-stop shop for farms that want to sell pollution credits to other industries. Red Barn works with farms to put together the application for credit-generating to submit to the DEP.[68] Those credit-generation proposals are based on BMPs that Red Barn recommends in Nutrient Management Plans that it creates for the farm.

Once the DEP certifies the proposal, it is Red Barn, not the state, that verifies that the credits are, in fact, being generated by the BMPs that Red Barn included in the farm's Nutrient Management Plan.[69] Red Barn then sells those "verified" credits at an auction run by the Pennsylvania Infrastructure Investment Authority (PENNVEST) to buyers that need the credits to meet their permit needs.[70] Red Barn, through its contracts with farmers and credit purchasers, is involved in every step — from proposal to disposition — of selling water pollution credits.

The lack of agency oversight and the degree to which companies like Red Barn control the trading process from



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cradle to grave create significant potential for abuse. Historically, pollution credit trading regimes, and especially those including offsets, have had difficulty detecting and preventing fraud and abuse. For example, INTERPOL looked at a variety of carbon cap-and-trade schemes, including the European Union's program, the world's largest such scheme, and found a variety of examples of current and potential fraud.[71] Likewise, the U.S. Renewable Fuels Standard (RFS) trading program, perhaps more than any other environmental trading scheme, has been vulnerable to fraud and manipulation. As of November 2011, the EPA believed that about 140 million renewable energy credits (9 percent of the total market) had been fraudulently generated and sold under the RFS program.[72]

Although our review of the Pennsylvania trading program uncovered no direct evidence of fraud, the oversight by regulatory agencies that trading proponents demand as an integral component of water pollution trading is virtually absent in the Pennsylvania program. Leaving private companies that profit from the sale of credits in charge of verifying that those credits do, indeed, exist makes a mockery of the concept of oversight and creates the potential for fraud.

Shifting Pollution From One Impaired Waterway to Another

One of the dominant BMPs that Red Barn and its client farmers engage in to generate nutrient credits under the Pennsylvania program is manure export, or shipping manure from industrialized animal factory farms out of the watershed to another location where it could be used as fertilizer.[73] This is especially attractive for poultry manure, which is fairly dry and therefore amenable to transportation.[74]

Not only does Red Barn like to take advantage of the manure transport system, but poultry litter transport also has been a favorite method of generating credits in Pennsylvania. About 29 percent of all nitrogen credits certified in the state in 2014 came from poultry manure

transport.[75] For Red Barn, poultry litter export has been a huge boon to its business. Red Barn registered about 17 percent of all of Pennsylvania's certified nitrogen credits in 2014.[76] About 92 percent of those came from poultry manure export, purportedly out of the Chesapeake Bay watershed.[77] Indeed, Red Barn alone accounted for over half of the certified nitrogen credits attributable to exporting poultry litter out of the Chesapeake Bay watershed statewide.[78] In the 2010–2011 farm year, which runs from October 1 to September 30,[79] this comprised over 10 million pounds of chicken manure.[80] In 2011–2012, it was over 5 million pounds.

Where Does the Manure Go, and How Is it Tracked?

Where do all those thousands of tons of manure go when they purportedly leave the Bay watershed? According to the documents produced by the DEP, the vast majority of the manure was transferred to a single hay farm in the southwestern part of the state, J&L Hay.[81] In 2010–2011, over 90 percent of Red Barn's manure export went to J&L Hay, while in 2011–2012, all of it was sent to J&L Hay.[82]

J&L Hay is located in the Ohio River Basin, itself the subject of a water pollution trading scheme.[83] Indeed, the farm that is listed as receiving all of this manure sits less than a mile from Wells Creek, which is impaired for both sediment and nutrient runoff.[84]

Once it arrives at J&L Hay, the manure can end up anywhere, because, according to state records, J&L Hay also acts as a manure broker.[85] When Food & Water Watch inquired about the final disposition of the manure, the Pennsylvania DEP responded that it had no records for the farm.[86] The broker can ship the manure to whomever wants it, and the DEP does not keep records for the final disposition.[87]

Simply shifting mountains of manure around the state, from one impaired waterway to another, is not dealing with our water quality problem (which water pollution trading proponents claim is the goal of trading), nor is it forcing the unsustainable factory farm industry to clean up its pollution problem. Instead, a significant number of pollution credits in Pennsylvania are being generated through what can only be described as a shell game, whereby piles of manure move from place to place to pollute local waterways while middlemen brokers skim profits from sales of highly questionable credits.

Other Questionable Credit-Generating Practices

The single-largest sector source of nutrient credits in Pennsylvania is wastewater treatment plants[c] that are below their effluent limits from their National Pollution Discharge Elimination System (NPDES) permits (see Figures 1–2).[88]

Fig. 1 • Phosphorous Credits BY SOURCE TYPE

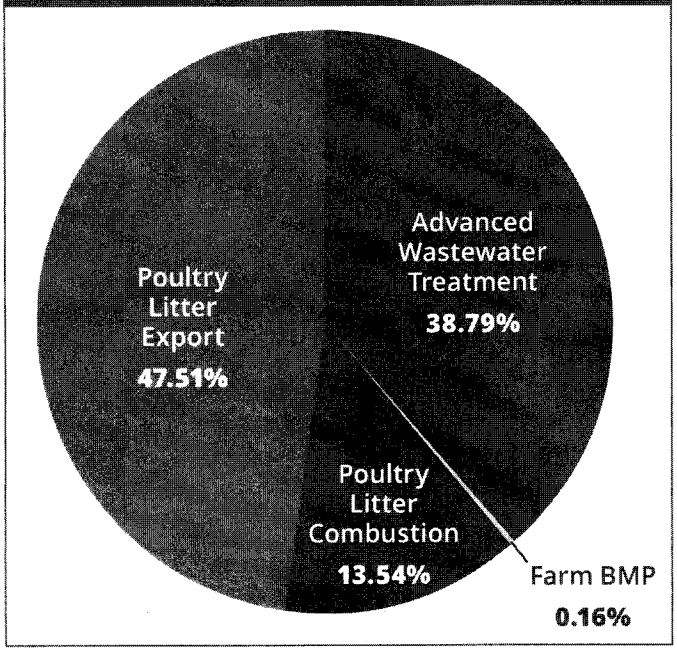
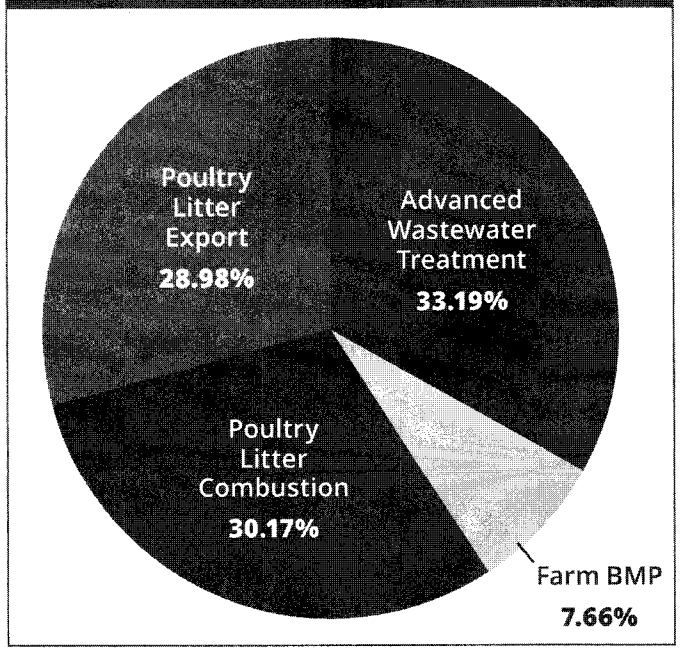


Fig. 2 • Nitrogen Credits BY SOURCE TYPE



SOURCE: Pennsylvania Department of Environmental Protection, "Certified Nutrient Credit Generator Proposals," Updated November 14, 2014.

c Pennsylvania distinguishes between poultry litter export and poultry litter incineration in calculating nutrient generation, leaving wastewater treatment plants as the single largest credit generator. However, when these two sources are combined, poultry litter from factory farms generates more nutrient credits than any other source, with 51 percent of phosphorus and 59 percent of nitrogen.

Under the Pennsylvania water pollution trading scheme, if a wastewater treatment plant discharges fewer pollutants than it is allowed under its permit, it can convert this excess, known as "headroom," to credits and sell them to other polluters.

The notion that point source facilities can even generate credits runs counter to the fundamental premise of the Clean Water Act. The very first section of the Act states that the goal is to eliminate discharge of pollutants to our waterways.[89] The CWA point source permitting system is designed to control discharges by imposing the greatest pollution controls that are economically feasible for each specific industry under regulation.[90] These standards are continually ratcheted down through annual review of the regulations and are revised to match changes in the regulated industry or in the available pollution control technologies.[91]

In short, point source facilities are required to be designed, operated and permitted in a manner that results in the least amount of discharge; there is no room for "headroom" in the permit. Allowing this headroom to be used to generate credits results in net increases of pollution to waterways, in direct contradiction of the goals of the CWA. In Pennsylvania, over 200,000 pounds of nitrogen credits were generated this way in 2014 alone.[92] That means that over 100 additional tons of nitrogen were discharged into the state's waterways because of trading.

The same problem can be found in agricultural credits certified by the state. For example, one farm received credit for three BMPs: a 35-foot riparian buffer, a 100-foot setback on which there was no mechanical manure spreading and continuous no-till farming.[93] While all of these may somewhat limit the nitrogen runoff from the farm, all three were already in place when the operations applied for the credits.[94] Therefore, the credits generated from these practices represented a net increase of pollutant loads to waters of the state.

Paradoxically, wastewater treatment plants not only generate a large amount of nutrient credits by selling off permit headroom, but those that are unable to meet protective permit limits can simply purchase credits from other sources to pollute. In the summer of 2014, the Scranton Sewer Authority entered into a multi-year contract with EnergyWorks — a company that converts chicken manure into energy — to allow the Scranton facility to operate above their permit cap limits.[95]

While trading proponents among the environmental community continue to insist that the practice is intended to clean up waterways, the joint press release from Scranton Sewer Authority and Energy Works' parent company leaves little doubt as to the real goal of pollution trading: "Pennsylvania law allows municipalities and businesses operating above their permit cap limits to purchase offsetting credits from facilities that are certified to produce verifiable reductions in the flow of nutrient pollution to the Chesapeake Bay."[96] But using credits to exceed permit limits is not "compliance" — it is simply attempting to excuse permit violations and avoid accountability.

Loss of Accountability Under the CWA Point Source Program

What is perhaps most disturbing about the Pennsylvania trading program is the destruction that it brings to the most successful part of the 40-year old Clean Water Act: the oversight and control of industrial point sources of pollution.

Brunner Island Steam Electric Station is a 1.4 gigawatt coal-fired power plant in Pennsylvania.[97] It has a history as a polluter, ranked as the 27th dirtiest power plant in the nation in 2006 for its sulfur dioxide (SO_2) emission rate, and as number 19 for total tons of SO_2 emissions.[98] In 2011, the PennEnvironment Research & Policy Center released a report calling Brunner Island the 59th most polluting power plant in the country.[99] This is shocking, given that there were over 7,300 power plants in the United States in 2013.[100] The EPA reports that Brunner Island has

been in noncompliance for nitrogen discharges two out of the last three times it was tested, dating back to 2012.[101]

Thanks to water pollution trading, Brunner Island's CWA permit compliance problems for nitrogen discharges are over. Before Pennsylvania engaged in water pollution trading, facilities like Brunner Island were given a permit to discharge pollutants within concrete, measured and verified limits. Facilities could discharge 100 or 1,000 or 10,000 pounds of nitrogen per year, but they needed to show, through regular end-of-the-pipe water sampling, that they met the limit. Over time, as reduction technologies improved, permit limits were ratcheted down to smaller amounts. That technology-driving, source-by-source approach has brought many of our waterways from the brink of disaster in the 1960s to relatively good health today.

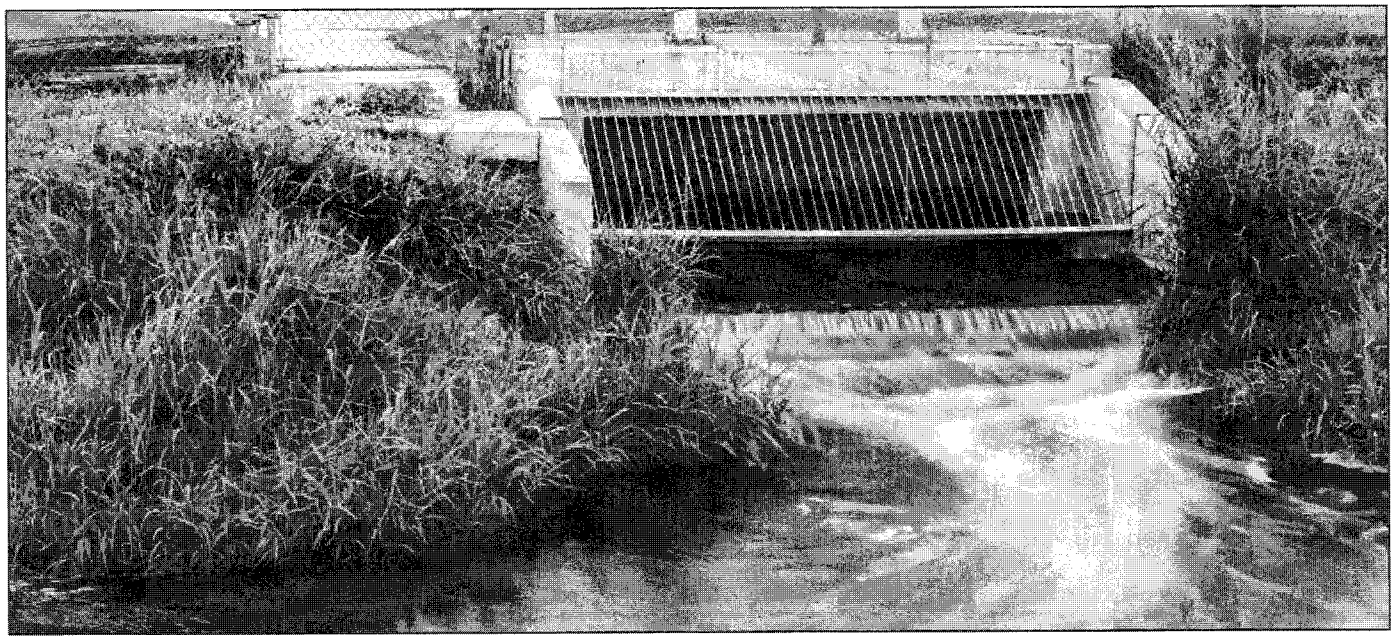
Water pollution trading has put an end to accountable CWA permitting.

Brunner Island now operates under a fictitious "net zero" nutrient discharge permit, free to discharge as much nutrient pollution as it purchases credits for.[102] And Brunner Island has been taking full advantage of the scheme. It was the third largest buyer of nitrogen credits in Pennsylvania in both 2013 and 2014, purchasing 87,000 credits in 2013 and 78,000 in 2014.[103] That amounts to almost 10 percent of all credits purchased statewide each year.[104]

Even some of trading's proponents are frustrated in their efforts to hold point source credit purchasers like Brunner Island accountable. In 2012, the USDA gave a grant of just over $700,000 to the Chesapeake Bay Foundation, a member of the NNWQT, to help assess water pollution trading in the Bay watershed, specifically in Pennsylvania and Virginia.[105] However, in October 2014, the Chesapeake Bay Foundation filed a 60-day notice of intent under the CWA to file suit against Brunner Island for its questionable use of nutrient credits, some of which were purchased from Red Barn.[106] Such notices are a common enforcement strategy under the Act that allows private citizens to sue permittees that are alleged to be in violation of a permit.[107] This has been a powerful tool for environmental activists, as it allows them to enforce the law even if state and federal agencies cannot or will not.

In its notice letter, the Chesapeake Bay Foundation pointed to the problems that Food & Water Watch has been pointing to for years: that the agricultural credits being purchased were not verified and that there is no proof that the claimed credit-generating activities actually took place.[108] In sum, the Chesapeake Bay Foundation said the Pennsylvania DEP failed to show that there is, through trading, a net reduction in pollution.[109]

Unfortunately, despite the threat of litigation, no suit was ever brought forward, even long after the expiration of the 60-day notice period, nor could it. Brunner Island no longer has permit limits that citizens can monitor and enforce; it essentially operates under a nutrient discharge allowance that is limited only by the number of credits that the facility purchases. Unfortunately, our waterways will bear the burden of this unaccountable approach; water pollution trading means the end of the CWA as we know it.

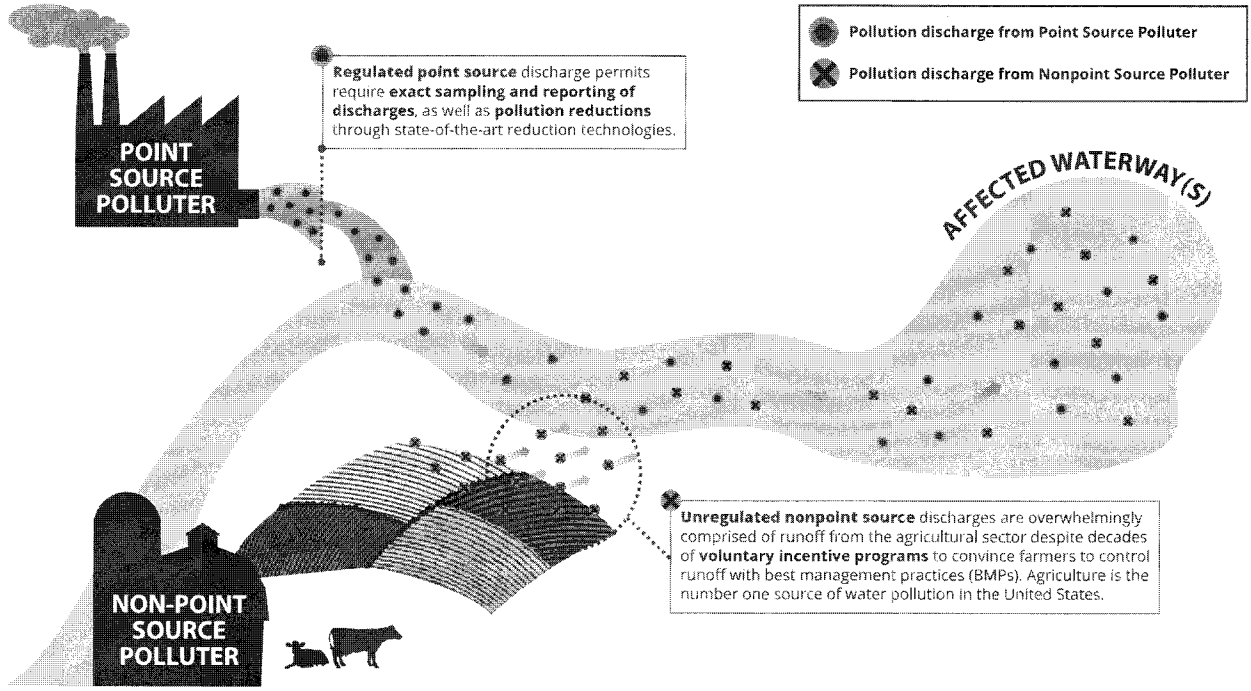


The Story of Water Pollution Trading

POINT SOURCE POLLUTER: Under the Clean Water Act, industrial facilities that discharge pollutants into a waterway through a pipe or any other kind of "discrete conveyance" are required to get a discharge permit issued by the EPA (or the state agency authorized to administer the program) and monitor and report their discharges to regulators and the public. CWA-permitted facilities are expected to install state-of-the-art pollution reduction technologies to minimize their discharges.

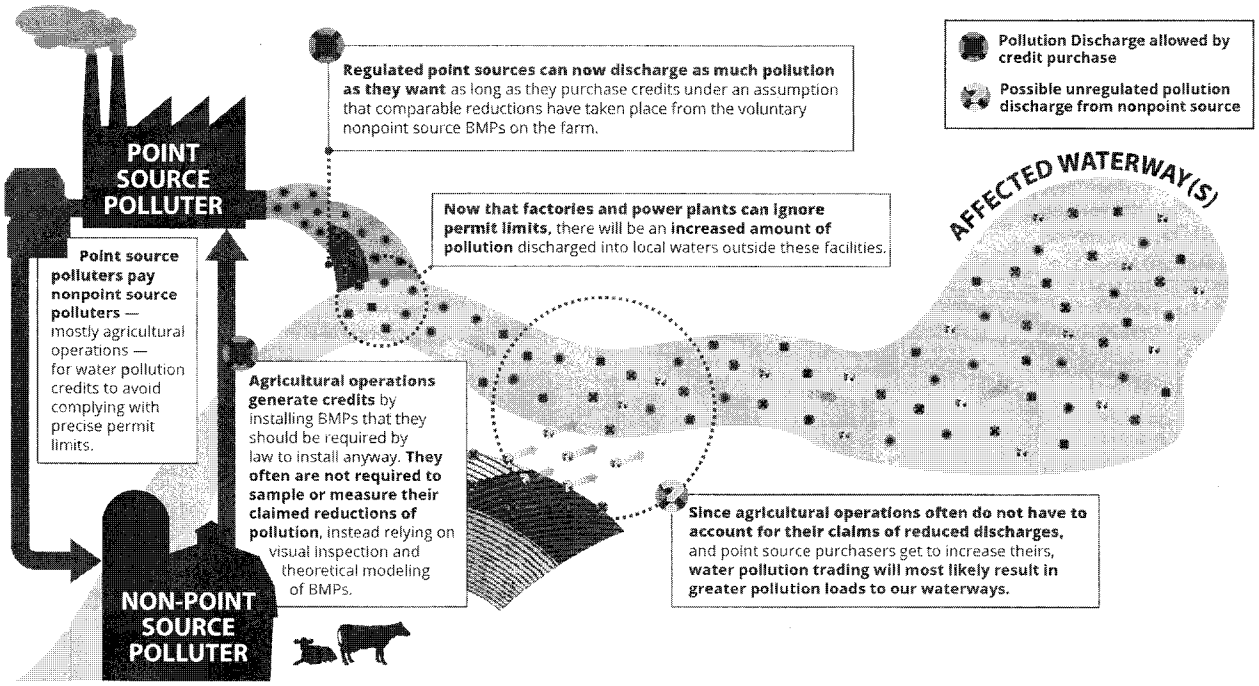
NONPOINT SOURCE POLLUTER: Nonpoint sources include all of the diffuse runoff that is not associated with discrete, point source industrial pollution. Chief among these polluting sources is the agricultural sector, which, despite more than 40 years since the introduction of the Clean Water Act, remains largely unregulated.

Pollution Discharge WITHOUT Water Pollution Trading



Water pollution trading is a pay-to-pollute scheme that brings the worst of our failed voluntary nonpoint source approaches to the point source sector, giving factories, wastewater facilities and power plants a way out of complying with their current discharge limits and threatening our already impaired waterways. The Clean Water Act has successfully reduced pollution from power plants, wastewater treatment plants and other point source polluters into our public waterways. However, nonpoint source discharges from agriculture and other diffuse sources have remained largely unregulated, resulting in significant pollution into rivers and lakes.

Pollution Discharge WITH Water Pollution Trading



Alpine Cheese Company in Ohio

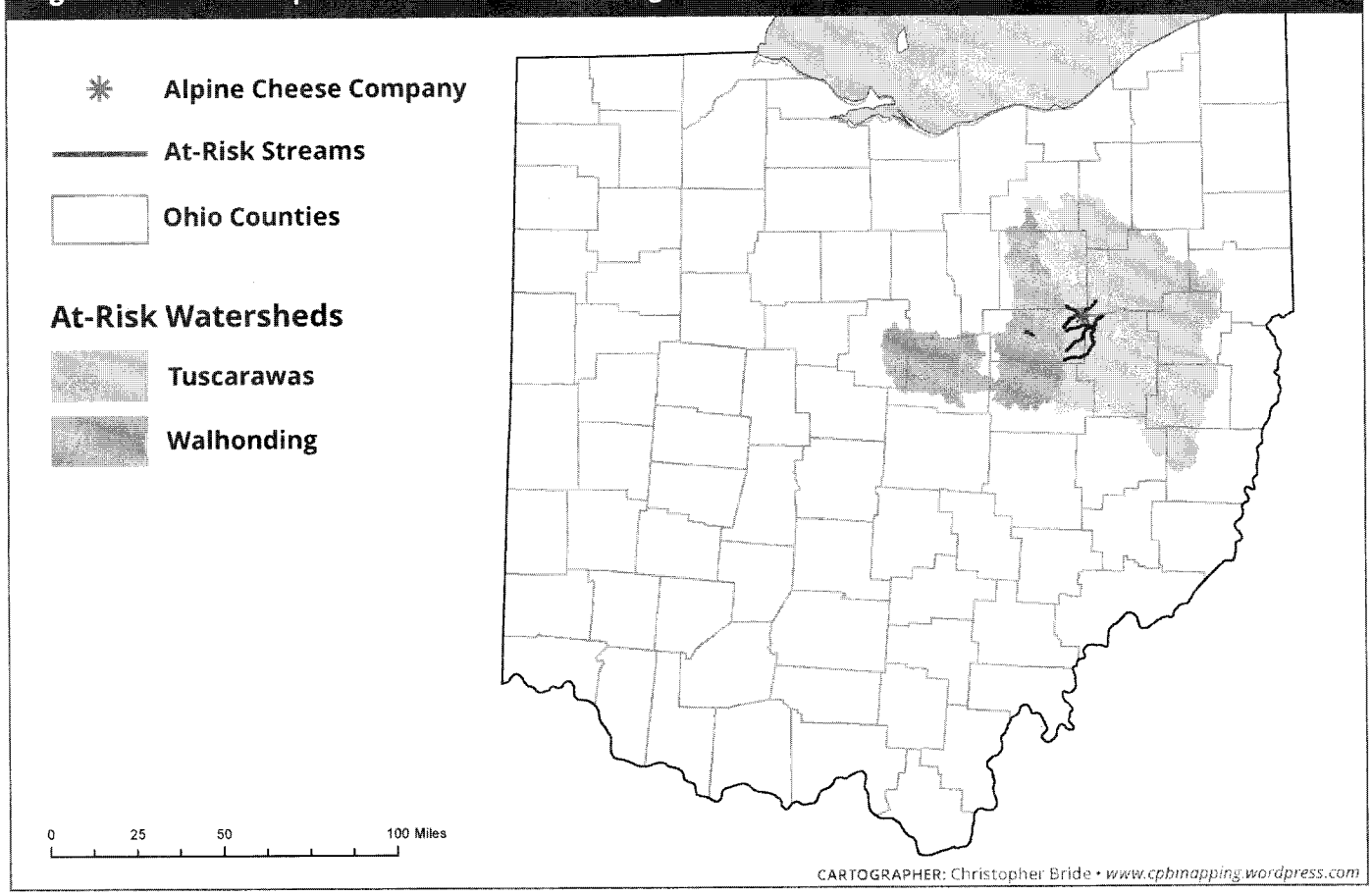
Pennsylvania is not the only example of how water pollution trading is destroying the Clean Water Act and handing our waterways over to the highest pollution credit bidders. Thanks to the Electric Power Research Institute (EPRI), working on behalf of its power plant clients, a broad, multi-state water pollution trading program is being implemented in the Ohio River Basin. States like Ohio have followed Pennsylvania's lead and have begun their own state-based trading programs.

In 2005, planning of a water pollution trading pilot program began when the Alpine Cheese Company of Winesburg, Ohio — a point source polluter — wanted to expand its operations.[110] This expansion meant increased amounts of wastewater discharge into local, impaired waterways — primarily Middle Fork Sugar Creek and other tributaries of Sugar Creek within the Tuscarawas Watershed of the Ohio River Basin.[111]

Under a TMDL for Middle Fork Sugar Creek, Alpine Cheese should have been allowed to discharge only 1.23 pounds per day of phosphorous, or 319 pounds each year, via wastewater discharges of 1 milligram per liter (mg/l) of phosphorous at a total wastewater volume of 0.02 million gallons per day (MGD), or 5.2 million gallons per year.[112] However, under its expansion and subsequent participation in the trading program, Alpine Cheese was permitted to increase its phosphorous discharge levels to 3.74 pounds of phosphorous per day, or 972 pounds per year, via wastewater discharges of 3.2 mg/l at a total wastewater volume of 0.14 MGD, or 36.4 million gallons per year.[113] This equates to a 200 percent increase in pounds of phosphorous released into waterways, or a 600 percent increase in phosphorous-containing wastewater discharge over what should have been allowed to protect local water quality.[114]

In order to comply with the TMDL limits, Alpine Cheese was facing wastewater treatment upgrades at a projected cost of about $1 million.[115] Rather than pay for these tried-and-true upgrades, however, the Alpine Cheese Phosphorous Nutrient Trading Plan was created in 2005 as an alternative — a project estimated to cost about $800,000.[116] Unfortunately, the $200,000 in savings does not reflect the continued costs to public waterways, such as Sugar Creek, that remain impaired.

Fig. 3 • OVERVIEW: Alpine Cheese Nutrient Trading Plan Area



SOURCE: Food & Water Watch analysis of FOIA documents from Northeast District Office, Ohio EPA. On file at Food & Water Watch.

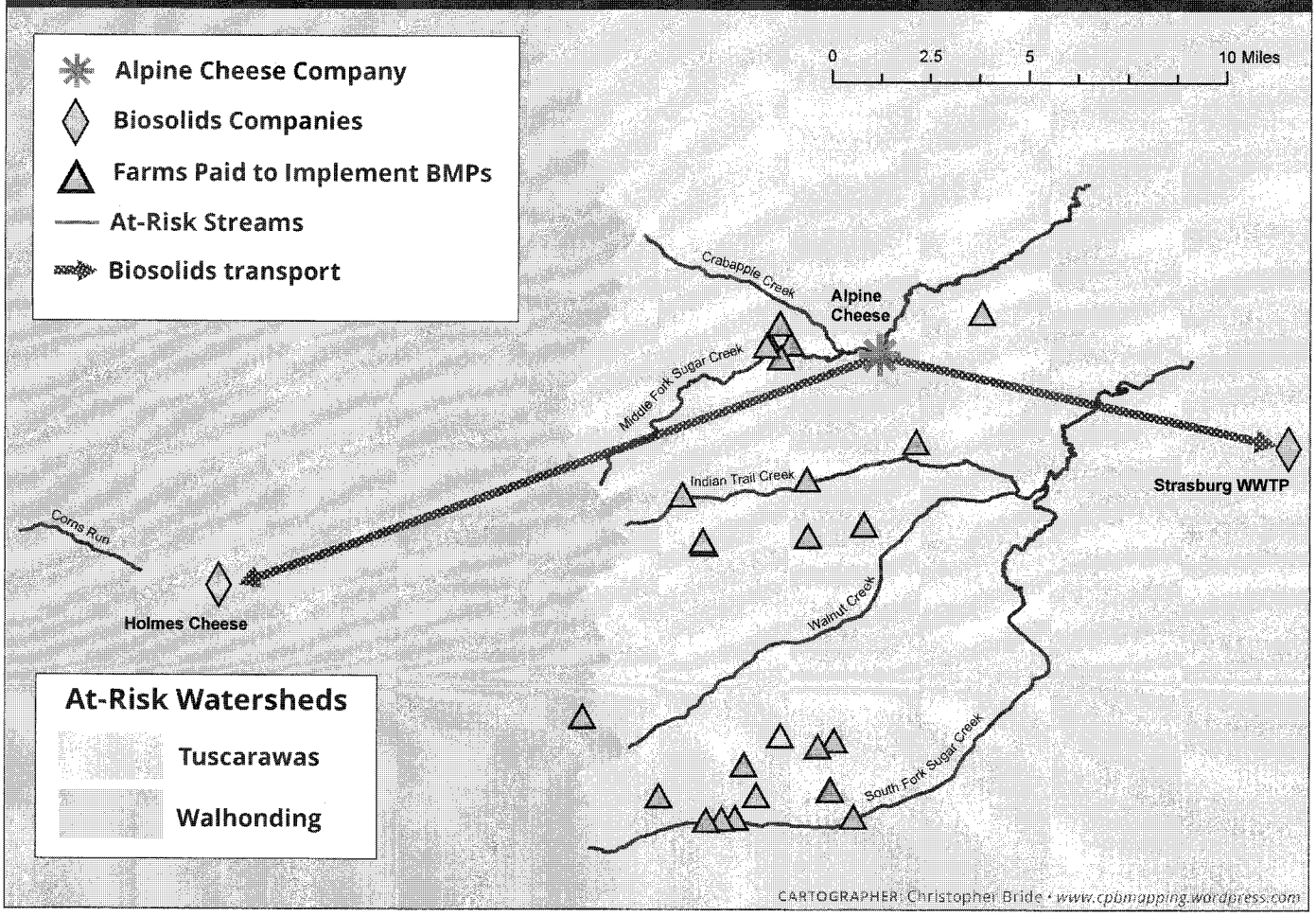
The Alpine Cheese Phosphorous Nutrient Trading Plan

Food & Water Watch requested documents related to the Alpine Cheese trading program through Freedom of Information Act requests (FOIAs) to the Ohio EPA. Based on the documents received, the Alpine Cheese case looks much less like the poster child that its proponents claim it to be; instead it is a program that embraces extensive permit noncompliance and violations, persistently impaired waterways, lax monitoring and verification of BMPs, and biosolids mismanagement, among other problems.

The Alpine Cheese trading program purportedly was designed to result in reduced phosphorous discharges into the Middle Fork Sugar Creek as well as the Indian Trail and Walnut creeks and South Fork Sugar Creek Headwaters. Instead of Alpine Cheese making phosphorus reductions to meet Sugar Creek water quality requirements, the facility was given relaxed discharge standards in a five-year NPDES permit, from 2007 to 2011.[117] In exchange for these relaxed standards, the facility paid 25 farms in the watershed to undertake some 90 BMPs in order to make the needed nutrient discharge reductions.[118] The trading program effectively allowed Alpine Cheese to keep discharging pollution on-site, as well as to increase discharges as part of its production expansion, rather than complying with the appropriate NPDES permit limit. This ultimately created an offsetting system to account for the discharges that Alpine Cheese wanted to continue.

The initiative was a joint effort by the Alpine Cheese Company, Ohio State University, Holmes County Soil and Water Conservation District (SWCD) and the Ohio Environmental Protection Agency.[119] The SWCD was the broker between the farms and farmers, and the Ohio EPA.[120] It also was responsible for verifying and monitoring the BMPs to ensure that reductions were happening.[121] The SWCD's oversight role in the trading program was necessitated, in part, because of political interference. In 2005, U.S. Representative Bob Gibbs, then-Ohio Representative of the 97th District, wrote a letter to the Ohio EPA stating his objection to its intended level of

Fig. 4 • DETAIL: Alpine Cheese Nutrient Trading Plan Area



SOURCE (Figures 5 and 6): Food & Water Watch analysis of FOIA documents from Northeast District Office, Ohio EPA. On file at Food & Water Watch.

PHOTO BY U.S.DEPARTMENT OF AGRICULTURE

involvement in the Alpine Cheese nutrient trading program.[122] He claimed that:

> *The Ohio EPA insists that they must be given approval in the plan that at any time of their choosing to visit any farm site involved in this Nutrient Trading Program [sic]. Area residents are insistent that for the Ohio EPA to [be] given authority to visit any farm at any time would destroy the program.*[123]

The inability of the Ohio EPA to carry out its environmental oversight function was just the first indicator that the Alpine Cheese trading program was not on the right track for success. That red flag has been borne out in Food & Water Watch's review of documents related to the trading program, which, with its lack of oversight, accountability, verification and water quality improvement, largely mirrors the Pennsylvania experience.

The Real Alpine Cheese Story

The very goal of the Alpine Cheese pollution trading project counters any pretense that water pollution trading is aimed at improving water quality, as opposed to providing a mechanism whereby point source polluters can avoid reducing discharges. Under the plan, success is defined as ensuring that biotic function of the watershed is maintained throughout the time of the pilot, and that phosphorous loading in year five does not exceed the 1.23 pounds per day limit after accounting for phosphorous reductions through BMP offsets at other farms.[124]

The first measure of success sets the tone for just how substandard this program is: the goal is not to improve the waterway beyond its current, impaired state, but rather to maintain the biotic dysfunction of the waterway — in essence, its current state of impairment.[125] As of 2010 (the most recent information available), 87.8 percent of Ohio waterways were impaired for aquatic life (which falls under the biotic functioning of these waterways), with nutrients listed as the fourth leading cause of impairment for 18,234 miles of the state's waterways.[126] Several sections of Sugar Creek were listed as impaired for aquatic life and recreational use, with nutrients listed as one of the causes of impairment for aquatic life.[127]

National Pollution Discharge Elimination System Permit Noncompliance and Violations

Proponents of trading offer it as a way for permit holders to meet permit limits.[128] However, Alpine Cheese has an inexcusable and ongoing history of permit violations. The information that Food & Water Watch received[d] shows that between 1999 and 2014, Alpine had a combined total of some 928 limit violations and about 323 reporting violations, for a total of about 1,251 permit violations over the last 15 years.[129] This number could be even higher, since not all data were disclosed in materials returned from FOIA requests.

Tellingly, the bulk of these violations occurred between 2005 and 2011, while the nutrient trading pilot program was being developed and later implemented.[130] During

d Despite Food & Water Watch's request for all documents related to Alpine Cheese's compliance with its permit, there were some gaps in the records we received.

this period, Alpine Cheese had about 712 limit violations and about 49 reporting violations, for a total of some 761 permit violations over the course of the pilot program (see Figure 5).[131] Again, these numbers could be even higher because of a lack of complete records provided by the Ohio EPA. It is also worth noting that these were not violations of the protective standards that should have been in place under the TMDL, but violations of relaxed standards left in place because of the trading program offsets.

Some of these violations were especially egregious, and, in some cases, Alpine Cheese exceeded permit discharge limits by as much as 3,893 percent and 778 percent.[132] A significant number of the violations were in excess of 50 percent of the required discharge limits.[133] These violations were for nutrients such as phosphorous, nitrogen, fecal coliform and others, and were discharged into the Middle Fork Sugar Creek via an unnamed tributary (see Figure 6).[134]

Fig. 5 • Alpine Cheese: Number of Limit and Reporting Violations

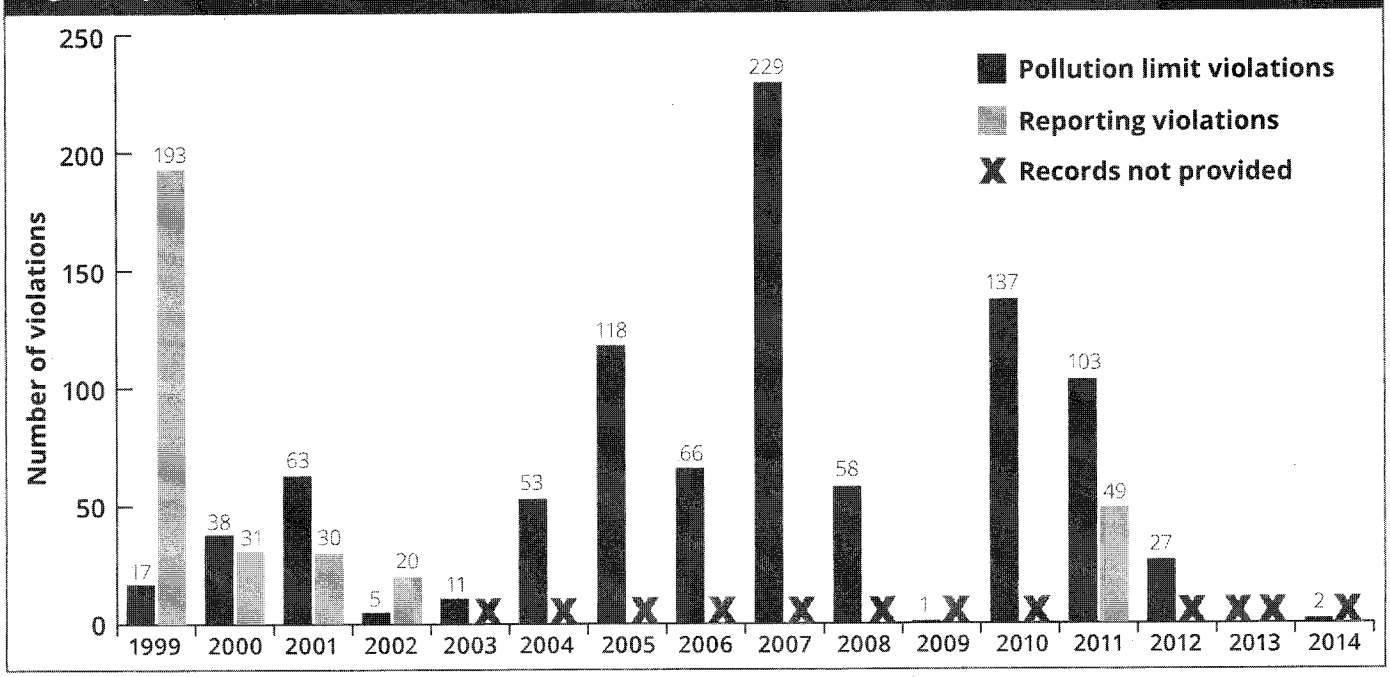
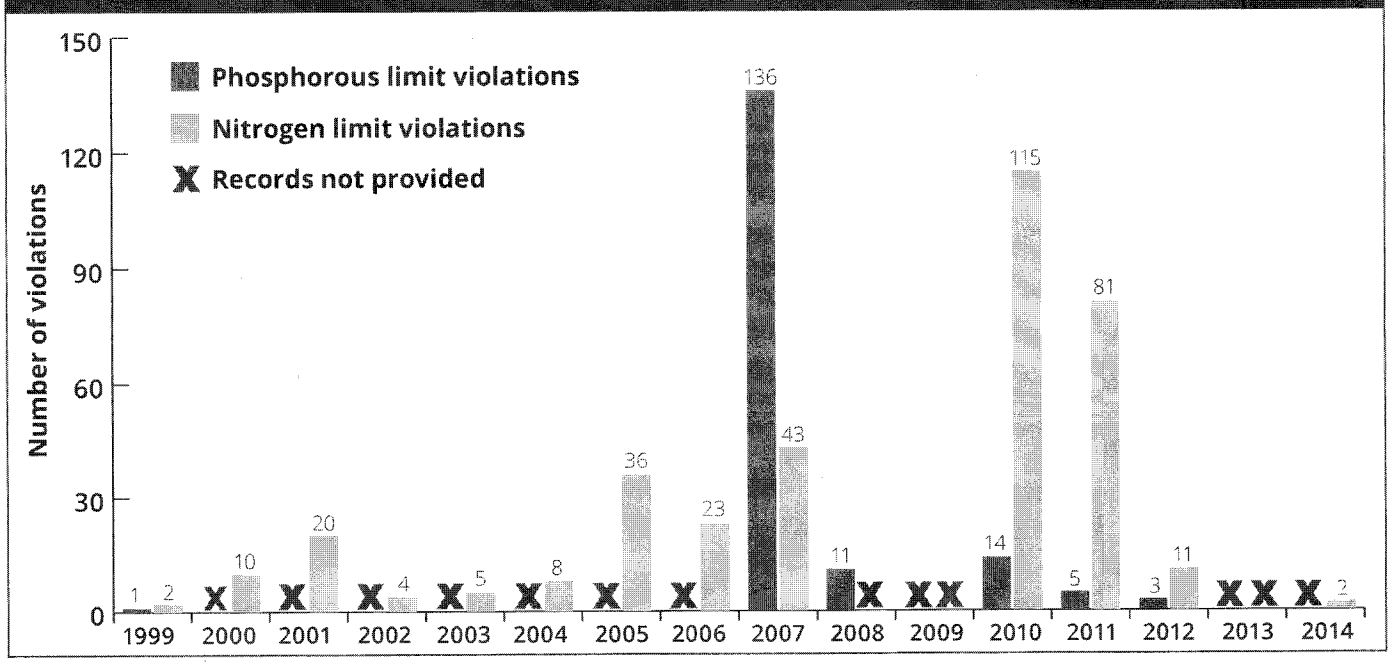


Fig. 6 • Alpine Cheese: Number of Limit Violations by Pollutant



SOURCE: Food & Water Watch analysis of FOIA documents from Northeast District Office, Ohio EPA. On file at Food & Water Watch.

Regarding the permit compliance status of Alpine Cheese, between 2012 and 2015 alone (the most recent reporting periods), the company was listed as being in "Noncompliance" for 8 quarters out of a total of 12.[135] In addition, between June 2010 and March 2015, Alpine Cheese had instances of noncompliance with its permit every year.[136] Documents obtained from Food & Water Watch's FOIA requests also show a persistent trend of violation and noncompliance between 1999 and 2009.[137]

Despite these ongoing examples of clear noncompliance, the most recent NPDES permit for Alpine Cheese, issued in May 2014, considers allowing Alpine to make changes to its wastewater treatment plant by moving the final outfall (discharge point of pollution) from the smaller unnamed tributary of Sugar Creek directly to the main stem of Middle Fork Sugar Creek.[138] The corresponding Antidegradation Report also discusses expanding the Alpine wastewater treatment plant capacity and hence its average daily flow (or discharge) volume into Sugar Creek from 0.140 million gallons per day to 0.160 MGD, since the main stem of Sugar Creek is a larger stream and can accommodate higher waste load allocations.[139]

In short, despite being able to take full advantage of upgrade avoidance by taking part in a nutrient trading program, Alpine Cheese has been a chronic violator of its discharge permit, with little to no accountability for the past 15 years. And now, after years of consistent noncompliance under cover of a trading program, the facility is seeking to expand and discharge even more pollution. Despite some trading proponents' insistence that permit violators should never be able to avail themselves of pollution trading, permit violators like Alpine Cheese seek to avoid compliance through credit purchasing.

Best Management Practices: Lack of Verification, Monitoring and Transparency

As stated, the Alpine Cheese trading program centers around the company paying nearby farms to implement BMPs to generate the credits it will use in place of making on-site reductions in nutrient discharges (see Figure 4). However, the verification, monitoring and transparency surrounding these BMPs is woefully inadequate, bringing into question the legitimacy of the entire program.

The phosphorous trading plan states that reports on the project will be submitted semi-annually over the five-year trading agreement by Holmes SWCD — the body responsible for monitoring and verifying BMPs — to the Ohio EPA.[140] However, in all of the 1,898 pages of documents that Food & Water Watch received via FOIA requests, there were only two of these semi-annual reports, totaling nine pages.[141] Other information, which may have been information on BMPs, was compiled on a compact disc and could not be fully accessed, or made sense of — not even by Ohio EPA personnel themselves — because of the software used.[142]

The other documents received from Holmes SWCD produced only some 29 pages of sparsely filled-out forms to show for the SWCD's monitoring and verification of the over 90 BMPs.[143] Many of these documents are barely filled out, or are filled out by hand and are often illegible. They are not even properly labeled in many cases, making it difficult to draw any kind of accurate conclusion about the number of credits generated.[144] Some forms consist of checking boxes and marking "yes" or "no."[145] This manner and scarcity of verification reports calls into question whether the verification methods are even accurate.

The lack of oversight becomes even more concerning since the BMP sites are in close proximity to Alpine Cheese, and, with very questionable monitoring and verification, the legitimacy of net reductions in nutrient discharges is highly suspect.[146] If it cannot be said for certain that BMPs are reducing nutrient discharges while Alpine Cheese continues to discharge pollutants above its permit limit, there is an incredible risk of no reductions in nutrient discharges and even net increases in nutrient discharges.

As stated earlier, point source pollution loads to our waterways under the Clean Water Act are subject to monitored and easily verified data. With Alpine Cheese and water pollution trading, we are now allowing a chronic CWA permit violator to swap out these verifiable and measurable discharges for unverifiable and unmeasured credits. Once again, water pollution trading represents a complete erosion of the CWA and its accountability core.

Biosolids (Mis)Management

Keeping in mind that the purported goal of water pollution trading is a net decrease of nutrient pollution to waterways, another disturbing component of Alpine Cheese's trading scheme concerns the company's sludge management. Under its NPDES permit, Alpine Cheese is required to properly manage its sludge byproduct, or biosolids.[147] These nutrient-rich biosolids are produced from the company's production processes, most of which come from the cheese-making facility.[148]

According to Alpine's "Biosolids Management Plan," the company produces 2,000 gallons per day of biosolids, with 260 days of production per year, or 520,000 gallons

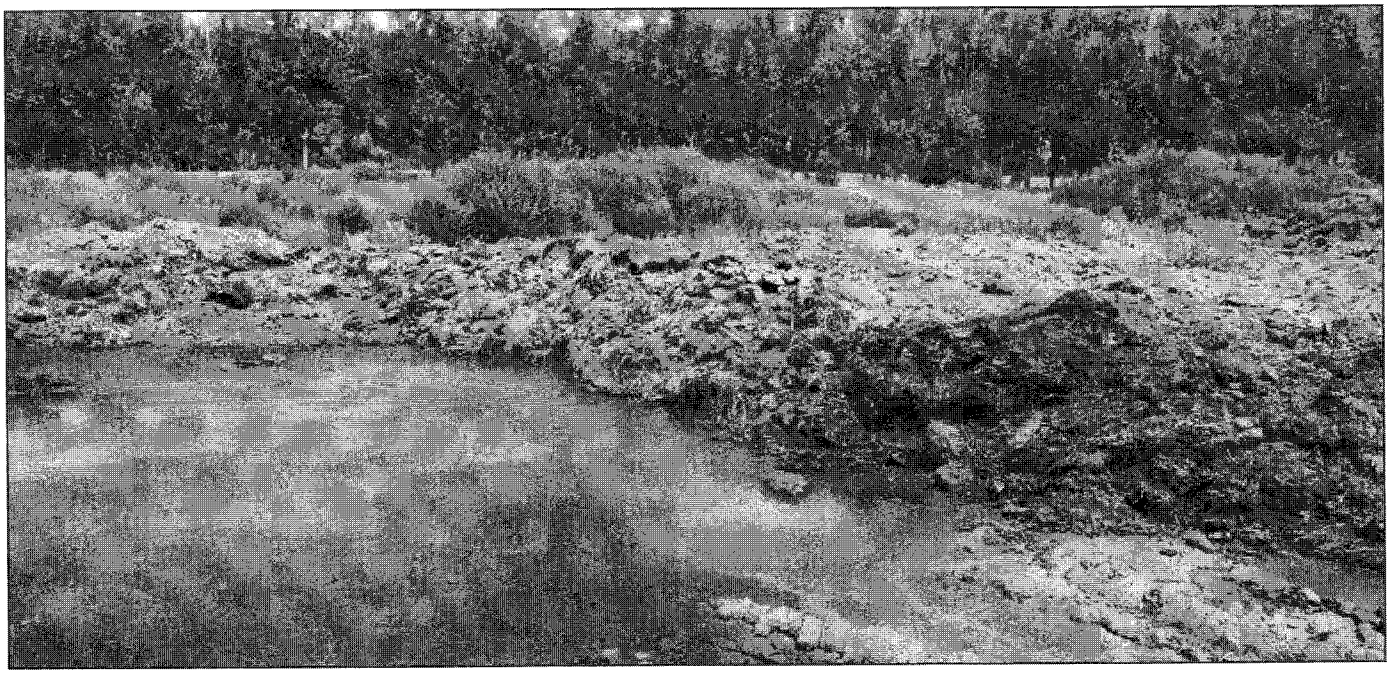
per year.[149] The biosolids are treated and held on-site before being transferred off-site to Holmes Cheese Co.,[150] Bull Country Compost (BCC), Agri-Sludge Inc. or the Strasburg wastewater treatment plant for land application (see Figure 4).[151] The portion of biosolids waste that is used for land application is applied on nearby fields in either liquid or solid form, and some receiving sites, like Holmes Cheese Company, are only about 18 miles away from Alpine Cheese (and Sugar Creek).[152]

As of August 2003, Alpine Cheese was transporting about 24,000 gallons per day of sludge each month to the Holmes Cheese Company facility for holding, dewatering and disposal nearby.[153] This process of shipping around biosolids is problematic, however, since "digested biosolids typically [have] significant amounts of nutrients such as nitrogen, phosphorous and potassium."[154] If improper management occurs, this could lead to additional nutrient runoff, and Holmes Cheese's track record of compliance casts significant doubt on whether the facility is properly handling biosolids from Alpine Cheese.

According to the EPA Enforcement and Compliance History Online (ECHO) database, Holmes Cheese Company — run by the same person that owns Alpine Cheese[155] — is listed under the status of "significant noncompliance" (the most severe level of noncompliance possible) for its permit.[156] Between 2006 and 2007 alone, Holmes Cheese had 152 total permit violations, of which 73 were pollution limit violations and 79 were reporting violations.[157] In some instances, there were even discharge limit violations of as much as 4,662 percent for pollutants like phosphorous.[158] Ohio EPA documentation from 2007 found that "[b]ased on the Ohio EPA compliance tracking system, Holmes Cheese is in Significant Noncompliance for both Total Dissolve[d] Solids (TDS) and ammonia [nitrogen]."[159]

Discharge monitoring reports for Holmes Cheese also show rampant violations, exceeding permit effluent limits for several pollutants every year between 2007 and 2015, again including nutrients like phosphorus and nitrogen.[160] In addition, the waterway that Holmes Cheese discharges into, Corns Run, is listed as impaired.[161] Much like the state of the Tuscarawas watershed (which Alpine Cheese falls within), the Walhonding watershed that Corns Run lies within has significant waterway impairment, with the most recent data from 2010 showing that 46 out of 52 waterways are listed as "impaired" and only the remaining 6 are listed as "good."[162]

Another recipient of Alpine Cheese's biosolids, the Strasburg wastewater treatment plant, is also listed as being in a state of noncompliance.[163] Although its violations are not as egregious as Holmes Cheese's, most of the treatment plant's noncompliance is for phosphorous limit violations — the very nutrient that Alpine's trading program is supposed to address — with overages of as much as 79 percent and 48 percent.[164] Between April 2012 and June 2015, the Strasburg wastewater treatment plant is listed as being in noncompliance for 7 of the 12 quarters.[165] Discharge monitoring reports also show noncompliance for phosphorous from 2012 to 2014.[166]



The trend of biosolids mismanagement only raises further concerns that nutrient loads to public waterways are not being reduced, despite misleading claims to the contrary. Alpine Cheese's extensive pollution shifting scheme allows the company to ignore protective nutrient permit limits by purchasing credits from farms that allegedly are implementing nutrient reduction BMPs, and then shipping a portion of its own nutrient-laden biosolids waste off to other farms and facilities to be applied to land and potentially pollute waterways — all the while violating even the relaxed standards contained in the company's own discharge permit.

In the face of the information gleaned from the FOIA documents, claims that the Alpine Cheese trading program is a success appear unfounded. In addition to serving as a case study of how pollution trading is a false solution, Alpine Cheese serves as an example of how offsets continue to fail as a policy.

Bioassessment Inconsistencies and Subjective Congressional Testimony

Proponents of the Alpine Cheese trading program also have depended on a bioassessment report as proof that the trading program is working to clean up the Middle Fork Sugar Creek waterway.[167] This report was carried out by the Center for Applied Bioassessment & Biocriteria (CABB) at the Midwest Biodiversity Institute, and it also is relied upon in Congressional testimony supporting the trading program. [168]

However, the bioassessment was completed in 2010, and data from the U.S. EPA on the years leading up to and including 2010 conflict with the findings of the report.[169] The CABB report claims that the Middle Fork Sugar Creek waterway achieved full attainment status, but EPA data show that the same waterway, as well as surrounding waterways and the overall watershed, are still listed as impaired during the same time period, bringing into question the reliability of this assessment.[170] The bioassessment also relies on the claim that water quality improved because the presence of pollution-tolerant species improved; however, within the same findings it shows that the presence of pollution-intolerant species declined.[171]

Moreover, the monitoring and analysis necessary to determine reductions in phosphorous loading, and subsequent improvements in water quality, must be carried out over at least 10, if not 40, years at several sampling locations.[172] The bioassessment for Alpine Cheese was conducted in 2010 — only three years after the NPDES permit allowing the trading program began. Any assessment of water quality that claims results after only three years, like the bioassessment for Alpine, is wholly unfounded.

Despite the fact the Sugar Creek bioassessment was conducted only three years into the trading project, and at a time when Alpine Cheese was in regular violation of its discharge permit, in 2014 Richard Moore testified in front of Congress that the Alpine trading program was a success. Moore is the executive director of the Environmental Sciences Network at Ohio State University, whose group at the Ohio Agricultural Research and Development Center (OARDC) helped to develop the Alpine Cheese trading program.[173] The OSU team also received payment from Alpine Cheese under the trading program.[174]

In the testimony, Moore claims his group "acted as an impartial body to monitor the streams in the area to determine changes" and "achieved our five-year reduction goal (5,500 lbs. of phosphorous) in three years, and by year five the actual amount of phosphorous remediated was 7,133 lbs."[175] Based on monitoring requirements for detecting decreases in phosphorous loading and improvements in water quality, not enough time has passed nor enough information collected to make these claims.

Pollution Laundering and Reduction Evasion

The basis of the Alpine Cheese trading program — paying nearby farms to reduce their pollution discharges via BMPs and generating credits that Alpine can apply toward its NPDES permit limits — is nothing more than an offset scheme. But here, there is no attempt to meet even the minimal offset requirements that even proponents of market-based pollution control claim are necessary.

In this case, the credits generated by the BMPs are the offsets. The entire design of the program is not to improve waterways beyond their state prior to the trading program, but to maintain the impaired *status quo.* It is dangerously inaccurate to say that the Alpine program is a model to improve water quality, when it is nothing more than a way to evade compliance with protective permit standards through BMP offsets.

The Alpine Cheese program does not even meet necessary offset standards. On the issue of "additionality" — the requirement that any reduction in pollutant loadings that generate credits would not have occurred but for the trading program — there is no apparent baseline to determine whether the farm pollution reductions from the BMPs were actually additional and would not have happened but for the Alpine Cheese project. On the issue of "permanence," the program fails outright, as the

farmers contracted to install BMPs and generate credits are often held only under five-year contracts to carry out the BMPs.[176]

On the requirement that offsets be "quantifiable," the missing or minimal oversight and verification information and reporting violations gives very little indication that any level of reliable measurement is occurring — making claims that this program is quantifiable rather incredulous. It is also important to note that excessive reliance on modeling, in place of on-the-ground monitoring data, can actually lead to greater uncertainty of outcomes.[177] Unsurprisingly, enforcement requirements are clearly not met — a case in point is the lack of oversight by Holmes SWCD and the inability of the Ohio EPA to fully do its job because of political interference.

In the end, offsets offer a cheap shortcut, making them attractive to polluters, but they do not actually deliver lasting results. Unfortunately, the cost of these scams is arguably far worse than the cost of tried-and-true methods like technology upgrades and point source reductions. Instead, with offsets and trading, pollution continues to be dumped into our public waterways, the *status quo* is maintained and no meaningful improvements result.

Summary and Recommendations

While proponents of water pollution trading put out lengthy, abstract treatises on the potential of idealized trading programs, the fact is that these approaches are being implemented the way that industries want them to be: as a mechanism to avoid permit compliance and expenditures for pollution reduction.[178]

As can be seen in both the Pennsylvania and the Ohio case studies, water pollution trading has not improved water quality and has allowed industries to discharge more pollution into our waterways. Water pollution trading represents the rollback of the Clean Water Act that industry has been seeking for over 40 years, and now many in the environmental community are embracing this market-based approach to undermine our current clean water laws.

Some trading proponents, while recognizing the potential pitfalls of trading, argue that the remedy is in designing "good" water pollution trading programs, with protective standards and strong verification and accountability measures.[179] Sadly, this is a naïve position that fails for a number of reasons. As seen above and in various other current trading projects, it is not the environmental community that will make and implement the trading rules. As is the case in Pennsylvania, the rules will be left to industry, third-party brokers and unengaged state agencies. And when the environmental community tries to use its right under the CWA to intercede in bad trading practices, as the Chesapeake Bay Foundation did with Brunner Island, it will find itself stripped of authority and without remedy.

Not surprisingly, not even the EPA is able or willing to enforce even the minimal water pollution trading standards it put in place in its 2003 trading guidance.[180] In that guidance, the EPA states that it does not support water pollution trading to "comply with existing technology-based" permit limitations.[181] Tech-based limits are those limits in a permit that a facility should be able to attain using Best Available Technologies. Additional limits, called water quality-based limits, can be added into permits when tech-based limits are not enough to attain local water quality.[182] According to the EPA and trading proponents, it is only these higher, water quality-based limits for which point sources should be able to purchase credits.[183] However, with Brunner Island, the EPA is allowing the facility to use credits to offset its entire nitrogen load to the Susquehanna River, regardless of whether those are tech- or water quality-based.

In addition, not even an ideally structured water pollution trading program can remedy the inherent defects in the approach. As the CWA is currently written, point sources are highly accountable for their discharges, and permit compliance is easily verifiable and enforceable. Water

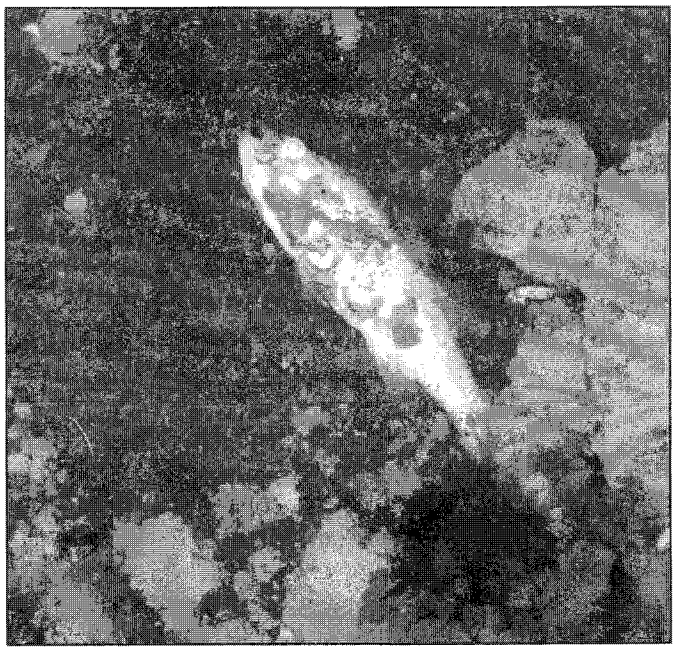


PHOTO BY U.S. GEOLOGICAL SURVEY

pollution trading allows this transparent, accountable system to be replaced with one that makes it virtually impossible for anyone to ever properly track point source compliance; credits that these facilities rely on are not the product of any measured decrease in pollutant loads from credit-generating agricultural sources, but from complex models filled with variables and from questionable manure transport programs that simply move pollutants from one impaired waterway to another.

Trading adherents also ignore that the CWA does not allow for water pollution trading as a mechanism for point sources to avoid permit compliance. The Act's permitting provisions are very clear that each point source of pollution must meet individual permit requirements; there are no allowances in the Act to purchase credits in lieu of compliance. While the Clean Air Act specifically allows for some degree of air emissions trading, efforts to amend the CWA to allow for trading have never passed, nor should they.

Pollution trading will not improve our waterways or protect our communities. It will not stop giant algae blooms or keep another Toledo disaster from occurring.

People who care about water quality should never support water pollution trading. Instead, we should be taking steps to strengthen the Clean Water Act, learning from its past successes and remedying its past failures. Some of the things that need to happen are:

- **Congress needs to reaffirm that the Clean Water Act does not allow for point source pollution trading.** It must defeat attempts to amend the Act to include a trading program and prohibit states from spending any funds on implementing trading programs. This groundbreaking statute was enacted in 1972 in order to turn our waterways around. It moved us from a watershed-based, ambient water quality approach to one of individual accountability through a point source permitting program. Water pollution trading is antithetical to that approach.
- **Federal agencies, particularly the U. S. Department of Agriculture, need to stop spending taxpayers' dollars to promote these pay-to-pollute schemes across the country.** The USDA, and to a lesser extent the EPA, are actively funding market-based approaches to water quality control, giving out millions of dollars to nonprofits, industry groups and researchers to set up pilot programs and implement pollution trading. Public funds should not be used to undermine our public trust waterways.
- **State and federal governments need to replace voluntary pollution control approaches with mandatory measures in the nonpoint source sector.** The CWA point source control program has been successful because of accountability and permitting. Regulators have failed to control our largest source of pollution, agriculture, because of our continued reliance on voluntary pollution control measures in that sector. The answer is not to move our failed approaches to the point source industries with water pollution trading, but to employ our successful point source strategies – monitoring, permitting and enforcement – in the agricultural industry.
- **Federal agencies must fund agricultural Best Management Practices without compromising current point source controls.** People rightfully concerned about uncontrolled industrial agriculture pollution see trading as a way to incentivize the adoption of BMPs on farms. But, as this report shows, using trading as an incentive undermines our successful point source control of other industries by allowing permit violators to buy their way into polluting more than they should. A better approach would be to diligently enforce the Clean Water Act against point source polluters who do not comply with their permits, and use the money from those enforcement actions to fund effective farm BMPs.
- **The environmental community needs to wake up to the dangers of water pollution trading.** These programs are being implemented across the county while the environmental community either ignores it or actively supports it. If you are a member of an environmental organization, contact the staff and ask them why it is not fighting against this irresponsible approach to water quality. If you work for an environmental organization, get involved and take a stand against these failing market-based schemes.
- **Advocacy groups need to legally challenge water pollution trading programs.** Any legal advocate who relies on the CWA to keep waterways clean and communities safe should be very concerned about what water pollution trading is doing to citizens' ability to enforce the law against polluters. With such trading, we are rapidly moving away from the ability to hold point sources accountable for permit violations because permits have no real limits and, even when they do, it will be impossible to track the credits used to exceed those limits.

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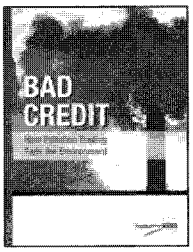
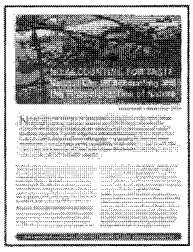


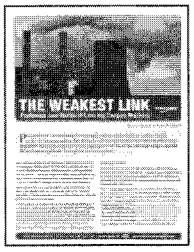
Bad Credit: How Pollution Trading Fails The Environment

Based on an obscure economic theory that gained prominence in the 1960s at the University of Chicago, cap-and-trade was embraced by the Reagan administration as a replacement for regulating air emissions. Since that time, it has gained acceptance among environmental organizations and the largest environmental funders. Unfortunately, cap-and-trade can undermine existing environmental laws like the Clean Water Act, which calls for the elimination of pollutants from our water. While our environmental laws make pollution illegal, cap-and-trade accepts the right of industries to pay-to-pollute while paying others money not to.



No Accounting for Taste: Natural Capital Accounting and the Financialization of Nature

Natural capital accounting is the latest effort to financialize our air, water, forests and land by putting a price on nature to save it. The theory claims that if private companies and countries account for environmental resources used in the production of other goods — accounting for their cost to the environment — we can better see the sustainability of our current economic path. But it is not the solution it appears to be. Natural capital accounting is plagued with myriad problems. To implement it requires assigning a financial value to nature, privatizing it and commodifying it — bringing the environment under economic control.



The Weakest Link: Problems and Perils of Linking Carbon Markets

Proponents of cap and trade increasingly seek to create a globally linked carbon market under the false reasoning that doing so will achieve improved economic efficiency and better emissions reductions than individual markets alone, because carbon dioxide (CO_2) is spread globally throughout our atmosphere. While promoted as a way to reduce carbon emissions, the main drive behind linking is economic efficiency and cost reduction. Focusing on economic concerns downplays the real priority of reducing emissions.

The Truth About Offsets

Under cap-and-trade, polluters are offered the opportunity to "pay to pollute," turning decades of environmental efforts on their head and undermining improvements in environmental health. The linchpin of these cap-and-trade schemes is offsets, or credits from outside the regulated industry that polluters can buy in order to keep on polluting. But offsets are only a further loophole and avoidance of achieving real, additional and permanent reductions.

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COVER PHOTO: GULF OF MEXICO "DEAD ZONE" AS SEEN FROM SPACE IN APRIL 2009.
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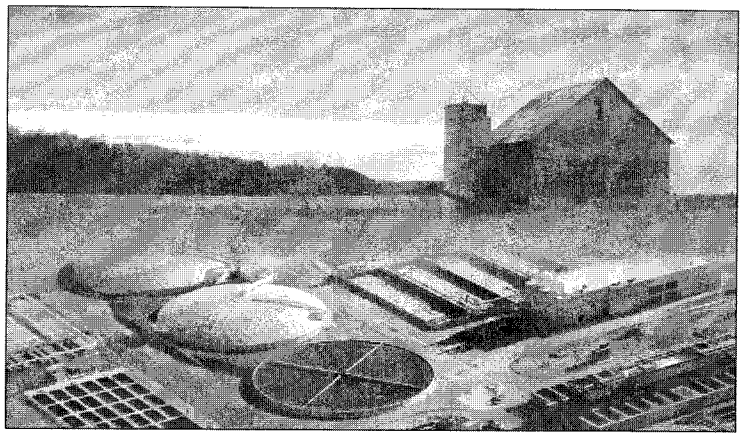
WRI ISSUE BRIEF
WATER QUALITY TRADING No. 1
WORLD RESOURCES INSTITUTE

Water Quality Trading Programs: An International Overview



MINDY SELMAN, SUZIE GREENHALGH, EVAN BRANOSKY, CY JONES, AND JENNY GUILING

Summary

Water quality trading is gaining traction in a number of watersheds around the world. It is a market-based approach that works alongside water quality regulation to improve water quality, providing flexibility in how regulations are met and potentially lowering regulatory compliance and abatement costs. Our research identified 57 water quality trading programs worldwide. Of these, 26 are active, 21 are under consideration or development, and 10 are inactive or are completed pilots with no plans for future trades. The majority of programs were located in the United States, with only six programs existing outside the United States—four in Australia, one in New Zealand, and one in Canada.

From our assessment of these water quality trading programs, we identified five key factors that stakeholders believed were important for the successful implementation of their trading programs:

- Strong regulatory and/or non-regulatory drivers, which helped create a demand for water quality credits;
- Minimal potential liability risks to the regulated community from meeting regulations through trades;
- Robust, consistent, and standardized estimation methodologies for nonpoint source actions;
- Standardized tools, transparent processes, and online registries to minimize transaction costs; and
- Buy-in from local and state stakeholders.

Before going to the expense of developing a water quality trading program, we recommend that the relevant bodies—either governmental or nongovernmental—ensure these factors are in place.

Setting the Scene

Water quality is one of the most pressing environmental concerns facing many parts of the world today. In the United States, for example, 48 percent of assessed rivers and streams, 60 percent of assessed lakes, reservoirs, and ponds, and 61 percent of assessed estuaries were threatened or impaired for their designated uses in 2006. A significant number were impaired by nutrients.[1]

Globally, approximately 532 coastal areas around the world have been identified as experiencing some form of eutrophication, or nutrient overenrichment. Of these, at least 405 coastal areas experience hypoxia (oxygen depletion).[2] Eutrophication affects the ability of lakes, rivers, streams, and estuaries to support aquatic life and provide suitable drinking water. It can also lead to the formation of hypoxic areas or "dead zones" in lakes and coastal areas such as the Black Sea (Eastern Europe), Pearl River Delta (China), the Gulf of Mexico (U.S.), and the Chesapeake Bay (U.S.).

Sources of water quality impairment are generally divided into two categories: point sources and nonpoint sources. Point sources are those sources that discharge pollutants into a waterbody via a discrete conveyance such as a pipe. Examples of point sources include sewage treatment plants and industrial facilities. By contrast, pollution from nonpoint sources is typically diffuse in nature, such as agricultural or urban runoff. Because the precise origin of pollution from nonpoint

sources is difficult to identify, these sources are frequently not regulated for pollutant discharges.[3]

To address the increasing occurrence of eutrophication in local waterbodies, some government agencies are beginning to implement nutrient caps or limits for sources that discharge nutrients in waterways. In some cases, water quality trading is being proposed to reduce the costs associated with meeting nutrient caps, as well as to offset additional nutrient discharges that may result from urban or agricultural productivity growth.

While some jurisdictions are experimenting with water quality trading as a means of reducing the costs associated with restoring and protecting water quality, the potential efficiencies from trading programs can only be realized if programs are appropriately structured and implemented. The purpose of this brief is to provide an overview of water quality trading programs, outline the various approaches to program design, and explore the program design elements that are important for implementing effective water quality trading programs. We use stakeholder satisfaction, trading activity, and ability to meet the environmental goal as our measures for an effective trading program. However, we do recognize that in many instances programs have not been operating long enough to adequately assess progress toward environmental goals or the ability of programs to continue meeting these goals in the long term.

What is Water Quality Trading?

Water quality trading is a market-based instrument that is gaining popularity as a mechanism to cost-effectively meet water quality goals. It is premised on the fact that the costs to reduce pollution differ among individual entities depending on their size, location, scale, management, and overall efficiency. Trading allows sources with high abatement costs to purchase pollution discharge reductions from sources that have lower abatement costs. Entities with lower abatement costs are able to economically lower their pollution discharges beyond regulated or permitted levels, enabling them to sell their excess reductions to entities with higher costs. Water quality trading is most commonly applied to nutrients (such as nitrogen and phosphorus), but has also been applied to temperature, selenium, and sediment.[4]

Water quality trading has many formulations. Trades between regulated point sources—that is, two sewage treatment plants trading to meet permitted discharge levels—are the most straightforward. The Long Island Sound Nitrogen Credit Exchange Program (Connecticut, U.S.) is an example of such a point-to-point-source trading program. Water quality trading programs can also allow trading between regulated point sources and unregulated nonpoint sources, such as agriculture. Trading between point and nonpoint sources enables point sources with high compliance costs to purchase pollution reduction credits (also referred to as "offsets") from nonpoint sources with lower pollution reduction costs. In most instances, point-source facilities are controlled by regulatory discharge permits—for example, the U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) permits—while nonpoint sources are generally not controlled by regulatory discharge limits. In these types of programs, nonpoint sources are typically sellers of pollution reduction credits and not buyers, since they are under no regulatory obligation to reduce their discharge.

In some instances, trading programs are focused entirely on nonpoint sources. In these instances, one or both of the nonpoint sources involved in the trades have been regulated. For example, the Lake Taupo Nitrogen Trading Program in New Zealand (under development) is allocating nitrogen discharge allowances to all agricultural sources within the Lake Taupo watershed. It will allow them to trade among each other to maintain compliance or to expand production.

Globally, the majority of nutrient pollution originates from nonpoint sources, principally agricultural sources. In the United States, approximately 82 percent of the nitrogen and 84 percent of the phosphorus in U.S. lakes, rivers, and estuaries come from nonpoint sources.[5] Water quality trading programs that allow point-to-nonpoint trades may therefore be viewed as mechanisms for leveraging point-source regulatory requirements to generate reductions from unregulated nonpoint sources. The point-to-nonpoint trades also provide point sources with flexibility in achieving their regulatory limits in a cost-effective manner, while providing incentives (in the form of additional revenue streams from credit sales) to nonpoint sources to reduce their pollution loads. Over 70 percent of active water quality trading programs allow trades between point and nonpoint sources.

Survey of Water Quality Trading Programs

In 2008, WRI undertook an assessment of water quality trading programs worldwide. We identified 57 programs; of these, 26 are active,[6] 21 are under consideration or development, and 10 are inactive. Of the programs identified, all but six are located in the United States. (See Box 1 for a discussion of the reasons why water quality trading has taken off in the United States.) The six trading programs that are not in

BOX 1 Water Quality Trading in the United States

The majority of the water quality trading programs identified by WRI were located in the United States. Three factors have helped spur the proliferation of water quality trading programs in the United States:

- *Increased regulatory interest in controlling nutrients as a result of increasing occurrences of eutrophication and hypoxia in U.S. waterbodies.* In the late 1990s, the enforcement of the Clean Water Act's (CWA) total maximum daily load (TMDL) requirement began in earnest. As a result of the enforcement of this provision, there was a proliferation of nutrient-based TMDLs. Point sources within nutrient-impaired TMDL watersheds are assigned permits, which limit their nutrient discharges to the waterbody.
- *The U.S. Environmental Protection Agency's (EPA) endorsement of water quality trading.* In 2003, EPA released its Water Quality Trading Policy, which encouraged the use of water quality trading to achieve watershed goals. More specifically, the policy was intended to encourage voluntary trading programs to facilitate the implementation of TMDLs, reduce the costs of complying with CWA regulations, establish incentives for voluntary reductions, and promote watershed-based initiatives. (See EPA's *"Final Water Quality Trading Policy"* available online at: http: //www.epa.gov/owow/watershed/trading/finalpolicy2003.html.)
- *Availability of government funding to finance market-based water quality initiatives.* EPA, together with the United States Department of Agriculture (USDA), encouraged the implementation of water quality trading programs through grant funding. Three of the primary funding sources for developing water quality trading programs include EPA's Targeted Watershed Grant and Section 319 grants, and the Conservation Innovation Grants Program authorized under the 2002 Farm Bill and funded through the USDA's Natural Resource Conservation Service (USDA-NRCS). These grants provide the resources to cover program start-up costs and fund any initial scoping or communication activities.

the United States include the Lake Taupo Nitrogen Trading Program (New Zealand; under development), Hunter River Salinity Trading Scheme (Australia; active), South Nation River Watershed Trading Program (Canada; active), South Creek Bubble Licensing Scheme (Australia; active), Murray-Darling Basin Salinity Credits Scheme (Australia; active), and the Moreton Bay Nutrient Trading Scheme (Australia; under development). Table 1 provides a list and brief profile of the trading programs evaluated.

In addition, we identified 13 statewide water quality trading guidance, policies, or rules that exist or are in development in the United States. These include:

- Colorado Pollutant Trading Policy (*inactive*),
- Connecticut Water Quality Trading Legislation,
- Delaware State Trading Initiatives (*under development*),
- Florida Water Quality Trading Rules (*under development*),
- Idaho Pollutant Trading Guidance,
- Maryland State Water Quality Trading Policy (*under development*),
- Michigan Water Quality Trading Rules,
- Minnesota Water Quality Trading Policy (*under development*),
- Ohio Water Quality Trading Rules,
- Oregon Final Internal Management Directive of Water Quality Trading,
- Pennsylvania State Water Quality Trading Policy,
- Virginia State Water Quality Trading Rules,
- West Virginia Water Quality Trading Guidance (*under development*), and
- Georgia Water Quality Trading Initiatives (*under development*).

Comparing Water Quality Trading Programs

We compared water quality trading programs along seven dimensions—policy drivers, allocation of caps, establishment of nonpoint-source baselines, nonpoint-source nutrient reduction calculations, use of trading ratios, market structure, and trading activity. Our comparison is based on literature research and phone interviews with water quality trading program representatives. In addition, we conducted in-person interviews with a variety of stakeholders involved with the eight trading programs listed below.

- Cherry Creek Reservoir Watershed Phosphorus Trading Program, Colorado
- Chatfield Reservoir Trading Program, Colorado
- Long Island Sound Nitrogen Credit Exchange Program, Connecticut
- Great Miami River Watershed Trading Pilot, Ohio
- Pennsylvania Water Quality Trading Program, Pennsylvania
- Red Cedar River Nutrient Trading Pilot Program, Wisconsin
- South Nation River Watershed Trading Program, Ontario, Canada
- Lake Taupo Nitrogen Trading Program, New Zealand

TABLE 1 Water Quality Trading Programs, 2008

PROGRAM NAME	STATE/COUNTRY	TYPES OF TRADES	MARKET TYPE[§]
Active Programs/Pilots			
Hunter River Salinity Trading Scheme*	New South Wales, Australia	PS-PS	Exchange market
South Nation River Watershed Trading Program *	Ontario, Canada	PS-NPS	Clearinghouse
South Creek Bubble Licensing Scheme	New South Wales, Australia	PS-PS	Clearinghouse (aggregate permit)
Murray-Darling Basin Salinity Credits Scheme[†]	Southeastern Australia		Bilateral
Grassland Area Farmers Tradable Loads Program*	California, U.S.	NPS-NPS	Bilateral
Bear Creek*	Colorado, U.S.	PS-PS/NPS	Bilateral
Chatfield Reservoir Trading Program*	Colorado, U.S.	PS-PS/NPS	Sole-source offsets
Cherry Creek Reservoir Watershed Phosphorus Trading Program*	Colorado, U.S.	PS-PS/NPS	Sole-source offsets
Lake Dillon (Dillon Reservoir) Trading Program*	Colorado, U.S.	PS-NPS	Bilateral
Long Island Sound Nitrogen Credit Exchange Program*	Connecticut, U.S.	PS-PS	Clearinghouse
Delaware Inland Bays*	Delaware, U.S.	PS-NPS	Sole-source offsets
Lower Boise River Effluent Trading Demonstration Project	Idaho, U.S.	PS-NPS	Bilateral
Middle Snake River Demonstration Project	Idaho, U.S.	PS-PS	Bilateral
Minnesota River Basin Trading Program*	Minnesota, U.S.	PS-PS	Bilateral
Rahr Malting*	Minnesota, U.S.	PS-NPS	Bilateral
Southern Minnesota Beet Sugar Cooperative Program*	Minnesota, U.S.	PS-NPS	Clearinghouse
Las Vegas Wash	Nevada, U.S.	PS-PS	Clearinghouse (aggregate permit)
Taos Ski Valley	New Mexico, U.S.	PS-NPS	Sole-source offsets
Neuse River Basin Total Nitrogen Trading Program*	North Carolina, U.S.	PS-PS/NPS	Clearinghouse (bubble permit)
Tar-Pamlico Nutrient Trading Program*	North Carolina, U.S.	PS-PS/NPS	Clearinghouse
Great Miami River Watershed Trading Pilot	Ohio, U.S.	PS-PS/NPS	Clearinghouse
Alpine Cheese Company/Sugar Creek*	Ohio, U.S.	PS-NPS	Bilateral
Clean Water Services/Tualatin River*	Oregon, U.S.	PS-PS/NPS	Bilateral, Sole-source offsets
Pennsylvania Water Quality Trading Program*	Pennsylvania, U.S.	PS-PS/NPS	Exchange market
Virginia Water Quality Trading Program	Virginia, U.S.	PS-PS/NPS	Clearinghouse/ Bilateral
Red Cedar River Nutrient Trading Pilot Program*	Wisconsin, U.S.	PS-NPS	Bilateral
Programs/Initiatives In Development or Under Consideration			
Moreton Bay Nutrient Trading Scheme	Queensland, Australia	TBD	TBD
Lake Taupo Nitrogen Trading Program	New Zealand	NPS-NPS	TBD
Lower Colorado River Basin	Colorado, U.S.	TBD	TBD
Florida Ranchlands Environmental Services Project	Florida, U.S.	NPS-NPS	TBD
Lake Allatoona	Georgia, U.S.	PS-PS or PS-PS/ NPS	TBD
Maryland Water Quality Trading Program	Maryland, U.S.	PS-NPS	Exchange Market
Massachusetts Estuaries Project	Massachusetts, U.S.	PS-NPS	TBD

TABLE 1 *continued*

PROGRAM NAME	STATE/COUNTRY	TYPES OF TRADES	MARKET TYPE§
Charles River Flow Trading Program	Massachusetts, U.S.	PS-PS	Bilateral
Kalamazoo: Gun Lake Tribe Trading Initiative	Michigan, U.S.	PS-NPS	Exchange market
Upper Mississippi River Basin	Minnesota, U.S.	PS-NPS	Clearinghouse
Vermillion River	Minnesota, U.S.	TBD	TBD
Cape Fear	North Carolina, U.S.	PS-NPS	TBD
Passaic River	New Jersey, U.S.	PS-PS/NPS	TBD
Lake Tahoe	Nevada, U.S.	NPS-NPS	TBD
Truckee River Water Quality Settlement Agreement	Nevada, U.S.	PS-NPS	TBD
Shepherd Creek	Ohio, U.S.	PS-NPS	Clearinghouse
Upper Little Miami River Basin	Ohio, U.S.	PS-NPS	TBD
Portland Tradable Stormwater Credit Initiative	Oregon, U.S.	PS-PS	TBD
Willamette Partnership	Oregon, U.S.	TBD	TBD
Bear River	Idaho/Utah/Wyoming, U.S.	TBD	TBD
West Virginia Potomac Water Quality Bank and Trade Pilot	West Virginia, U.S.	PS-PS/NPS	Exchange market
Inactive Trading Programs/Completed Pilot or Demonstration Programs			
Clear Creek*	Colorado, U.S.	PS-PS[1]	Sole-source offsets
Boulder Creek Trading Program*	Colorado, U.S.	PS-NPS	Sole-source offsets
Upper Maquoketa and South Fork Maquoketa Watersheds Nutrient Trading Directory*	Iowa, U.S.	NPS-NPS	Bilateral
Sudbury River (Wayland Center)*	Massachusetts, U.S.	PS-PS	Bilateral
Kalamazoo River	Michigan, U.S.	PS-NPS	Clearinghouse
Passaic Valley Sewerage Commission Pretreatment Trading*	New Jersey, U.S.	PS-PS	Bilateral
New York City Watershed Phosphorus Offset Pilot Programs*	New York, U.S.	PS-PS	Sole-source offsets
Lake Champlain*	New York/ Vermont, U.S.	PS-PS	Sole-source offsets
Fox-Wolf Basin	Wisconsin, U.S.	PS-NPS	Bilateral
Rock River	Wisconsin, U.S.	PS-NPS	Bilateral

Notes

NPS = nonpoint source; PS = point source; TBD = to be determined

§ Market types are described in the market structure section later.

* Program has had at least one trade or offset.

† This program differs from others as the salinity credits are held by the Australian states that are part of the program, not individual sources.

1. In the Clear Creek program, a mining company financed clean-up efforts at an abandoned mine. Mines are "orphan" sources. They are not permitted, not owned by an individual, and are difficult to monitor, but are similar to point sources because they are one central source of pollutant discharge.

These programs were selected because they represented a diverse cross-section of different market structures, different scales, different participants, different commodities, differing lengths of time since establishment, and differing levels of trading activity. See Box 2 for brief descriptions of the water quality trading programs that WRI selected for interviews.

1. Policy Drivers

The primary policy driver for all water quality trading programs has been the implementation or forthcoming implementation of nutrient caps that limit pollutant discharges. In the United States, the Clean Water Act (CWA) provides the foundation for point-source nutrient caps. The law requires states to adopt water quality standards for various pollutants. Violation of these standards may result in a total maximum daily load (TMDL)

BOX 2 Selected Water Quality Trading Programs

Cherry Creek and Chatfield Reservoir Trading Programs, Colorado, U.S.

The Cherry Creek and Chatfield reservoirs are both subject to a state-imposed Total Maximum Annual Load (TMAL) that limits the amount of phosphorus that can be discharged into the reservoir by both point and nonpoint sources. There are five point sources that discharge to the Cherry Creek reservoir and 12 point sources that discharge to the Chatfield reservoir. To meet short-term credit demand (for example, upset conditions at a treatment facility that cause the facility to exceed its permit), regulated point sources are allowed to purchase credits from other regulated point sources or from the Watershed Authorities' Reserve Fund which has established long-term credit-generating projects. For credits needed to offset new or expanding facilities, facilities must generate credits through the implementation of urban nonpoint source projects that reduce phosphorus loads to the reservoir. While most regulated facilities have been discharging below their allowable loads, a few trades have occurred: four trades in Cherry Creek and seven trades in Chatfield.

Long Island Sound Nitrogen Credit Exchange Program, Connecticut, U.S.

In 2001 a TMDL for dissolved oxygen was implemented for the Long Island Sound. As a result, point sources were given caps for total nitrogen discharges; in total there are 79 point sources that trade in the Long Island Sound program. The nitrogen cap allocations were distributed to each facility depending on discharge volume, with allocations decreasing every year or every other year. Any new facilities must purchase credits to offset 100 percent of their discharge (though there have been no new facilities since inception of the program). In 2002 the Connecticut legislature created a Nitrogen Credit Exchange (NCE) that is overseen by the Nitrogen Credit Advisory Board. One of the principal roles of the Nitrogen Credit Advisory Board is to determine the price of a nitrogen credit. Credit trading occurs once yearly after the close of the permit year. To date nearly 12 million credits have been bought and sold on the NCE for a total value of nearly $30 million.

Great Miami Water Quality Credit Trading Program, Ohio, U.S.

A TMDL is in place for one of three subwatersheds in the Great Miami, and TMDLs are under development for the remaining two. The TMDLs are expected to result in strict phosphorus discharge limits for regulated facilities. The Great Miami pilot began in 2006 and seeks to encourage facilities under threat of regulation to be early actors by purchasing phosphorus credits before permit limits are enacted. The Water Conservation Subdistrict of the Miami Conservancy District has led the pilot and acted as a credit bank or clearinghouse. The credit bank was capitalized with money from grants as well as money from point sources wishing to purchase credits. To obtain credits, the Miami Conservancy District issued a request for proposals to generate agricultural credits. Soil and Water Conservation Districts in the area worked with farmers to submit applications for credit generation. Once applications were received, the Miami Conservancy District held a reverse auction to select and fund those applications that provided the greatest phosphorus reductions at the least cost. Credits were then allocated to investors based on their initial investment amount. To date, the Miami Conservancy District has held four rounds of reverse auctions to purchase phosphorus credits. A total of 50 projects have been funded, with payments totaling $923,069. The projects have produced 324 tons in phosphorus reductions. (Hall, D. and S. Hippensteel. 2008. "Benefits and Obstacles to Trading." CTIC Workshop, Troy, Ohio.)

Pennsylvania Water Quality Trading Program, Pennsylvania, U.S.

Under the Chesapeake Bay Agreement, Pennsylvania must reduce nitrogen and phosphorus loads to the Chesapeake Bay by 2010, or a TMDL will be developed for the watershed. Beginning in 2010, Pennsylvania plans to issue nitrogen and phosphorus discharge limits for permitted facilities. These permit limits will affect 183 permitted dischargers in Pennsylvania's Potomac and Susquehanna watersheds. In addition, new and expanding facilities of any size will be required to offset 100 percent of nitrogen and phosphorus discharges.

being developed for the waterbody. A TMDL defines the maximum amount of a pollutant that can be discharged into a waterbody, yet still maintain water quality standards. During the TMDL development process, pollutant loads are allocated among the various sources in a watershed (point and nonpoint), so that water quality standards can be met. The pollutant limit allocated to point sources under a TMDL, or "wasteload allocation," forms the basis of a water quality-based effluent limit that is placed in a regulated facility's NPDES permit. These permit limits—or threat of permit limits—have driven the development of a large number of water quality trading programs in the United States.

Local and regional pollution caps have been the driver for trading in other countries as well as for some of the trading programs in the United States. Under the Resource Management Act, which grants regional governments in New Zealand the authority to make resource management decisions, the Waikato Regional Council has imposed nitrogen discharge caps on all sources in the Lake Taupo catchment. The Provincial Ministry of Environment (MOE) guidelines are the driver for the South Nation River Watershed Trading Program in Ontario, Canada. MOE is responsible for water quality and sewage treatment plant licensing in Ontario. It stipulates that if water quality

BOX 2 *continued*

In anticipation of these permit limits, Pennsylvania issued water quality trading guidance in 2006. Pennsylvania's guidance allows for point-to-point and point-to-nonpoint trades. To date, five point-to-nonpoint trades have been completed and approved though the actual exchange of credits will not take place until 2010 when permit limits are in place. Most of the nitrogen and phosphorus credits generated thus far have been generated through manure export projects where the landowner agrees to export manure generated on his or her agricultural operation to nutrient-poor abandoned mine lands. Pennsylvania is structured as an exchange market where credit prices are determined by the market. While Pennsylvania has implemented an online marketplace to facilitate trades, all trades to date have been transacted through private bilateral negotiations.

Red Cedar River Trading Program, Wisconsin, U.S.

The City of Cumberland wastewater treatment facility faced a total phosphorus limit of 1 mg/l and elected to meet this cap through trading with agricultural nonpoint sources. The City of Cumberland was required to obtain 4,400 pounds of phosphorus credits per year in order to meet its discharge permit. The City of Cumberland worked with the Barron County Land Conservation District to identify and enroll farmers that were willing to generate phosphorus reductions through the implementation of no-till or conservation tillage practices on their operations for a period of three years. The credit payments that participating farmers receive from the City of Cumberland are equal to the incentive payments they would have received from the federal cost-share programs. The number of credits generated through these practices has been pre-determined using average soil loss values and soil phosphorus concentrations. The first trades took place in 2001, and to date there have been eight rounds of credit purchases.

South Nation Total Phosphorus Management Program, Ontario, Canada

The South Nation Conservation Association (SNCA) runs a phosphorous management program that allows 15 municipal and two industrial dairy wastewater treatment plants to comply with federal load limits for the South Nation River. Under the "Policy 2" requirement established by the Canadian Ministry of the Environment, no new construction that could increase total phosphorous discharge may occur because the South Nation River exceeds water quality guidelines.

SNCA has established a Clean Water Committee comprised of agriculture and point source representatives to manage the Clean Water Fund (Fund). The Fund allocates money to farmers to pay for BMPs that generate credits. Point sources may purchase credits from the Fund to offset their increased phosphorous discharge, and sale revenue is used to replenish the fund.

Lake Taupo Trading Program, Waikato, New Zealand

Lake Taupo in New Zealand is located in a primarily agricultural watershed. Under the Resource Management Act, Environment Waikato (the regional council with regulatory authority) has capped the amount of nitrogen entering the lake. Each land use and hectare of land in the Lake Taupo watershed will have a nitrogen discharge limit. The benchmark (or initial allowance allocation) for agricultural sources is based on the average nitrogen losses between 2000 and 2005. There is a goal to reduce nitrogen losses to Lake Taupo by 20 percent. However, the trading program, which focuses on agricultural sources, is aimed at maintaining water quality at 2001 levels. Any landowners wishing to increase their nitrogen discharge will need to purchase allowances from other landowners in the watershed. A separate fund, The Lake Taupo Protection Trust, has the mandate to achieve the permanent 20 percent reduction in nitrogen entering the lake. They are likely to achieve this through a mix of land retirement, land conversion, and purchasing allowances that result in permanent reductions of nitrogen. The Lake Taupo program has been under development for the past 7 years and will allow trading once agricultural sources have been benchmarked.

guidelines are exceeded, then no new pollutant discharge is allowed in a watershed.[7]

In Australia, the Hunter River Salinity Trading Scheme in New South Wales is driven by salinity concerns for the Hunter River. To address these concerns, the New South Wales Environmental Protection Agency (NSW EPA) set a numeric salinity goal for the river, with the major point sources holding an Environmental Protection License to discharge.[8] Similarly, NSW EPA created a total pollutant load limit for nutrients in South Creek and allowed the affected sewage treatment plants to trade in order to stay within that limit.[9]

2. Allocation of Water Quality Caps

Once a watershed water quality cap has been established, the cap has to be allocated among all regulated entities. Pollutant caps for point sources are generally allocated based on regulatory numeric effluent concentration limits for a given pollutant. To facilitate trading, effluent pollutant concentration limits are often translated into an annual discharge limit expressed as a unit of mass over time (for example, pounds per year). The annual discharge limit is based on the numeric effluent concentration limit and an annual facility flow volume. In many instances, the flow volume used to determine the annual discharge limit is equal to the facility's annual average design flow. A sewage

treatment plant, for example, that has an annual discharge limit based on a nitrogen concentration of 6 mg/l and a design flow of 20 million gallons per day (mgd) would be allowed to discharge a total of 365,292 pounds of nitrogen per year.[10]

Because most discharge limits are allocated based on design rather than actual flows, many point sources have not been in danger of exceeding their permitted limit in the short term, as they operate below their maximum capacity. In our example, if a treatment plant has a current flow of 14 mgd and a current nitrogen concentration of 8 mg/l, it would discharge approximately 340,939 pounds of nitrogen per year—which is under its annual discharge limit of 365,292 pounds of nitrogen per year (a limit that was based on design flow of 20 mgd and a nitrogen concentration limit of 6 mg/l). In many water quality trading programs (for example, Cherry Creek and Chatfield Reservoir trading programs in Colorado, U.S.), increases in urban growth—which translate to greater flow rates—is the main factor threatening the ability of sewage treatment plants to meet their discharge limits.

In some cases, such as the South Creek Bubble Licensing Scheme and Tar-Pamlico Nutrient Trading Program, the point sources involved must meet the cap in aggregate, and there is no allocation to the individual sources. This type of voluntary grouping of point sources for the purpose of meeting a cap is generally referred to as a "trading association." These associations often consist of multiple facilities grouped together under a single aggregate permit and are generally free to choose whatever means they prefer to achieve the cap.

However, many water quality trading programs have not yet allocated water quality caps for the pollutants of concern to the regulated sources. For example, the Middle Snake River Demonstration Project in Idaho was developed in anticipation of a TMDL for phosphorus, but the TMDL has yet to be finalized. As a result, point source regulatory caps for phosphorus have not been enacted or allocated. Other active programs where there has been no allocation of individual caps to sources include the Lower Boise River Effluent Trading Demonstration Project and the Great Miami River Watershed Trading Pilot. In addition, many of the programs under development are also awaiting finalization of a TMDL or relevant legislation and/or allocation of water quality caps. Until these caps are allocated, trading is unlikely to occur.

3. Establishment of Nonpoint Source Baselines

As nonpoint sources are typically not regulated, their baseline nutrient discharges have to be established before they are able to generate and trade any nutrient reduction credits. Establishing baselines is critical to ensure that credits generated by nonpoint sources are "additional" water quality improvements that would not otherwise have taken place. For agricultural nonpoint sources, baselines are frequently either a cut-off date for eligible activities that reduce pollutant loadings—for example, a program might stipulate that no practices installed before 2007 are eligible to generate credits—or a performance standard, where a program might stipulate that a farm must implement a certain suite of practices or achieve a certain level of environmental performance before they are eligible to generate credits. Virginia, for example, established a performance-based baseline for agriculture requiring farmers to implement riparian buffers, streambank fencing, cover crops, and no-till agriculture before subsequent activities that reduce pollution are eligible to generate credits that can be used in Virginia's trading program. Similarly, the Maryland program (under development) is considering a performance-based baseline for agriculture that is expressed as a numeric per acre nutrient load that a farm must achieve before being able to generate credits. In the Lake Taupo Nitrogen Trading Program, nitrogen discharge permits will be allocated to each farm based on their highest annual discharge between July 2001 and June 2005. Choosing the highest year during this period allows for the variation in nitrogen discharges related to weather conditions to be taken into account.

4. Nonpoint-Source Nutrient Loss and Reductions Calculations

Because current nutrient losses and thus reductions in nutrient losses from nonpoint sources are difficult to measure, program designers have to identify the measurement or estimation approach they will use to determine the nutrient losses and reductions from these sources. Three common approaches are:

- ***Direct measurement through monitoring***. This approach uses direct measurements based on in-field samples to determine the nutrient reductions that result from the implementation of a control measure. While this approach is potentially the most accurate, it is also costly and is not readily applicable to all sources of nutrients or actions that reduce nutrient losses. The diffuse nature of agricultural nutrient pollution means that most agricultural best management practices (BMPs) are not readily monitored. The Chatfield Reservoir Trading Program in Colorado requires regulated point sources to monitor the performance of the practices implemented to offset their nutrient discharge. The initial estimated number of credits that the project receives is then adjusted up or down once monitoring data is available. The Lower Boise River

Effluent Trading Demonstration Project (Idaho, U.S.) does not require monitoring, but provides incentives to directly measure nutrient reductions from BMPs on irrigated lands by lowering the uncertainty ratio (see the trading ratio section) and thus the discount rate applied to reductions from monitored projects.

- ***Site-specific calculations.*** This approach uses established calculation methodologies to estimate nutrient losses and reductions from nonpoint sources, taking into account site-specific variables such as soil type, slope, and fertilizer application rate. The Pennsylvania Water Quality Trading Program, Maryland Water Quality Trading Program, Great Miami River Watershed Trading Pilot, Gun Lake Tribe Trading Initiative, and Lake Taupo Nitrogen Trading Program use this approach for estimating reductions. Some examples of tools that have been developed to estimate on-farm losses and reductions include the OVERSEER®[11] program in New Zealand, the Nitrogen Trading Tool, the Region 5 model, and WRI's NutrientNet in the United States (see Box 3). Site-specific calculations are typically more accurate than pre-determined levels of nutrient discharges (described below).
- ***Pre-determined nutrient reductions for practices regardless of location or other site-specific characteristics.*** This approach assigns a pre-determined reduction credit for each practice based on an estimated average nutrient reduction. These credit values are generally derived from scientific literature or watershed-level modeling and do not change across the watershed or region. The Red Cedar River Nutrient Trading Pilot Program, for example, uses average erosion rates and phosphorus soil concentrations to assign a phosphorus reduction of 12 pounds per acre per year for converting from conventional tillage to no-till and 8 pounds per acre per year for converting to conservation tillage. The South Nation River Watershed Trading Program and Virginia Water Quality Trading Program also use this approach. This is an appealing approach because it is simple to administer, and nonpoint source generators know in advance the reductions they can achieve for implementing a practice. However, it reduces the ability to capitalize on the biophysical heterogeneity within a watershed, which limits the ability of a trading program to identify the most cost-effective activities for generating nutrient reductions.

Box 3 Tools of the Trade: Estimating the reduction in nutrient losses from U.S. farms

In the United States, several tools have been developed to estimate nutrient losses from farms for use in water quality trading programs.

Nitrogen Trading Tool

The USDA has begun development of the Nitrogen Trading Tool (NTT). The NTT is an online tool that allows users to calculate changes in nitrogen loss potential based on changes in crop management practices. Users can assess how various BMPs may affect the nutrient losses from their farm, and calculate the total nitrogen reductions they can generate through changes in management practices. Although NTT is currently being developed only for nitrogen, the USDA hopes to adapt it to other pollutants such as phosphorus and sediment. The NTT is currently under development and is not yet used in any trading programs. The demonstration site can be accessed at http://199.133.175.80/nttwebax/.

Region 5 Load Estimation Spreadsheet Model

The U.S. EPA Region 5 spreadsheet model estimates pollutant reductions for (a) sediment; (b) sediment-borne phosphorus and nitrogen; (c) feedlot runoff; and (d) commercial fertilizer, pesticides, and manure utilization. Unlike the NTT, which is based on a dynamic field-level model, the Region 5 model is based on farm-level data inputs coupled with static equations that characterize relationships between field-level practices and nutrient losses. While Region 5 has acknowledged the limitations of its tool, it does provide a uniform system of estimating relative pollutant loads. The Region 5 model is the standard used in the Michigan trading rules for estimating nonpoint source reductions and is also used in the Great Miami Watershed Trading Pilot. The spreadsheet model can be found at http://it.tetratech-ffx.com/stepl/.

NutrientNet

NutrientNet is an online application developed by the World Resources Institute that can be used to estimate nonpoint source reductions from agriculture. Like the Region 5 Load Estimation Spreadsheet Model, NutrientNet estimates nitrogen, phosphorus, and sediment losses from farms using farm-level data inputs. Unlike the NTT model and the Region 5 model, NutrientNet applies program-appropriate delivery factors and trading ratios to the edge-of-field losses and reductions in order to calculate the actual number of credits generated through the implementation of best management practices. NutrientNet calculation tools have been developed for the Pennsylvania, Maryland, West Virginia, and Kalamazoo trading programs. NutrientNet can be found at www.nutrientnet.org.

5. Trading Ratios

Trading ratios are frequently used to account for a number factors in water quality trading programs such as uncertainty in reduction estimates (particularly for nonpoint-source reductions), creating equivalency among multiple pollutants, ensuring overall water quality benefits, accounting for the effects of nutrient transport, and mitigating buyer risks. Trading ratios

are applied to the estimated nutrient reductions to determine the saleable reduction credit. For instance, a 2:1 trading ratio means that an entity needs to purchase two pounds of pollutant reductions to offset every pound they discharge above their regulatory limit. Below are the types of ratios that are used in water quality trading programs:

- ***Delivery ratio***. Delivery ratios (also called "attenuation factors") are ratios applied to point and nonpoint-source pollutant reductions to account for pollutant losses/attenuation during transport in a watershed. Unlike carbon markets, where the location of pollutant discharges are not generally important, location is important in water quality markets. Physical, chemical, and biological processes can diminish the effect of some pollutants—such as nutrients—as they move downstream. A pound of nitrogen or phosphorus reduced further upstream from the point of concern often has a smaller water quality benefit than a pound of nitrogen or phosphorus reduced closer to the point of concern. Similarly, a pound of reduction close to a point of concern—such as a dead zone—can have a greater water quality benefit than an upstream reduction occurring several miles from the point of concern. In water quality trading programs, delivery ratios are used to estimate the percentage of nutrients and sediment ultimately delivered to a waterbody from a particular location within the watershed—such as a farm or sewage treatment plant discharge pipe—and the percentage that is "lost" or "attenuated" during transportation.

  Applying a delivery ratio helps ensure equivalency between the water quality effect of a purchased credit and the purchaser's nutrient discharge at the point of concern. This maintains the environmental integrity of the water quality trading program and provides fungibility between credits. Despite the importance of equivalency, many of the programs surveyed by WRI did not use delivery ratios. One reason for this omission was the difficulty in determining an appropriate ratio. Most delivery ratios are determined using a watershed fate and transport model.[12] This is often beyond the capability of many programs due to the funding and knowledge needed to create such watershed models. The Chesapeake Bay Watershed Model, developed and maintained by the U.S. Environmental Protection Agency, models nutrient losses and transport from over 300 subwatersheds to the mouth of the Chesapeake Bay. All of the Chesapeake Bay state water quality trading programs—Pennsylvania, Virginia, Maryland and West Virginia—use these model-derived delivery factors, applying them to point source and nonpoint source nutrient discharges. The Minnesota River Basin Trading Program also uses model-derived delivery factors to convert reductions into "Jordan Trading Units," which account for the attenuation of phosphorus from various points within the watershed to a monitoring point in Jordan, Minnesota.

- ***Uncertainty ratio***. Uncertainty ratios are used by water quality trading programs to compensate for two factors: (1) random variability in weather and other environmental factors that affect the efficacy of pollution reduction measures (especially for nonpoint sources), and (2) uncertainty regarding efficiency values used to estimate nonpoint-source reductions in nutrient losses. Uncertainty ratios mean that credit buyers are required to purchase more reductions than they need to meet their regulatory obligation. Uncertainty ratios are often set at 2:1, though this varies among programs. We found no instances where uncertainty ratios were derived based on scientific or statistical information; rather these ratios were generally set at a value deemed suitably conservative, while remaining politically acceptable to stakeholders.

- ***Equivalency ratio***. An equivalency ratio is used when two or more pollutants are traded in a market to achieve the same environmental result. Some pollutants contribute to the same environmental problem; however one pollutant may be more potent than another at producing the effect. An equivalency ratio is needed to make the two pollutants equivalent to one another. The Rahr Malting trade in Minnesota used an equivalency ratio. Rahr Malting's discharge permit allows it to choose between reducing five-day carbonaceous oxygen demand (CBOD5), phosphorus, nitrogen, or sediment loads to the receiving water. The Minnesota Pollution Control Agency established equivalency ratios between these four pollutants. The ratios are based on a scientific assessment of the relative impacts of these pollutants on chlorophyll levels in the river. For example, one pound of phosphorus has the same impact as eight pounds of CBOD5 and one pound of nitrogen the same as four pounds of phosphorus. Rahr Malting chose to meet its CBOD5 requirements by purchasing phosphorus offsets.

- ***Retirement ratio***. When retirement ratios are used, a proportion of the credits are retired with each trade, resulting in net water quality benefits. Retirement ratios, or "environmental benefit ratios," are used to ensure

that the program achieves a net water quality benefit beyond what can be achieved through regulation alone. For example, the Michigan Water Quality Trading Rules stipulate a 1:1.1 environmental benefit ratio for point-to-point trades. This means that 10 percent of all credits generated and sold by point sources are retired and cannot be used to offset new loads. Similarly, Maryland's program (under development) will employ a five percent retirement ratio for all point and nonpoint-source credits generated.

- ***Insurance/Reserve ratio***. An insurance or reserve ratio is used to set aside a portion of all generated credits into a reserve pool or insurance fund. A reserve ratio is used in the Pennsylvania Water Quality Trading Program and is being considered in the West Virginia Potomac Water Quality Bank and Trade Pilot as well. Pennsylvania applies a 10 percent reserve ratio to all generated credits. These credits are held in a centrally administered credit reserve fund and serve as insurance for regulated sources should any purchased credits default. In addition, Pennsylvania has pledged to also use the credit reserve to create liquidity in the market when credit supplies are low.

All or some of these trading ratios are used by most trading programs in the United States and Canada. Of the 26 active trading programs in the United States, 20 programs use some form of trading ratio; another is considering using trading ratios in the future. In many cases the trading ratio is not clearly defined and actually represents a stacked ratio. The South Nation River Watershed Trading Program, for example, applies a 4:1 trading ratio to all phosphorus reductions to compensate for delivery as well as uncertainty factors.

6. Market Structure

Market structure defines how trading will occur and the infrastructure used to support the water quality trading program. The water quality trading programs reviewed by WRI have engaged in the following types of trading:[13]

- ***Bilateral trades***. Bilateral trades are characterized by one-on-one negotiations where a price is typically arrived at through a process of bargaining and not simply by observing a market price. This market structure generally has high transaction costs. Of the 26 active trading programs evaluated, 10 operate through bilateral negotiations. The Virginia Water Quality Trading Program has a hybrid bilateral/clearinghouse market structure; the Tualatin River program uses bilateral and sole-source offsets.
- ***Sole-source offsets***. Sole-source offsets occur when sources are allowed to increase nutrient discharge at one point if they reduce their nutrient discharge elsewhere (either on-site or off-site). In both cases the nutrient reductions are undertaken by the regulated entity. Five active programs have this market structure, including the Cherry Creek Reservoir Watershed Phosphorus Trading Program, the Chatfield Reservoir Trading Program, Delaware Inland Bays, Taos Ski Valley, and the Tualatin River Program. In the Chatfield Reservoir Trading Program, many of the trades involved offset projects that decommissioned septic systems and connected homes to a sewage treatment plant. The sewage treatment plant receives credits equivalent to the total amount of nutrients retired through decommissioning the septic systems. Programs using sole-source offsets often involve a single offset project that can generate sufficient credits for the duration of one or more permit cycles.[14]
- ***Clearinghouse***. A clearinghouse market is one where a single intermediary links buyers and sellers of credits. The clearinghouse converts a commodity that may have a variable price—such as a nutrient credit—into a uniform commodity. The clearinghouse market structure is used by nine of the active water quality trading programs, including the Virginia Water Quality Trading Program. Regulated facilities that need to purchase credits pay into a clearinghouse fund. The fund then purchases nutrient credits generated from reductions achieved either within the regulated community or from nonpoint sources outside the regulated community. This type of market structure can also be thought of as a "fee-in-lieu" system. A clearinghouse creates a simplified market that regulated facilities may prefer since they avoid having to locate and purchase credits on their own, thereby lowering their transaction costs and mitigating their risk. This type of market structure works more efficiently where there are a number of regulated entities and economies of scale can be achieved.
- ***Exchange market***. An exchange market is where buyers and sellers meet in a public forum (for example, online) with all commodities being equivalent and all prices transparent. An exchange is characterized by its open information structure and fluid transactions between buyers and sellers. The two active programs with exchange markets are the Hunter River Salinity Trading Scheme and the Pennsylvania Water Quality Trading Program. Online marketplaces to facilitate exchange markets are also being developed or considered for the Gun Lake Tribe Trad-

ing Initiative, Maryland's trading program, and the West Virginia Potomac Water Quality Bank and Trade Pilot.

Third parties—such as brokers, aggregators, or credit banks (for example, an agricultural association)—are sometimes considered to constitute a distinct market structure. However, brokers, aggregators, and banks are in reality simply operators within the market. Regulated entities who wish to purchase nutrient credits can contract with a third party broker, aggregator, or bank to identify and purchase credits on their behalf. In practice, brokers, aggregators, and banks have typically worked within the agricultural sector as an entity that collects nutrient reduction credits and re-sells them to the regulated point source community. Some programs where third-party aggregators or banks have come to the fore include the Red Cedar River Nutrient Trading Pilot Program, Great Miami River Watershed Trading Pilot, Pennsylvania Water Quality Trading Program, Tualatin River program, and Alpine Cheese Company/Sugar Creek trade.

Some trading programs combine elements of several of these market structures. For example, the Virginia Water Quality Trading Program will use a combination of a clearinghouse and bilateral trades. Existing point sources that need to trade to meet their cap will trade within the Virginia Nutrient Credit Exchange Association, which is a clearinghouse run by the association of point sources. The Exchange will facilitate the identification of available point-source credits and set credit prices. However, new or expanding facilities under the Virginia Water Quality Trading Program must obtain offsets from nonpoint sources.[15] These credits must be located and purchased by the facility through a bilateral trade. If the facility is unable to locate credits, they are given the option of paying into the state Water Quality Improvement Fund (WQIF). The WQIF will be administered by the Virginia Department of Environmental Quality, and will be tasked with banking nonpoint-source credits and will sell credits to point sources that are unable to locate their own offsets for a set fee.

As water quality trading becomes more widespread, we can expect to see a variety of new, innovative market structures emerge.

7. Trading Activity

Most active programs reviewed have experienced at least one trade. According to the U.S. EPA, in 2006 there were a total of 236 point source facilities in the United States covered by permits that allowed trades. Of these, 121 facilities had traded at least once over the life of the permit.[16] Unfortunately, there is no accurate record of the total number of trades completed each year. Most U.S. facilities that were shown to have traded at least once over the life of their permit had completed only one trade; however, some have conducted many trades. For example, in the Tualatin River program, Clean Water Services acquired temperature credits from 25 different farmers who generated the credits by implementing riparian buffers on their property. The riparian buffers are expected to generate credits for 30 years, meaning that Clean Water Services will not have to acquire additional temperature credits until 2035 or until the regulatory conditions of their permit change. The Southern Minnesota Beet Sugar Cooperative trades were similar; they acquired credits from 256 of their cooperative farmers as a condition of their permit. In fact, it is expected that in most cases (especially those involving point-to-nonpoint trades) trading activity is unlikely to be continuous and ongoing, but rather involve single transactions that create credit streams of up to 10 years or more. This is preferable, as regulated entities are likely to want the certainty of securing credits upfront for future compliance periods, and sellers want continuous funding streams for the life of their water quality improvement practice.

Of the active trading programs, only the Long Island Sound Nitrogen Credit Exchange Program in Connecticut and Hunter River Salinity Trading Scheme in Australia have experienced continuous trading activity since inception. The Hunter River Salinity Trading Scheme has conducted approximately 170 trades since 2002, and the Long Island Sound Nitrogen Credit Exchange Program trades nearly one million credits per year. The Hunter River and Long Island Sound programs are the water quality trading programs that come closest to commoditizing water quality credits. In large part, this is possible because both of these programs are limited to trades between regulated point sources where there is considerable certainty in the value of the reductions and the certainty of delivery of those reductions. Second, these programs have a large number of regulated entities eligible to participate in the market, creating depth and fluidity in the market.

While many programs have experienced at least one trade, there are many that have yet to experience any trades. In many cases, the program was developed in anticipation of a regulatory driver that is not yet in place (for example, a permit discharge limit for regulated sources), or the established regulatory limits did not necessitate trading (for example, the regulated facility is already operating below its regulatory limit and does not currently need to trade). The Great Miami River Watershed Trading Pilot, the Middle Snake River Dem-

onstration Project, and Lower Boise River Effluent Trading Demonstration Project are all programs that were developed in anticipation of a TMDL driver that has yet to be finalized. In the Gun Lake Tribe Trading Initiative, the TMDL is in place, but it is not sufficient to create a demand for trading by the regulated point sources in the watershed. Absent or weak nutrient regulations—which in turn lead to little or no demand for credits by regulated sources—are often cited by experts as the foremost reason for little or no trading activity in water quality trading programs.[17]

Lessons Learned: Elements of Effective Water Quality Trading Programs

Much can be learned from existing and inactive trading programs, especially the elements and conditions that lead to programs with trading activity and/or stakeholder perceptions that the program is a viable means of meeting their regulatory obligations. These lessons should be considered and solutions incorporated into new or emerging water quality trading programs. The following elements emerged from our analysis as being important for the development of effective water quality trading programs.[18]

Adequate drivers exist for pollutant reductions. We found that many water quality trading programs were developed in anticipation of regulatory caps that never materialized, or the regulatory requirements ultimately proved too weak (that is, nutrient caps were set at a level that did not create sufficient demand for trading). As a result, these programs experienced little or no trading. The Lower Boise River Effluent Trading Demonstration Project is an example of a water quality trading program that was developed in anticipation of a TMDL that has yet to be finalized. The water quality trading program was finalized in 2002 but has sat idle for the past six years. In contrast, water quality trading programs in the Chesapeake Bay states (Virginia, Maryland, Pennsylvania, and West Virginia) are being developed in conjunction with newly adopted water quality standards. These standards have been translated into nutrient limits in point-source discharge permits. These meaningful nutrient limits have meant that trades have already occurred in the watershed, despite these programs being relatively young. Our recommendation is that before spending the time and money to develop a water quality trading program, ascertain whether regulatory requirements or voluntary motives are likely to generate the demand for credits.

Potential risks to the regulated community are adequately addressed. Because of the potential for costly CWA enforcement actions for permit violations, regulated point sources in the United States are generally risk-averse. Frequently, when faced with regulatory limits, point source entities express a preference for costly upgrades that they can control, rather than being exposed to risks associated with purchasing credits from other parties, either point or nonpoint source, in a trading market. Under the CWA, a regulated point source purchasing credits from another regulated point source can transfer regulatory compliance liability to the seller. However, a regulated point source purchasing credits from an unregulated nonpoint source cannot transfer legal liability. This creates the risk that a regulated point source buyer would be held in violation of his permit should the contract with the unregulated entity default. While the contract between the buyer and seller could protect the buyer financially in this event, it does not preclude enforcement action from the regulatory agency, nor the public disapprobation that goes with it. This legal reality makes the purchase of nonpoint-source credits too risky for some regulated sources.

Purchasing credits from nonpoint sources also holds other risks for regulated point sources. In most instances, regulated facilities are looking for long-term supplies of credits in order to sustain new or expanded operational capacity. However, the supply of nonpoint-source credits, especially those from agriculture, is variable and can depend on annual management decisions made by farmers. In addition, farmers are often unable to guarantee a supply of credits over a long period of time due to the nature and duration of typical on-farm nutrient management practices.

WRI identified a number of ways of addressing this risk, including:

- ***Allowing and encouraging aggregators to operate within the market.*** Aggregators are entities that purchase credits (generally large quantities of nonpoint source credits) to re-sell them to interested buyers. By introducing an aggregator, the direct liability link between the regulated entity and the unregulated nonpoint-source entity is severed. Because an aggregator deals with large portfolios of credits, it can more easily mitigate risks associated with delivery and performance of nonpoint-source credits. For example, an aggregator might sell only a portion of its credit portfolio and keep the remainder in reserve should one or more of the credit-generating projects fail or are not implemented as promised.
- ***Creating credit reserves.*** Pennsylvania's water quality trading program has created a centrally administered credit reserve to mitigate risks for regulated buyers. This

credit reserve effectively guarantees that a buyer who acts in good faith to secure credits will be able to draw from the reserve should his purchased credits default at the end of the compliance year. Similarly, Virginia's trading statute stipulates that credits will be available from the state if there are shortfalls in the market or credits default. If a buyer is not able to locate credits at reasonable cost within its watershed, it can buy them from the Virginia Water Quality Improvement Fund.

- ***Creating reconciliation periods***. Because sewage treatment plants are subject to periodic "upset conditions" (for example, unexpected disruptions of the treatment process from variations in temperature, flow, and nutrient concentration levels), regulated sources cannot predict with absolute certainty the number of credits they will need to buy—or conversely, how many they might be able to sell—in a given compliance period. Some programs have created reconciliation periods at the end of the annual compliance period to allow regulated facilities sufficient time to either purchase credits to make up for any shortfalls or place excess credits on the market. These reconciliation periods work hand-in-hand with the credit reserves.

Standardized estimations of nonpoint-source emissions and reductions are developed. Determining pollutant reductions from nonpoint sources represents a considerable challenge for water quality trading markets. Generally, pollutant loads and reductions from the implementation of nonpoint-source pollution abatement measures are not practical to measure directly and are, therefore, estimated. It is important that estimation methodologies used to calculate the reductions from nonpoint sources are defensible from a scientific and regulatory perspective.

Methodologies to estimate the reduction in nutrient losses from agricultural practices can be time-consuming to develop, but much can be learned from the experiences of existing and emerging programs. In the United States, some trading programs use spreadsheet-based tools that incorporate nationally available algorithms (for example, the Revised Universal Soil Loss Equation, which estimates sediment losses from farms). These are relatively straightforward to adapt to different watersheds. The Chesapeake Bay Program has incorporated a set of long-term average agricultural loading rates and BMP nutrient removal efficiencies into its watershed model. New Zealand's Crown Research Institute, AgResearch, has developed Overseer®, a nutrient budgeting model to facilitate the estimation of nitrogen and phosphorus losses from pastoral lands. This model is national in scope, enabling it to be used by any watershed in the country that may propose a trading program. Because of national similarities in data availability and farming practices, estimation algorithms may be more difficult to transfer between countries, but they are most likely transferable within a country.

Transaction costs within the trading program are minimized. There are many ways to streamline the trading process and reduce transaction costs within a trading program. For instance, developing standardized language in regulatory compliance documents, drafting model contracts for sale transactions, and streamlining processes to eliminate unnecessary delays are all important for improving the efficiency of a trading program.

Identifying and locating buyers and sellers within the market is one transaction cost common to many trading programs. In particular, point sources often find it difficult to locate willing nonpoint-source credit sellers due to both thin markets—that is, few qualified sellers—and the unfamiliarity of the nonpoint source sector with trading markets. Aggregators can, in part, reduce these transaction costs. Aggregators are typically established entities within the nonpoint-source community—for example, agricultural consultants or conservation district staff—and are well-placed to identify and purchase credits from nonpoint source sellers and resell these to point sources. By purchasing from an aggregator, a point-source entity eliminates the need to manage and police multiple contracts from a variety of sellers, thus reducing transaction costs for the buyer.

Tools such as online marketplaces and registry databases to track credits and trades can also help reduce transaction costs and may be easily transferable between trading programs. There should be little need to dramatically change the marketplaces and registries between watersheds and countries. The use of existing tools that provide a ready-made structure for markets and transaction processes can decrease the time and cost of developing, implementing, and administering the various aspects of a trading program. In collaboration with WRI, the Pennsylvania Water Quality Trading Program, West Virginia Potomac Water Quality Bank and Trade Pilot, Maryland Water Quality Trading Program, and the Gun Lake Tribe Trading Initiative have all developed (or are developing) an online trading tool called NutrientNet that will facilitate market transactions and the administration of the water quality trading program (see Box 4).

Increasing standardization of water quality trading programs through the use of standard tools, marketplaces, registries, and

credit calculations may provide additional benefits beyond reducing transaction costs. Increasing standardization will likely facilitate the future broadening of water quality markets where it makes sense. For example, states within the Chesapeake Bay (Virginia, Pennsylvania, Maryland, and West Virginia) share many commonalities in their established and developing trading programs, making it possible that in the future, interstate trading within major basins may be possible.

Program has buy-in from local government, the regulated community, and other stakeholders within the watershed. A stakeholder process that complements the development of a water quality trading program is important for successful implementation. Often the lack of understanding about what water quality trading is—and is not—creates misconceptions and tensions during the development and implementation phase of a program. Early education and ongoing dialogue with relevant stakeholders on trading concepts and the goals of the trading program are necessary to ensure that the development process runs smoothly and to create stakeholder buy-in and support. However, it is not necessary to "reinvent the wheel" when it comes to communicating trading concepts and creating elements of a trading program—to a large extent educational materials have already been developed or can be borrowed from existing programs.[19]

The success of the stakeholder process will frequently depend on the process employed and the stakeholder personalities involved. Identifying a "trading champion" can be useful in this context. A high-level elected official—for example, a governor, head of an environmental agency, or a council chairperson—can help motivate other high-level officials during the early stages of developing a trading program, while a local trading champion can generate enthusiasm for trading at the grassroots level and help push a trading program forward. Many of the programs in the United States that have languished have not had the support of important stakeholders. For example, with the encouragement of the director of the Michigan Office of the Great Lakes and support from key staff members within Michigan's Department of Environmental Quality (DEQ), Michigan implemented state trading regulations in 2002, but support for trading diminished once the director and key DEQ staff left. Subsequently, the Gun Lake Tribe Trading Initiative has suffered several set-backs as a result of agency resistance to trading. For this reason, bottom-up approaches are perhaps more successful and easier to maintain over time. The Great Miami River Watershed Trading Pilot is one that has enjoyed considerable buy-in at the local level, which has led to significant support for the program at the state level.

BOX 4 NutrientNet—Water Quality Trading Online

The World Resources Institute has created an online trading tool—NutrientNet—that can act as a registry, marketplace, and estimation tool. NutrientNet has been developed for the Gun Lake Tribe Trading Initiative and the Pennsylvania Water Quality Trading Program. It will also be used to underpin the programs in Maryland and West Virginia. NutrientNet is designed to serve the following functions:

- Provide farmers, sewage treatment plants, and industrial plants with tools for estimating nutrient losses to surface waters from their operations;
- Provide a marketplace where market participants can identify each other, and buy and sell credits;
- Provide a registry that can track the volume and type of trades within a watershed; and
- Provide potential market participants and other stakeholders with background information on nutrient trading.

See http://www.nutrientnet.org for more information.

Where Next?

Water quality issues are on the rise—there has been a fourfold increase in identified hypoxic zones globally in the past 12 years—and governments will increasingly look for new ways to deal with these problems. The prevalence of water quality trading programs has steadily grown and will likely continue to grow. While trading does not supplant regulation, it does provide a mechanism to help regulated sources meet their regulatory obligations at lower costs than traditional command and control approaches, and allows new or expanding regulated entities to operate within watersheds with nutrient caps. Over time, there is likely to be more standardization between trading programs and the infrastructure that supports them. In addition, trading processes will become more streamlined and efficient. All of these developments are good news for those who believe that water quality trading can indeed be a cost-efficient mechanism to help meet water quality goals.

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Notes

1. USEPA. 2006. *Water Quality Assessment and TMDL Information.* http://iaspub.epa.gov/waters10/attains_nation_cy.control (Accessed 8/29/2008).
2. Statistics compiled from Selman, M., S. Greenhalgh, R. Diaz and Z. Sugg. 2008. *Eutrophication and Hypoxia in Coastal Areas: A Global Assessment of the State of Knowledge.* Washington, DC: World Resource Institute; and Diaz, R. and R. Rosenberg. 2008. "Spreading Dead Zones and Consequences for Marine Ecosystems." *Science* 321(5891): 926–929.
3. Not all nonpoint-source runoff is unregulated. In the United States, urban stormwater runoff is often regulated through stormwater permits. In New Zealand, some regions have begun to regulate nonpoint-source agricultural runoff as well.
4. Because water quality trading depends on the environment being relatively indifferent to the source of the pollutant, trading programs are generally deemed unsuitable for toxic and bioaccumulative pollutants.
5. Carpenter, S.R., N.F. Caraco, D.L. Correll, R.W. Howarth, A.N. Sharpley, and V.H. Smith. 1998. "Nonpoint Pollution of Surface Waters with Phosphorous and Nitrogen." *Ecological Applications* 8(3):559–568.
6. Active programs refer to those programs that have finalized their trading program design and allow for trading.
7. O'Grady, D. (unknown) "Phosphorus Trading in the South Nation River Watershed, Ontario, Canada." http://www.wvnet.org/downloads/posted%20nov282004%20PSIG/OGrady_2003%20South%20Nation%20River%20P%20Trading.pdf (accessed 110/2008)
8. Environmental protection licenses are a central means to control the localized, cumulative, and acute impacts of pollution in NSW. They set limits on the pollutant loads emitted by holders of environmental protection licenses, and link license fees to pollutant emissions. See NSW EPA (2008) Hunter River Salinity Trading Scheme. http://www.epa.nsw.gov.au/licensing/hrsts/index.htm (accessed 1/10/2008)
9. NSW EPA. 2008. "South Creek Bubble Licensing Scheme." http://www.environment.nsw.gov.au/licensing/bubble.htm (accessed 1/10/2008)
10. To calculate the annual discharge mass load limit from the concentration limit and flow, the following formula is used: 365 (days) * flow (million gallons/day) * concentration (mg/l) * 8.34 lbs/gal.
11. See http://www.agresearch.co.nz/overseerweb/ for more details.
12. An example of a watershed fate and transport model is the "soil and water assessment tool" (SWAT), which can be modified for various watersheds. SWAT is able to model the flow of water and sediment throughout the basin based on existing or projected hydrology and land use patterns.
13. Adapted from Woodward, R.T., R.A. Kaiser, and M.B. Wicks. 2002. "The Structure and Practice of Water Quality Trading Markets." *Journal of the American Water Resources Association* 38(4): 967–980.
14. The U.S. NPDES permit cycle is 5 years.
15. Virginia's water quality trading regulation stipulates that new or expanding sources must obtain offsets from nonpoint sources, and cannot purchase allowances from existing point sources. http://www.deq.virginia.gov/vpdes/nutrienttrade.html for more information.
16. Personal communication with Virgina Kibler at U.S. EPA.
17. For a larger discussion on these issues, see King, D and P. Kuch. 2003. *Will Nutrient Credit Trading Ever Work? An Assessment of Supply and Demand Problems and Institutional Obstacles.* Washngton, DC: Environmental Law Institute (33-ELR-10352); and King, Dennis. 2005. "Crunch Time for Water Quality Trading." *Choices* 20(1): 71–75.
18. WRI convened an advisory group of water quality trading experts to help identify the major successes and failures of water quality trading schemes to date. The advisory group consisted of Paul Faeth of Global Water Challenge, Virginia Kibler of U.S. EPA, Mark Kieser of Kieser and Associates, Dennis King of University of Maryland, Clay Landry of WestWater Research LLC, and Rhonda Sandquist of Jackson Kelly, PLLC.
19. Examples of water quality trading educational resources include:
    - US EPA. 2004. *Water Quality Trading Assessment Handbook (EPA 841-B-04-001). Washington, DC: Office of Water, USEPA.* http://www.epa.gov/owow/watershed/trading/handbook/
    - USEPA. 2007. Water Quality Trading Toolkit for Permit Writers (EPA 833-R-07-004). Washington, DC: Office of Water, USEPA. http://www.epa.gov/owow/watershed/trading/WQTToolkit.html
    - Conservation Technology Information Center. 2006. Getting Paid for Stewardship: An Agricultural Community Water Quality Trading Guide. West Layfayette, IN: CTIC.

About WRI

The World Resources Institute is an environmental think tank that goes beyond research to find practical ways to protect the Earth and improve people's lives. Our mission is to move human society to live in ways that protect the Earth's environment and its capacity to provide for the needs and aspirations of current and future generations.

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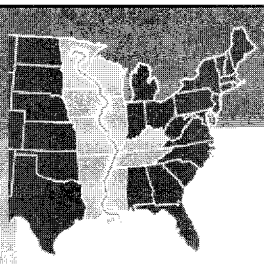
Water Quality Trading and the CWA: Risks and Opportunities

Bradley Klein, Environmental Law and Policy Center

ALI CLE / ELI Clean Water Act Course – Washington D.C.

Nov. 18, 2014



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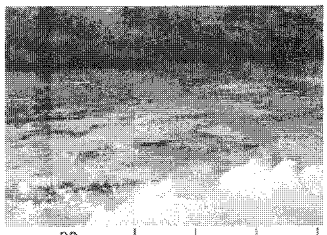
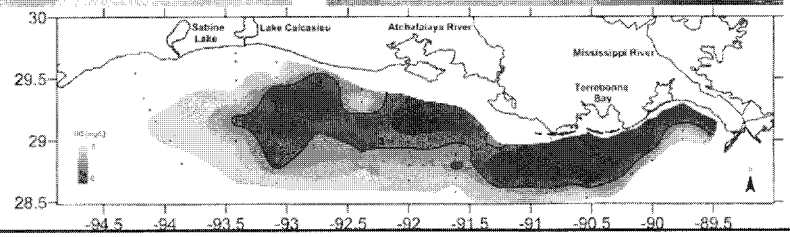
The problem: Nutrient pollution

- Algae-fueling phosphorus and nitrogen pollution are fouling our lakes, streams and rivers and choking the Gulf of Mexico.

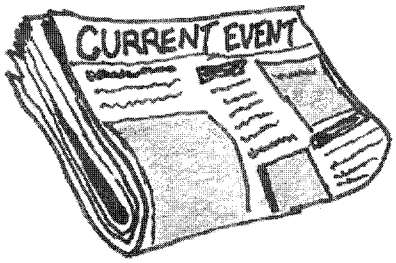




3

In the news...

- ❑ Toledo drinking water / Gulf of Mexico "Dead Zone"
- ❑ Chesapeake Bay TMDL and litigation
- ❑ MRC "nutrient petition" lawsuit
- ❑ Florida nutrient litigation
- ❑ EPRI / Ohio River trading program

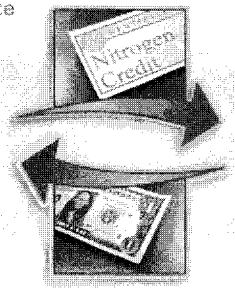


4

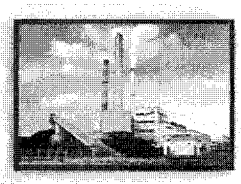
What is Water Quality Trading?

- EPA 2003 Water Quality Trading Policy Statement:
  - **"[Water quality trading] allows one source to meet its regulatory obligations by using pollutant reductions created by another source that has lower pollution control costs."**

Farm installs best management practice to generate credit



Permitted source buys credit to meet regulatory requirement



Source: Electric Power Research Institute

5

EPA resources on trading:

- Water Quality Trading Policy (2003) *"EPA believes that market-based approaches such as water quality trading provide greater flexibility and have potential to achieve water quality and environmental benefits greater than would otherwise be achieved under more traditional regulatory approaches."*
- Water Quality Trading Toolkit (2009) *"The Toolkit is intended to facilitate trading by providing NPDES permitting authorities with the tools they need to facilitate trading and to authorize and incorporate trading in NPDES permits"*

EPA

Water Quality Trading Toolkit for Permit Writers

6

EPA / USDA Partnership on Trading

- EPA / NRCS Partnership Agreement (2006)
  - To express "mutual commitment" to trading; coordinate programs, support establishment of standards, and explore/overcome barriers.
- EPA / USDA Expanded Partnership (2013)
  - To "coordinate and enhance communications and outreach" and "collaborate on developing tools and information resources" for stakeholders.

Water Quality Trading Toolkit for Permit Writers

7

Trading has inspired vigorous debate in the environmental community…

8

Some arguments commonly raised against trading…

- ❑ Trading is inconsistent with the CWA's framework.
- ❑ Trading gives polluters leeway to pollute by creating a market for it.
- ❑ Trading is untested and results are hard to measure.
- ❑ Trading can allow "hot spots."
- ❑ Trading lets agriculture off the hook.

9

Some arguments for trading …

- ❑ Traditional CWA approaches can't reach agriculture.
- ❑ Trading is one potential solution <u>if designed well</u>
  - May enable collaborative/watershed-based solutions
  - May enable lower cost progress towards standards
- ❑ Trading may help overcome political and regulatory stalemate on phosphorus and nitrogen pollution.

10

Like most regulatory issues, the details matter:

- ❑ Who is eligible to trade?
- ❑ What's the "cap" or "regulatory driver"?
- ❑ What's the "baseline"?
- ❑ How do you calculate "credits"?
- ❑ What are the compliance safeguards?
- ❑ How does the public effectively participate?

11

Five categories of proposed "principles"

1) Protect or improve local water quality / no hotspots
   - Trading programs must meet the water quality-based goals of the Clean Water Act and may not degrade local water quality.

2) Baselines / minimum eligibility requirements
   - Trading programs should establish minimum performance standards for participation (including compliance with all existing state and federal water quality requirements).

3) Defensible and science-based credits and trade ratios
   - Trading programs must establish defensible metrics for credit calculation and verification.

12

Five categories of proposed "principles"

4) Transparency, accountability, verification
   - Trading programs must promote accountability, transparency, accessibility, and public participation.
5) Compliance and enforcement
   - Trading programs must include compliance and enforcement provisions that ensure long-term success.

13

MRC Draft Principle 1

Trading programs must meet the goals of the Clean Water Act and may not degrade local water quality.

- CWA water quality based goals (TMDLs, WQBELs, etc) establish the goals for the trades.
- Local water quality must not be sacrificed for a trade (no "hotspots"). Can't use a trade to "cause or contribute" to a water quality violation.
- Trading program should result in actual net improvement to water quality.

14

MRC Draft Principle 2

Trading programs must establish minimum performance standards for participation (including compliance with all existing state and federal water quality requirements).

- Performance "baselines" required to generate credits
- No trading against TBELs
- No "double-dipping" by generating credits from government-funded practices.

15

MRC Draft Principle 3

Trading programs must establish defensible metrics for credit calculation and verification.

- Credit formula and trading ratios must account for uncertainty, pollutant equivalency, geographic scale and temporal consistency.
- Program should be science-based and promote confidence that credits are linked to real pollution reductions.
- The program should be reviewed and revised periodically to reflect best practices and new information.

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MRC Draft Principle 4

Trading programs must promote accountability, transparency, accessibility, and public participation.

- Program should provide maximum transparency and accessibility to the public, including compliance with all CWA requirements for public participation.
- Programs must include mechanisms to verify that nonpoint BMPs are installed, maintained, and performing as predicted.

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MRC Draft Principle 5

Trading programs must include compliance and enforcement provisions that ensure long-term success.

- Trades used for CWA compliance must meet all CWA standards for compliance and enforcement, including provision for CWA citizen suits.
- Program must ensure legal accountability for trades between point and nonpoint sources.

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Resources

- U.S. EPA
  - Trading Policy Statement
  - Water Quality Trading Toolkit for Permit Writers
  - Chesapeake "Appendix S"
- EPRI-ORSANCO Trading Program
  - http://wqt.epri.com/
  - Trading case studies
- Willamette Partnership's *In It Together* series
  - *http://willamettepartnership.org/in-it-together*
- Chesapeake Bay Commission – Economic Study
  - http://www.chesbay.us/nutrienttrading.htm

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Resources

- Chesapeake Bay Foundation Factsheet
  - http://www.cbf.org/document.doc?id=141
- Choose Clean Water Coalition Principles
  - http://choosecleanwater.org/index.php/download_file/view/167/
- Congressional Hearings
  - http://transportation.house.gov/calendar/eventsingle.aspx?EventID=373351
- Webcasts and webinars
  - http://www.wef.org/waterqualitytrading/
- National Network on Water Quality Trading (forthcoming)

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Water Quality Trading Business Case for Montana

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Appendix B: "UPGRADE COST CALCULATIONS FOR EACH DISCHARGER"

1.0 EXECUTIVE SUMMARY

The Project Team of Morrison-Maierle (Helena, MT), Kieser & Associates, LLC (Kalamazoo, MI), and M J Walsh & Associates, Inc. (Downers Grove, IL) was retained by the State of Montana Department of Environmental Quality (MDEQ) to develop a "business case" for Water Quality Trading (WQT) in Montana. The purpose of the business case was to assess viable market program structures to support nutrient trading in Montana in conformance with ARM 17.30.1701, incorporating by reference, Montana's Policy for Nutrient Trading (CIRCULAR DEQ-13). The premise of this study was that wastewater treatment plants (WWTPs) will face treatment upgrade costs over the next 20 years to meet expected effluent limits for Total Nitrogen (TN) and Total Phosphorus (TP) in response to Montana's new nutrient standards. Use of trading to cost-effectively meet future permit limits for TN and TP would be afforded through implementation of land-based conservation practices in agriculture and forestry to generate nonpoint source (NPS) nutrient credits. Thus, the business case for trading examined whether trading could provide such a cost-effective compliance alternative. In turn, based on the projected trading volume and potential cost-savings with trading, the business case would identify options and costs for a one-time-only MDEQ investment for developing and launching a WQT program framework under the existing trading policy.

This report presents the results of these business case analyses by documenting methods, findings and conclusions of the Project Team's efforts to identify future MDEQ investment options in WQT. Key elements of the report include sections on WQT demand, trading credit supply, comparisons of credit demand and supply as well as costs, and the resulting business case recommendations. This Executive Summary highlights methods and findings of the overall analysis.

1.1 WWTP Demand

For assessment of potential demand for WQT credits, the Project Team examined trading opportunities in the context of spatial and temporal scales for municipal and industrial WWTPs in Montana. The assessment of trading demand focused on the largest WWTPs and other facilities with mechanical treatment technology. Through discussions with MDEQ, demand was represented by difference in current WWTP loads and future loads under nutrient standards. These loads were derived from MDEQ's DEPARTMENT CIRCULAR DEQ-12A (Montana Base Numeric Nutrient Standards) and DEPARTMENT CIRCULAR DEQ-12B (Nutrient Standards Variances). If current treatment technology and built infrastructure was capable of meeting anticipated future effluent limits reflecting the new instream standards, the facility was not considered as a potential buyer of NPS nutrient credits. Otherwise, PSs likely requiring some form of facility upgrade were targeted for the demand assessment.

The final list of dischargers with potential trading demand identified 27 major and minor point sources that should likely consider trading to meet seasonal (July to September) nutrient limitations. WWTP nutrient demand was calculated for each discharge permit over four discharge cycles (20 years). Nutrient removal demand for each treatment plant was based on historical performance (or expected performance if an upgrade is in process) compared to the variance limits in the regulations. A flow increase was assumed for each treatment plant at 2 percent for each permit cycle. This equated to approximately 0.5 percent growth per year.

Upgrade costs for all of the WWTPs were ultimately based on relevant literature values[1]. Such data were used by MDEQ to develop costs for Montana WWTPs[2] that were applied here. Based on various assumptions applicable to the Montana setting, upgrade costs were estimated for each plant for each 5-year permit based on the nitrogen and phosphorus variance limits in the regulatory language. These included facility upgrade capital and O&M costs. In addition, the net present value (NPV) was also calculated using a 3.3% inflation factor over a 20-year life cycle. This NPV cost was also used for comparisons to point source trading costs. This analysis found that approximately $87 million dollars (in 2014 dollars) will be needed for potential upgrades for the 27 WWTPs identified to meet variance limits over the 20 years for which variances will be available.

1.2 Credit Supply

Assessment of nutrient credit supply in Montana focused on hypothetical implementation of conservation practices in agriculture and forestry. To a limited degree, the supply assessment also examined TN supply through septic system disconnection programs. Estimated annual and seasonal NPS loads (July-September corresponding to the period nutrient standards application) for TN and TP were estimated for all the HUC-12 watersheds in the state based on land cover. Designated Wilderness Areas were removed from consideration as directed by MDEQ.

An empirical method was used to calculate pollutant loads using event mean concentrations (EMCs), monthly average precipitation values, and imperviousness percent coverage values per land use category. This method provided a very coarse estimate of nutrient loads delivered by surface runoff for each land use category in a watershed. Preliminary loading calculations were used here to: 1) estimate the nonpoint load from various land uses at the HUC-12 level; and, 2) assess the potential for nonpoint source credit generation of nutrients from limited portions agricultural and forest lands situated upstream of WWTPs potentially needing to consider trading. Nonpoint source loads were manipulated to derive credits for direct comparison to WWTP demand by applying a trading ratio or 2:1.

1.3 Comparison of Demand and Supply

Evaluating the viability of a Montana trading market was based on: 1) the determination of whether there was ample credit supply from NPSs to meet the demand of PSs, and 2) whether there were substantial cost savings with trading versus WWTP upgrades. The comparison of demand versus supply was completed for the 27 identified potential point sources identified in the demand analysis that should consider trading. Of these, only 19 would likely realize ample credit supply considering both TN and TP. TN credits, based on the methods applied were only predicted to be in short supply for two plants based on small upstream watersheds from which credits could be produced. TP supply was a substantially different picture than TN whereby calculations suggested TP shortages for 7 WWTPS even with the most generous crediting scenarios of substantial upstream landowner participation.

Comparison of credit volume demand and supply was next used to compare costs for WWTP upgrades versus agriculture and/or forestry credits to determine whether there were associated economic benefits for this type of trading in the various Montana settings. These comparisons revealed that there were slightly over half of the 27 point sources that would find trading (and then

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[1] "Striking the Balance between Nutrient Removal, Greenhouse Gas Emissions, Receiving Water Quality, and Costs, WERF Nutrient Removal Challenge Report, Michael Falk, David Reardon, JB Neethling, David Clark, Amit Pramanik, December 2013".

[2] "Wastewater Treatment Performance and Cost Data to Support an Affordability Analysis for Water Quality Standards, May 31, 2007".

only for TN), cost-effective using Project Team assumptions for agriculture and forestry NPS credits.

Six major dischargers and 8 minor dischargers were identified as having suitable conditions for WQT. These included the major dischargers of: Western Sugar Cooperative, Missoula, Dillon, Bigfork, Miles City and Havre. Minor dischargers included: Elkhorn Health Care, East Helena, Manhattan, Conrad, Montana Behavioral Health, Rocker, Lolo and Absarokee. Missoula was the largest facility that might benefit from TN trades where credit costs were 31% of upgrade costs. Miles City would stand to save nearly 85% or $5M of projected upgrade costs with TN trading. Potential nitrogen treatment savings with NPS credits for all 14 potential buyers ranged from 1-31% of upgrade costs. Of the more than $23M in projected upgrade costs for these 14 PSs to meet TN limits, equivalent TN trading costs were estimated at $3.2M, an approximate $20M savings over 20 years. This reflected an average of 14% of the cost of upgrades for all facilities. NPS phosphorus credits were not cost-effective for any facility as credit costs ranged from an estimated $58-161/credit compared to equivalent unit upgrade costs of approximately $4-25/pound.

Of particular note for any potential PS/NPS trading scenario examined in Montana was the limitation of NPS runoff-generated credits largely due to very low rainfall during the critical months of July to September (typically <2 inches). In some cases, facilities lacking trading opportunities were located in headwater areas where there was insufficient upstream land to generate such credits. For others, beneficial cost differentials between WWTP upgrades and NPS credits did not exist. Notably in some settings with larger facilities, the potential to obtain additional nitrogen offsets from septic system disconnects, though expensive, was possible and considered a feasible alternative where NPS TN credits were in short supply or too difficult to aggregate. Though not considered in this study because of a paucity in available research findings and/or site-specific details needed for credit calculations, were nitrogen reductions from improved irrigation practice management as a possibility in select areas where upstream irrigation was present above a WWTP. Such options would need to be identified on a case-to-case basis.

There were certain trading options identified whereby any point source considering trading might purchase credits initially for TN to provide compliance for one or more permit cycles before plant upgrades became necessary to meet future more stringent TN effluent limits. Conversely, certain facilities might consider upgrading in earlier permit cycles to meet second or third permit cycle nutrient targets, then use trading for a much smaller incremental level of required reductions with latter permit cycles. Such considerations reinforced a fundamental premise of trading; all potential buyers must each carefully examine their own particular needs and opportunities.

1.4 Business Case Considerations and Recommendations

Based on study findings, the Project Team identified that there appeared to be a relatively limited number of potential point source/nonpoint source trading opportunities in Montana. These were also likely to be spread out over four permit cycles. Results of estimating treatment plant upgrade costs compared to costs of water quality credits produced by agriculture and forestry practices did, however, indicate that purchase of credits can offer a lower cost of compliance for some but not all treatment plants and watersheds. During the next few years the regulatory schedule for variances will impose water quality improvement mandates on relatively few plants positioned to benefit from trading. Accordingly, establishing a comprehensive WQT framework and state program to manage credit trading (such as a registry, full time staffing, etc.) is not recommended by the Project Team at this time.

That said, a relatively modest level of further regulatory guidance would reduce uncertainties and transaction costs to parties interested in credit trading, thereby boosting the chances for Montana to realize economic gains from trading. Additional guidance would help lead to standardization

of matters such as credit calculations, trade ratio determination, crediting-project verification and permit modification procedures. This could be important regulatory infrastructure that would enhance the ability to complete sensible, cost-lowering trades and minimize MDEQ administrative burdens. The prospects for Montana to realize overall benefits from WQT may thus be enhanced through one-time investments that provide a reasonable opportunity to help potentially benefited credit buyers to become actual buyers.

The Project Team therefore recommends that MDEQ:

- Not invest in formally developing any specific and/or prescriptive WQT program framework under CIRCULAR DEQ-13. Rather, MDEQ should simply allow point sources that might choose to trade, to best determine how they should each proceed under CIRCULARS DEQ-12A, 12B and 13 absent a formal WQT framework.
- Alternatively consider limited investments to write appendices to DEQ-13 that clarify and facilitate credit calculation methods, provide standardized forms for trading participants and lay out expectations for crediting project verification and aggregator participation.
- Consider limited investments in expenditures for public outreach and/or workshops related to DEQ-13 suggested appendices.

Based on best professional judgment and Project Team experience, implementation costs for these latter two recommendations are estimated to minimally range from $150,000-$220,000 assuming outside contractor assistance.

Overall, this investment strategy facilitates what will likely be limited trading through bilateral exchanges between buyers and sellers and/or buyers and aggregators. It eliminates the need for formal program development and management as these elements that are already allowed in the existing trading policy. Trading integrated into the existing permit process should also be within the current purview of permit writers. Buyers and sellers would therefore bear the bulk of responsibilities for trading.

MDEQ investment at this time is not deemed as essential by the Project Team for future WWTP application and use of the trading policy. MDEQ investment in some or all of the recommended elements will simply help facilitate trades and reduce future costs associated with transactions and administration of potential trades. Fundamentally, all additional elements developed to facilitate trades under the existing policy, could be documented in appendices to DEQ-13, and easily integrated into existing MDEQ program functions.

2.0 INTRODUCTION

The Project Team of Morrison-Maierle (Helena, MT), Kieser & Associates, LLC (Kalamazoo, MI), and M J Walsh & Associates, Inc. (Downers Grove, IL) was retained by the State of Montana Department of Environmental Quality (MDEQ) to develop a "business case" for Water Quality Trading (WQT) in Montana. The purpose of the business case was to assess viable-market program structures to support nutrient trading in Montana in conformance with ARM 17.30.1701, incorporating by reference, Montana's Policy for Nutrient Trading (CIRCULAR DEQ-13). The business case includes costs for a one-time-only MDEQ investment in launching such a program. This report presents the business case by documenting the analyses, findings and conclusions of the Project Team's efforts to identify future MDEQ investment options in WQT. Such efforts included:

- Assessment of nutrient demand (Total Phosphorus – TP and Total Nitrogen – TN) by municipal and industrial wastewater treatment plants (WWTPs)
- Assessment of nutrient credit supply from implementation of conservation practices in agriculture and forestry as well as septic system disconnection programs
- Comparison of demand and supply crediting opportunities including comparison for costs (i.e., trading versus WWTP upgrades)

The Project Team recognizes the importance of establishing a business case for nutrient trading in Montana. The functional framework for WQT programs depends principally on the size of the market. More sophisticated programs, like central clearinghouses for example, are most efficient where there is substantial market demand for trading credits with multiple buyers and thus the need for multiple sellers in a single watershed or across many watersheds. These can manage complex program accounting and reporting, as well as related activities for verification and oversight. Limited compliance demand for WQT credits, even modest demand but temporally distributed over decades, would suggest that such a robust, complex framework with numerous moving parts would be inefficient and expensive considering costs and human resources. Alternatively, markets with limited demand may function more effectively with bilateral trades and/or market facilitators such as brokers and aggregators. Consistent throughout all efficient programs, however, are standardized methods and approaches for administrative, legal, regulatory, and technical program elements.

Recently promulgated nutrient standards, TMDLs, and new growth will require permitted dischargers to consider various compliance options to meet more stringent effluent limits, offset impacts of additional or new discharges of phosphorus and nitrogen, and/or protect high quality waters. Montana's nutrient trading policy was established to provide an additional compliance option. The policy allows for various trading options, including point source-point source and point source-nonpoint source trades. Montana Pollutant Discharge Elimination System (MPDES)-permitted dischargers, septic systems, agriculture, and other private parties are noted in the policy as potential participants in nutrient trading. The policy has only been used a few times for septic system trades, although it can be anticipated that a range of potential users will now surface given near and long-term nutrient compliance requirements.

Given this pending need, a business case has been rapidly developed that principally targets potential nutrient credit demand by point sources (PSs) including municipal and industrial WWTPs spatially and temporally, and corresponding credit supply from nonpoint sources (NPSs) associated with agriculture and forestry conservation practices. The following sections identify how the Project Team prepared the business case to: 1) identify an effective trading framework or policy needs to accommodate the results of this rapid assessment of demand and supply; and

2) assist MDEQ with identifying a strategic, one-time investment for establishing trading program opportunities and/or policy enhancements.

2.1 Overview of Approach

Though treatment technology is well understood, a variety of considerations must be made on a case-by-case basis to assess what each point source must do to potentially meet more stringent nutrient effluent requirements. Thus, the major wastewater treatment plants (WWTPs), smaller mechanical treatment plants, and dozens of wastewater lagoon facilities in Montana all will need to eventually assess compliance options and costs. The Project Team addressed this challenge by tapping into the existing experience of Morrison-Maierle with wastewater dischargers in the state, permit information from MDEQ, and direct contact with select wastewater operators for the major dischargers and mechanical plants where necessary. Assessment of demand stems from the compilation of this information in light of pending and future regulatory conditions.

A finite analysis of credit supply was challenging given a lack of watershed nonpoint source loading data, limited available information on current practices, and even assessing landowner willingness to potentially engage in trading. The Project Team therefore employed a relatively broad-based empirical modeling approach for nonpoint source loading. This approach was used successfully in the business case analysis of the multi-state Ohio River Basin trading program. Replicated here for Montana, the team interacted with the Montana Association of Conservation Districts (MACD) and State USDA-NRCS office in an attempt to identify current practices, commonly employed Best Management Practices (BMPs) and associated life cycle costs (20-year net present value) to broadly estimate nutrient reduction costs. Feedback in these regards, proved to be quite limited.

Based on demand and supply results, the Project Team spatially and temporally examined nutrient trading opportunities to forecast: 1) cost-savings with WQT based on cost differentials between WWTP upgrades versus use of nutrient credits from agriculture; and 2) the potential scale of trading that may occur in Montana to assess the scope and magnitude of MDEQ investment for future trading.

This information is presented in the following report sections:

3.0 Assessment of Credit Demand
4.0 Assessment of Credit Supply
5.0 Comparison of Demand and Supply
6.0 The Business Case for WQT in Montana

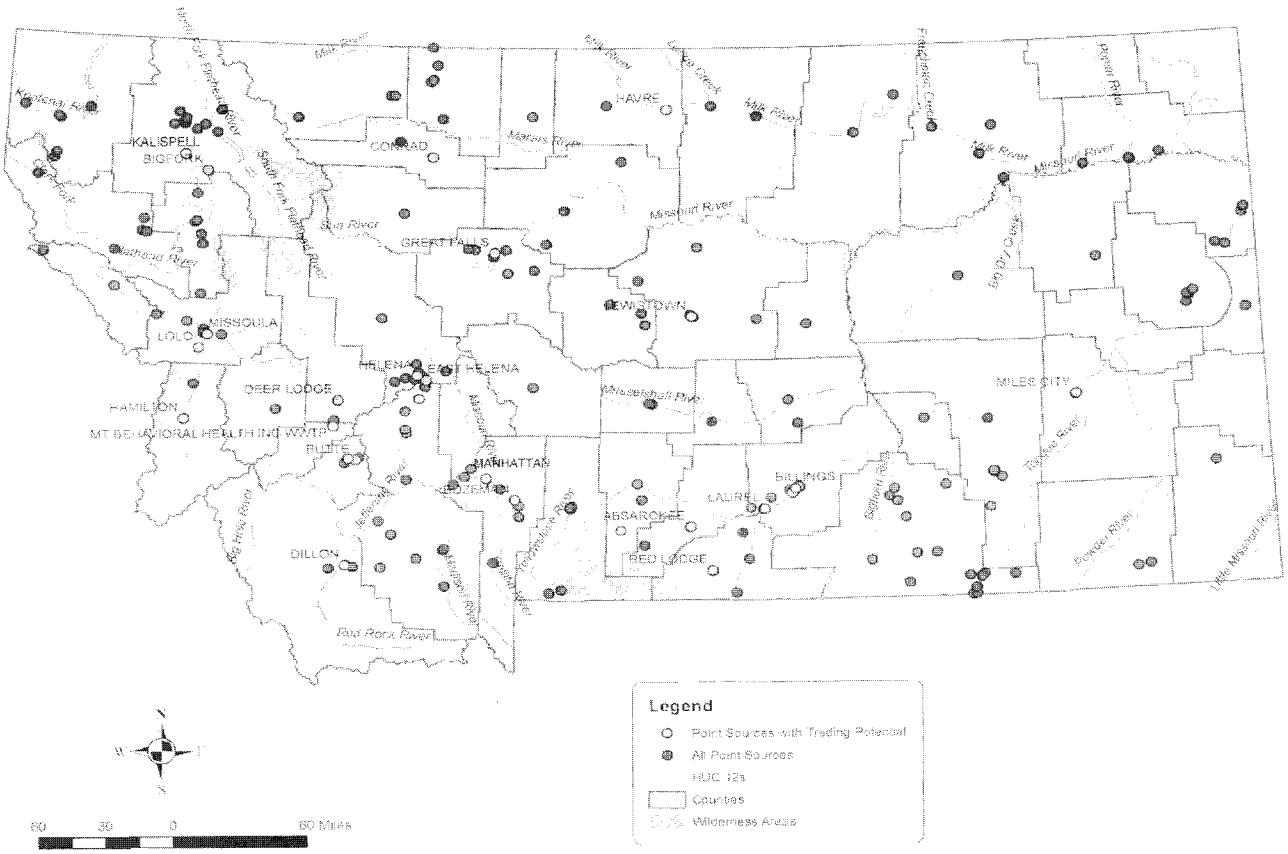
3.0 ASSESSMENT OF CREDIT DEMAND

3.1 Overview

For this assessment, potential demand for WQT credits was explored in the context of spatial and temporal scales for municipal and industrial WWTPs. The assessment of trading demand focused on the largest WWTPs and other facilities with mechanical treatment technology. Demand was represented by difference in current WWTP loads and future loads under nutrient standards. If current treatment technology and built infrastructure was capable of meeting anticipated future effluent limits reflecting the new instream standards, the facility was not considered as a potential buyer of NPS nutrient credits. Otherwise, PSs likely requiring some form of facility upgrade were targeted for the demand assessment.

3.2 WWTP Demand Analysis

Demand was examined on spatial and temporal scales recognizing various WQT drivers and permit cycles. This initially involved mapping point source locations (to identify potential trading areas by subwatershed). Figure 3-1 shows the location of the more than 200 permitted facilities considered in this application in relation to HUC-12s. The second element of this effort focused on assessing readily available treatment information (current loads, effluent concentrations, mean and maximum discharges, treatment methods and capacity). Information was obtained from MDEQ, Protect Team files and communications with the largest facilities and others with mechanical treatment technology. Trading demand was determined from MDEQ's DEPARTMENT CIRCULAR DEQ-12A, Montana Base Numeric Nutrient Standards and DEPARTMENT CIRCULAR DEQ-12B, Nutrient Standards Variances to define the temporal conditions of potential demand and the scale of such demand.



MORRISON MAIERLE, INC.

KLEESER & ASSOCIATES

Map of All Permitted Dischargers in Montana

Possible Credit Buyers in Yellow

3-1

3.2.1 Analysis Methods

Demand analysis started with creating a list of all municipal wastewater dischargers and industrial dischargers in Montana. Discharge Monitoring Reports (DMRs) were requested and analyzed for all of the dischargers for the period 2010 through 2014. Flow, Total Nitrogen (TN), and Total Phosphorus (TP) were collected and analyzed from the DMR data and are summarized in Appendix A.

The first modification to the list was to remove industrial discharges without nutrients in their effluent. MDEQ suggested using Appendix A of "Demonstration of Substantial and Widespread Economic Impacts to Montana That Would Result if Base Numeric Nutrient Standards had to be Met by Entities in the Private Sector in 2011/2012, MDEQ, December 2012" to make that cut since they had already analyzed which industrial dischargers to include in that study. The next modification was to remove dischargers on reservations (these are under the control of EPA Region 8 and not under the purview of MDEQ). The list was then categorized as follows:

- Dischargers who discharge to "Large Rivers" as defined in Table E-1 in "MDEQ Circular DEQ-12-A"
- Industrial discharges to wadeable streams
- Municipal dischargers to wadeable streams with more than 1,000 residents
- Municipal dischargers to wadeable streams with less than 1,000 residents.

This initial list also included location information (from EPA public information), permit expiration dates (from EPA public information), flow information (from DMR data), treatment type (lagoon or mechanical from individual permit descriptions), and the HUC-12 designation (from EPA public information) where each plant discharges. Appendix A shows this initial list of dischargers.

The discharger list was discussed at an initial meeting with the Project Team and MDEQ representatives involved in the project. One of the decisions made early in that meeting was to remove municipal dischargers with less than 1,000 residents from the study. Almost all of these systems are lagoons that do not discharge during all months (most only discharge 6-7 months per year). These systems may be able to make simple operational changes so that they do not discharge during the months where nutrient limits will be applied (July-September). Other systems might have farmers and ranchers nearby that can use the effluent during the summer months. The premise here is that the costs to build an equalization basin and contribute to some improvements on the landowner's irrigation system are likely to be much less than nutrient trading. While there might be a few small dischargers (<1,000 residents) that will be interested in undertaking nutrient trading, it was decided that the trading approach that is ultimately implemented based on the analysis of the remaining systems would also apply to smaller systems.

Industrial dischargers were then analyzed closely related to flow, nutrient load, and receiving water. Several were removed from the analysis because it was relatively obvious that their mixing zones would be large enough relative to their discharge that reasonable potential would not exist for them to have a nutrient discharge limit. MDEQ agreed with the Project Team to review the remaining list of dischargers related to TMDL implementation and schedule, receiving water status (impaired or not), and their knowledge of ongoing studies and upgrade plans for the dischargers. MDEQ then identified other dischargers that should be removed from the study. These changes were made and are presented in the next section.

3.2.2 WWTP Demand Analysis Results

The final list of dischargers with potential trading demand is presented in Table 3-1. The table includes permit number, discharger name, location, flow information, historical effluent nutrient concentrations, type of plant, and classification (major or minor) for 27 PSs. Where upgrades were known to be underway (either in design or construction), the anticipated effluent nutrient concentrations after upgrade were included. Where treatment plants have been upgraded between 2010 and 2014, only the data after the upgrade were used in the analysis.

WWTP nutrient demand was calculated for each discharge permit over four discharge cycles (20 years). For the discharges that currently use lagoons, it was assumed that they would initially get ammonia limits and be allowed to upgrade their treatment to meet those limits before nutrient limits started to be applied (if the lagoon was upgraded to a mechanical plant to meet ammonia limits).

Nutrient removal demand for each treatment plant was based on historical performance (or expected performance if an upgrade is in process) compared to the variance limits in the regulations.

Some treatment plants will eventually need to meet more stringent limits if they are currently performing at a higher level than the variance limits. There could also be treatment plants that will be held to lower standards than the variance limits depending on their receiving stream water quality and flow versus treatment plant flow. Additional nutrient limit considerations will apply if a receiving stream has a TMDL with higher wasteload allocations than the variance requirements. In all cases examined herein, the Project Team used variance limits as directed by MDEQ.

Finally, a flow increase was assumed for each treatment plant at 2 percent for each permit cycle. This equates to approximately 0.5 percent per year. This growth assumption is valid for the vast majority of Montana towns but there are a few towns and cities that will grow at a faster rate. These would likely include those near the eastern border (from the North Dakota oil boom) or possibly some of the larger cities like Billings, Bozeman, or Missoula. However, for the purposes of this study, it was decided that having different growth rates and for which cities and towns have different growth rates and by how much was beyond the scope of this study and would not affect the final recommendation. Thus, the same growth rate was applied across the board.

Table 3-1: Point Dischargers Included in Study

NPDES ID	Description	Population	Latitude	Longitude	Effective Date	Expire Date	Design Flow	Average Flow	Maximum Flow	Average TN (mg/l)	Average TP (mg/l)	Size
MT0026808	STILLWATER MINING EAST BOULDER		45.502500	-110.083889	8/1/2000	7/31/2005	0.65	0.23	0.42	3.3	5.1	Minor
MT0022594	MISSOULA	66,788	46.874160	-113.994600	11/1/2006	10/31/2011	8.99	7.06	10.39	9.3	0.47	Major
MT0021938	KALISPELL	19,927	48.176690	-114.309360	9/1/2008	8/31/2013	5.40	2.70	4.80	8.1	0.12	Major
MT0020478	RED LODGE	2,125	45.213389	-109.240861	3/1/2009	2/28/2014	0.29	0.59	1.30	14.5	2.2	Minor
MT0020311*	LAUREL*	6,718	45.657500	-108.752222	7/1/2009	6/30/2014	0.50	0.94	1.60	8	3	Major
MT0022560	EAST HELENA	1,984	46.589460	-111.921020	10/1/2009	9/30/2014	0.63	0.37	0.81	14.8	2.5	Minor
MT0023566	ELKHORN HEALTH CARE WWTP		46.449444	-111.985278	11/1/2009	10/31/2014	0.02	0.00	0.02	21.3	2.7	Minor
MT0000281	WESTERN SUGAR COOPERATIVE		45.770000	-108.500833	12/1/2009	11/30/2014	9.36	0.73	N/A	13.4	0.2	Major
MT0021750	ABSAROKEE	1,150	45.531111	-109.440000	2/1/2010	1/31/2015	0.35	0.26	N/A	14.8	1.8	Minor
MT0021458	DILLON	4,134	45.230556	-112.618611	3/1/2010	2/28/2015	1.10	0.36	0.63	32	4.9	Major
MT0020397	BIGFORK	4,270	48.063780	-114.083100	8/1/2010	7/31/2015	0.69	0.22	0.39	13.6	0.3	Major
MT0021857	MANHATTAN	1,520	45.877060	-111.332420	9/1/2010	8/31/2015	0.40	0.13	0.70	10.5	1.1	Minor
MT0021920*	GREAT FALLS*	58,505	47.519889	-111.300778	12/1/2010	11/30/2015	21.00	10.00	25.50	8	2.3	Major
MT0020001	MILES CITY	8,410	46.430550	-105.830900	4/1/2011	3/31/2016	1.98	1.13	1.80	23.7	2.5	Major
MT0022535*	HAVRE*	9,310	48.559444	-109.662500	5/1/2011	4/30/2016	1.30	1.55	2.59	8	1.9	Major
MT0020028	HAMILTON	4,348	46.253300	-114.175790	9/1/2011	8/31/2016	1.98	0.64	0.88	5	4.6	Major
MT0020079	CONRAD	2,570	48.204444	-111.919167	2/1/2012	1/31/2017	0.65	0.23	0.94	14.2	3.2	Minor
MT0022012*	BUTTE*	33,525	45.996960	-112.553600	4/1/2012	3/31/2017	8.50	3.78	4.83	3	0.3	Major
MT0022608	BOZEMAN	37,280	45.722778	-111.067778	6/1/2012	5/31/2017	5.78	5.55	8.40	6.6	1.1	Major
MT0021431	MT BEHAVIORAL HEALTH		46.237222	-112.776528	8/1/2012	7/31/2017	0.10	0.00	0.01	29	5.7	Minor
MT0020044	LEWISTOWN	5,901	47.064060	-109.424980	9/1/2012	8/31/2017	2.83	1.88	3.90	2.6	0.5	Major
MT0022641	HELENA	28,190	46.619167	-112.005000	10/1/2012	9/30/2017	6.00	3.06	9.05	6.5	2.4	Major
MT0022616*	DEER LODGE*	3,111	46.429167	-112.739167	3/1/2013	2/28/2018	2.40	1.27	8.40	6.1	1	Major
MT0027430	ROCKER	100	46.004167	-112.623611	6/1/2013	5/31/2018	0.04	0.02	0.05	18.1	10.8	Minor
MT0030180	YELLOWSTONE ENERGY FACILITY		45.813333	-108.440278	5/1/2014	4/30/2019	0.25	0.12	0.23	NA	7	Minor
MT0020168	LOLO	3,892	46.774670	-114.070210	9/1/2014	8/31/2019	0.34	0.21	0.32	25	4.4	Minor
MT0022586*	BILLINGS*	104,170	45.802500	-108.466944	11/1/2014	10/31/2019	26.00	15.10	21.90	6	0.5	Major

*Currently upgrading facility (either in design or construction). TN and TP adjusted to expected performance after upgrade.

3.2.3 WWTP Upgrade Costs

Upgrade costs for all of the WWTPs were based on the final report "Striking the Balance between Nutrient Removal, Greenhouse Gas Emissions, Receiving Water Quality, and Costs, WERF Nutrient Removal Challenge Report, Michael Falk, David Reardon, JB Neethling, David Clark, Amit Pramanik, December 2013". This report is available through the Ingenta Connect website and a draft of this report was used by MDEQ to develop costs in the "Wastewater Treatment Performance and Cost Data to Support an Affordability Analysis for Water Quality Standards, May 31, 2007". This report was used as a basis for the "Demonstration of Substantial and Widespread Economic Impacts to Montana that would Result if Base Numeric Nutrient Standards had to be Met by Entities in the Private Sector in 2011/2012". This report ("Striking the Balance") presents nitrogen and phosphorus upgrade costs for a 10 mgd plant in the form of dollars per pound of nutrient to be removed (per season). The cost data were based on the assumption that the treatment plant is a basic 10 mgd activated sludge plant with primary treatment at 20 degrees Celsius capable of meeting typical BOD and TSS limits (referred to as Level 1). The report defines different levels of performance as follows:

- Level 1: Basic BOD / TSS removal activated sludge plant (no nutrient removal)
- Level 2: Basic Nitrification/Denitrification activated sludge plant (typically MLE) with alum addition for medium level phosphorus removal
- Level 3: 5-Stage Plant with enhanced denitrification (post-anoxic treatment) and enhanced biological phosphorus removal and alum addition for enhanced phosphorus removal and methanol addition for enhanced denitrification.
- Level 4: 5-Stage Plant with enhanced denitrification (post-anoxic treatment) and enhanced biological phosphorus removal and alum addition for enhanced phosphorus removal and methanol addition for enhance denitrification and filtration for limits of technology nitrogen and phosphorus removal short of using reverse osmosis technology.

Reverse Osmosis was also included in the report as part of Level 5 treatment but Level 5 treatment was not necessary for the purposes of this report so is not included here. The following effluent characteristics are associated with each level of treatment (1 through 4):

- Level 1: Activated Sludge with primary treatment, BOD < 30 mg/l, TSS < 45 mg/l, TN ~30 mg/l, TP~6 mg/l
- Level 2: Level 1 except TN < 8 mg/l, TP < 1 mg/l
- Level 3: Level 1 except TN 4-8 mg/l, TP 0.1 – 0.3 mg/l
- Level 4: Level 1 except TN <3 mg/l, TP <0.1 mg/l

For Montana, the "Base Numeric Nutrient Standards Implementation Guidance" sets the variance limits as guidance values as shown below:

For facilities >1 million gallons per day

- First permit cycle: 10 mg/l TN, 1 mg/l TP (or historical performance, if lower)
- Second permit cycle: 8 mg/l TN, 0.8 mg/l TP (or historical performance, if lower)
- Third permit cycle: 8 mg/l TN, 0.5 mg/l TP (or historical performance, if lower)
- Fourth permit cycle: Under development – for the purposes of this report the Fourth permit cycle was assumed to be 6 mg/l TN, 0.3 mg/l TP (or historical performance, if lower)

For facilities <1 million gallons per day

- First permit cycle: 15 mg/l TN, 2 mg/l TP (or historical performance, if lower)
- Second permit cycle: 12 mg/l TN, 2 mg/l TP (or historical performance, if lower)
- Third permit cycle: 10 mg/l TN, 1 mg/l TP (or historical performance, if lower)
- Fourth Permit cycle: 8 mg/l TN, 0.8 mg/l TP (or historical performance, if lower)

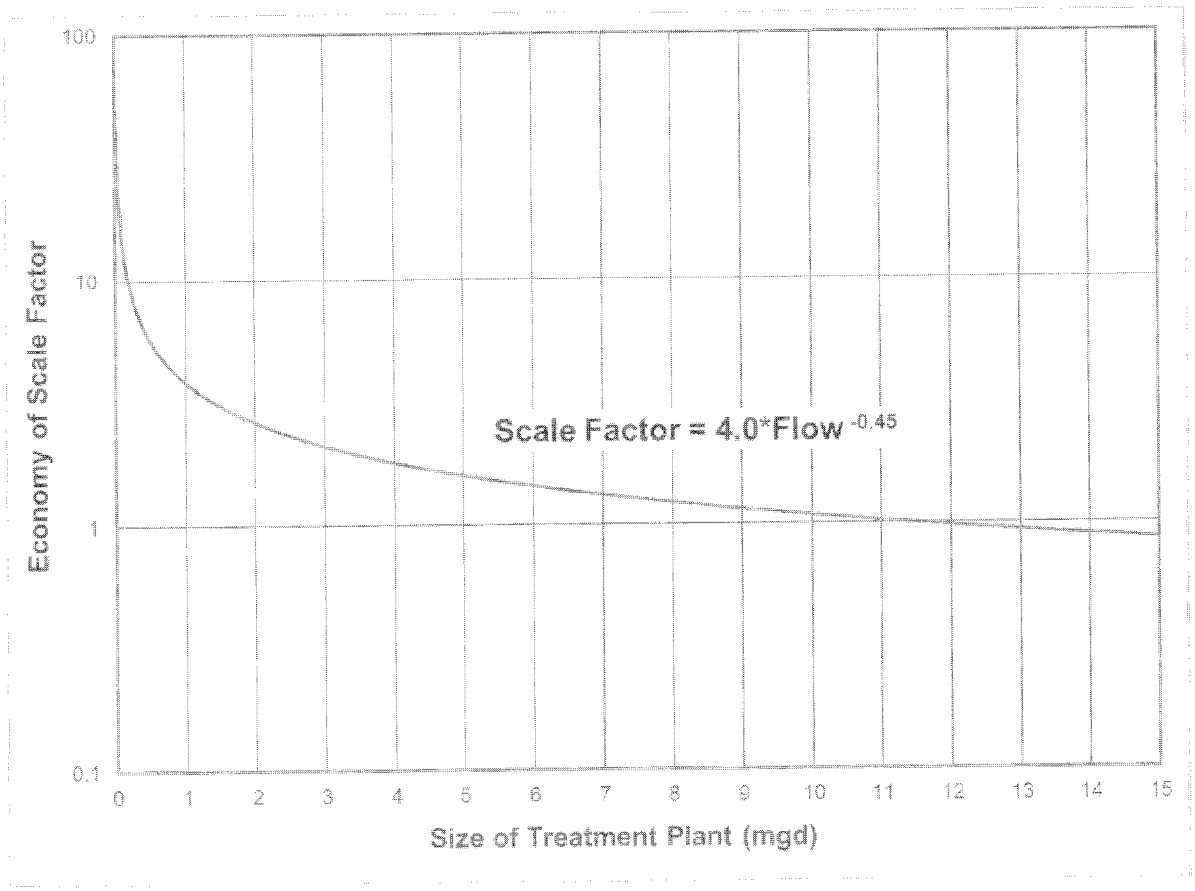
The costs presented in the "Striking the Balance" report were applied to the 27 dischargers in the Montana study group (Table 3-1). For capital costs, the calculated cost for 90 days (the MDEQ variance period) was multiplied by four because the infrastructure to remove nutrients must be built for the entire year, even though it will only be used for three months. The O&M costs were calculated for just the three months of assumed operation for phosphorous because in most cases, this will only consist of starting up a chemical feed system, but four and a half months was used for nitrogen to allow operators to bring the biological nitrogen removal process up to speed prior to the nutrient compliance period. There are some plants in Montana that perform biological phosphorous removal and biological nitrogen removal year-round and the O&M costs will be higher for those plants, but for the purposes of this report, there was no attempt to identify which plants fall under this category either now or in the future and it was concluded that this distinction would not change the final recommendations of the report. The following conclusions were made from the cost calculations in Montana:

1. Nitrogen upgrade costs were reasonably valid for treatment plants that fell within the 8-12 mgd average flow range but were significantly low for smaller treatment plants. It was obvious that an "economy of scale" factor needed to be applied to correctly estimate nitrogen upgrade costs for small plants in Montana. The economy of scale factor for nitrogen removal is shown in Figure 3-2. The reason for the economy of scale factor relates to the amount of additional volume and subsequent concrete tankage that needs to be constructed to allow for the additional anoxic nitrogen reduction, whether through endogenous decay or with the addition of carbon such as methanol or "Carbon C" or other commercially available carbon sources. Several iterations were applied before settling on the equation shown in Figure 3-2. Professional judgment and experience with several small treatment plant upgrades were used to settle on the final economy of scale factor equation. The economy of scale factor takes into account the increased cost of mobilization, demobilization, engineering, and general construction costs on a dollars/pound of removal basis for smaller treatment plants.

2. Phosphorus upgrade costs were reasonable when applied to all of the dischargers in the Montana study. The economy of scale factor was found not to be required. The reasoning for this is likely due to the fact that most treatment plants will need to apply some form of chemical feed system to remove phosphorus to the levels required to meet the variance limits. Most plants will not need to build significantly larger treatment basins to achieve phosphorus removal. For this reason, chemical feed systems and chemical costs will be very similar to all treatment plants on a dollars per pound basis. Therefore, no economy of scale factor was applied for phosphorous removal across the range of treatment plants studied in Montana.

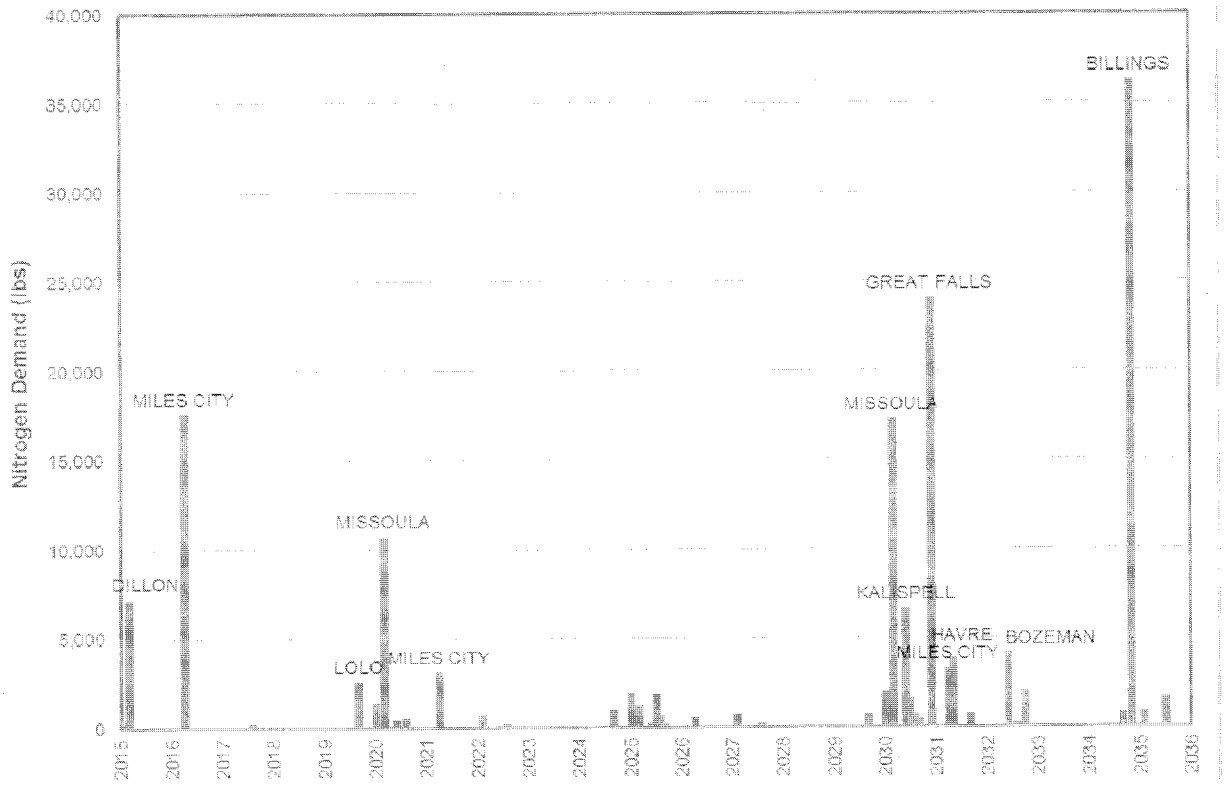
Based on the assumptions presented above, upgrade costs were estimated for each plant for each 5-year permit based on the nitrogen and phosphorus variance limits in the regulatory language (see Appendix B). It should be noted here that not all of the plants in this study will be subject to the variance limits. It is recognized that some will be held to a higher standard if they are performing at a higher level of treatment. It is also recognized that others will be held to a less stringent standard if they are on a large river with a large relative volume of mixing available, or if their TMDL (on a non-wadeable stream) creates differences from the variance requirements presented in this report.

FIGURE 3-2
ECONOMY OF SCALE FACTOR (NITROGEN UPGRADE COST ONLY)



It was beyond the scope of this project to attempt to predict which treatment plants would be given discharge limits for nutrients that are different than the adopted variance limits. Therefore, it was a conscious decision by the Project Team to make the simplifying assumption that all 27 dischargers would be held to the variance limits presented above. None of the dischargers will know for certain what their actual discharge limits will be until their MDEQ permit is issued and approved. This decision was recognized as a simplifying assumption but was agreed that it would not change the ultimate recommendation of this study. Based on the assumptions stated in this section, nutrient demand was calculated for each discharger in the study over the full 20 years where variances will be available based on CIRCULAR DEQ-12. These were then sorted over time and incremental and cumulative nutrient demand was calculated. WWTP nutrient demand is shown in Figures 3-3 through 3-6. Both incremental and cumulative demand are shown for nitrogen and phosphorous.

The facility upgrade capital and O&M costs were calculated as described above. In addition, the net present value (NPV) was also calculated using a 3.3% inflation factor over a 20-year life cycle. This NPV cost was used in subsequent sections of this report as a comparison point for nutrient trading costs. Upgrade costs are presented in Table 3-2 and incremental and cumulative costs are shown in Figures 3-7 through 3-9. As shown, approximately $110 million dollars (in 2014 dollars) will be needed for potential upgrades for dischargers in Table 3-2 to meet the variance limits over the 20 years where variances will be available.



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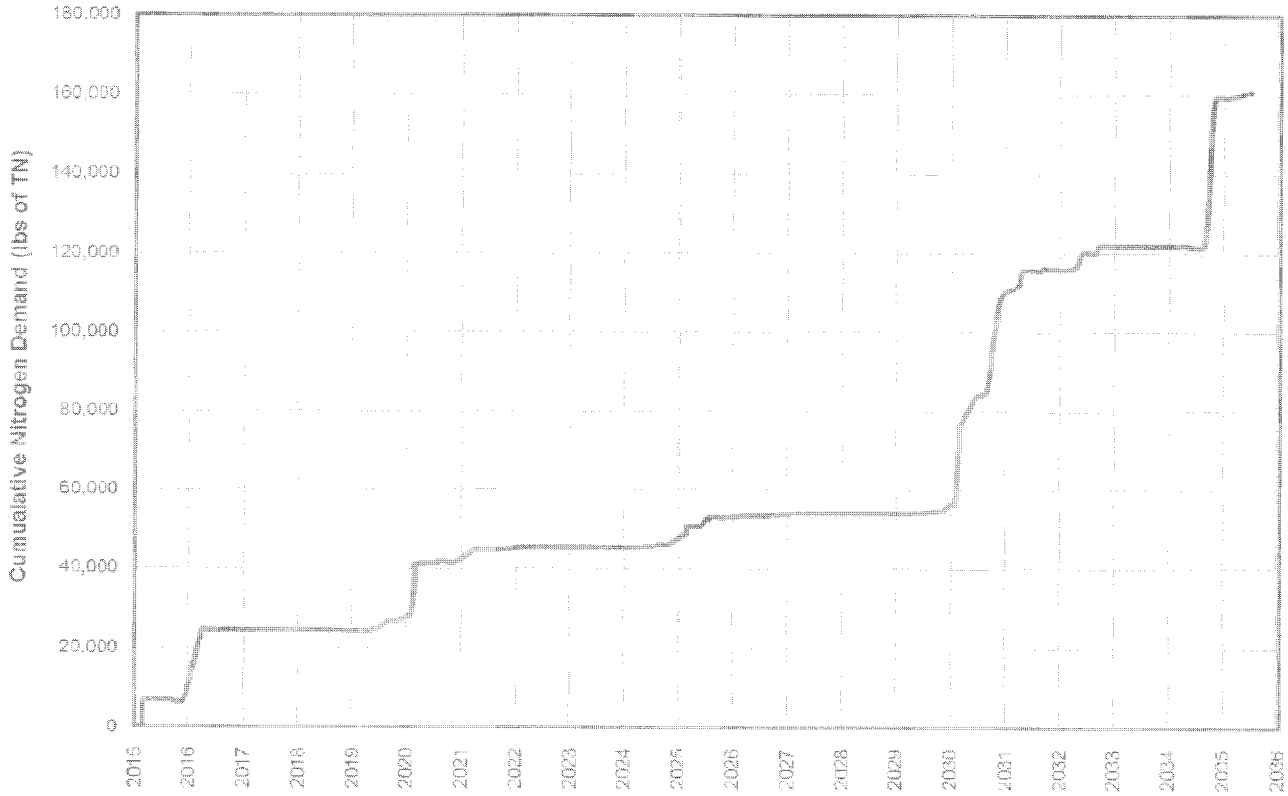
Point Source Nitrogen

Incremental Demand

FIGURE NUMBER 3-3



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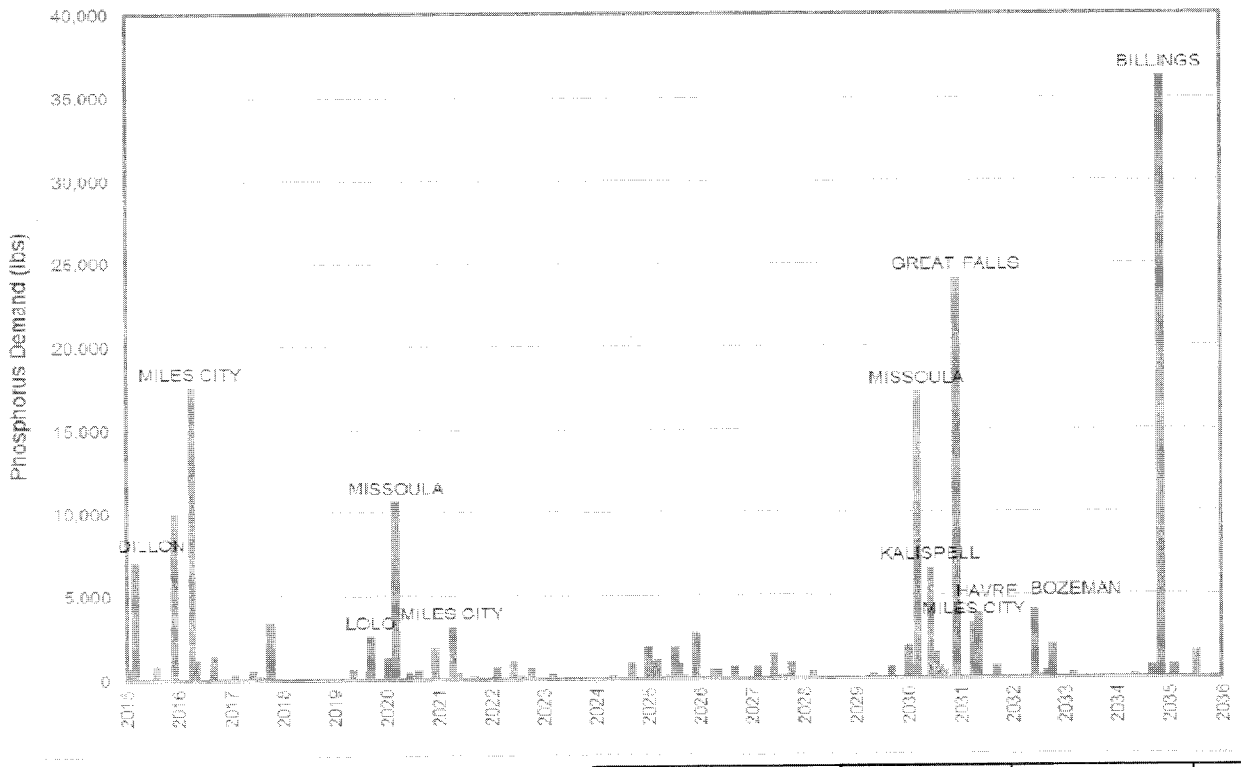
Point Source Nitrogen Demand

Cumulative Demand

3-4



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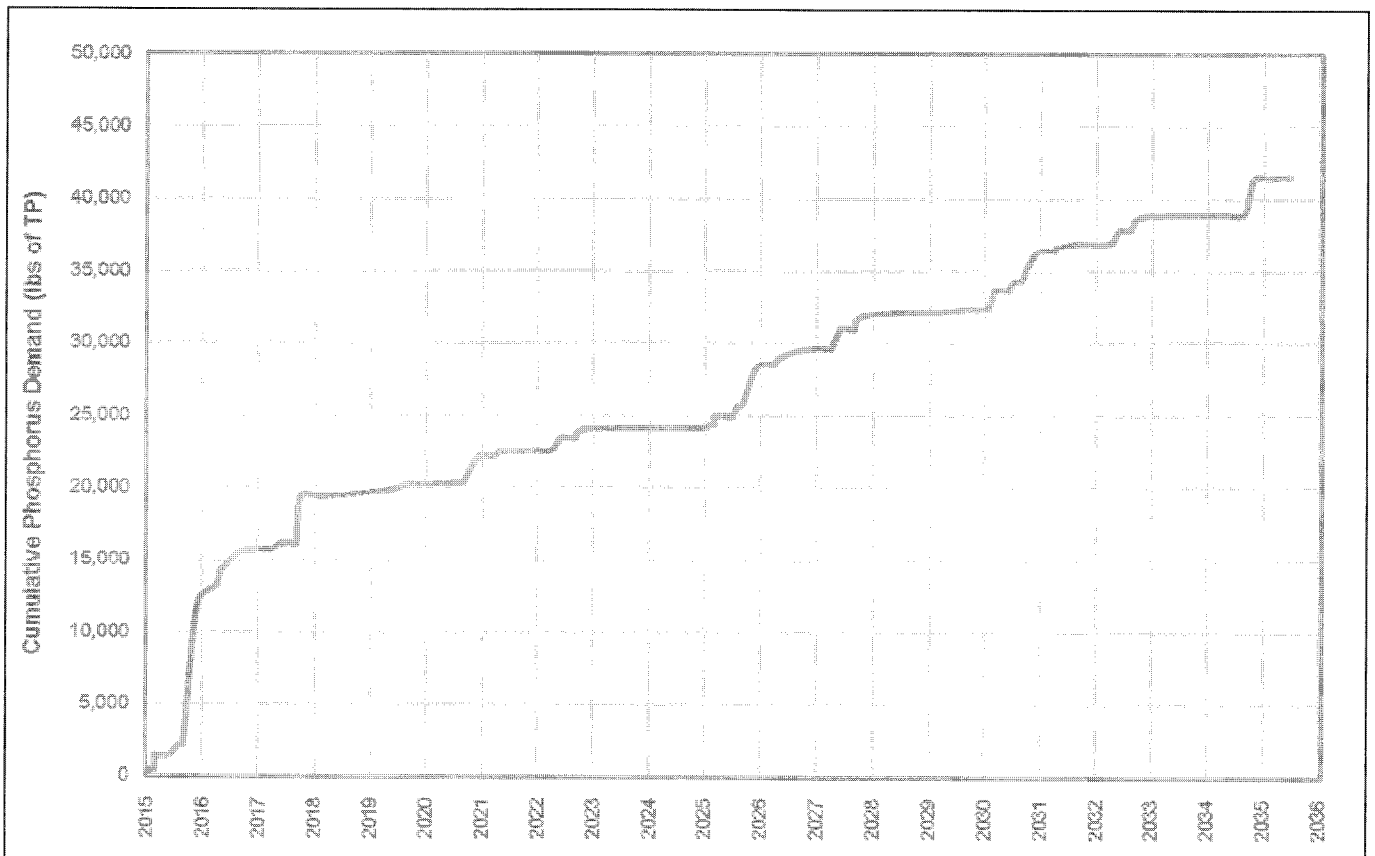
Point Source Phosphorus Demand

Incremental Demand

FIGURE NUMBER 3-5



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Point Source Phosphorus Demand

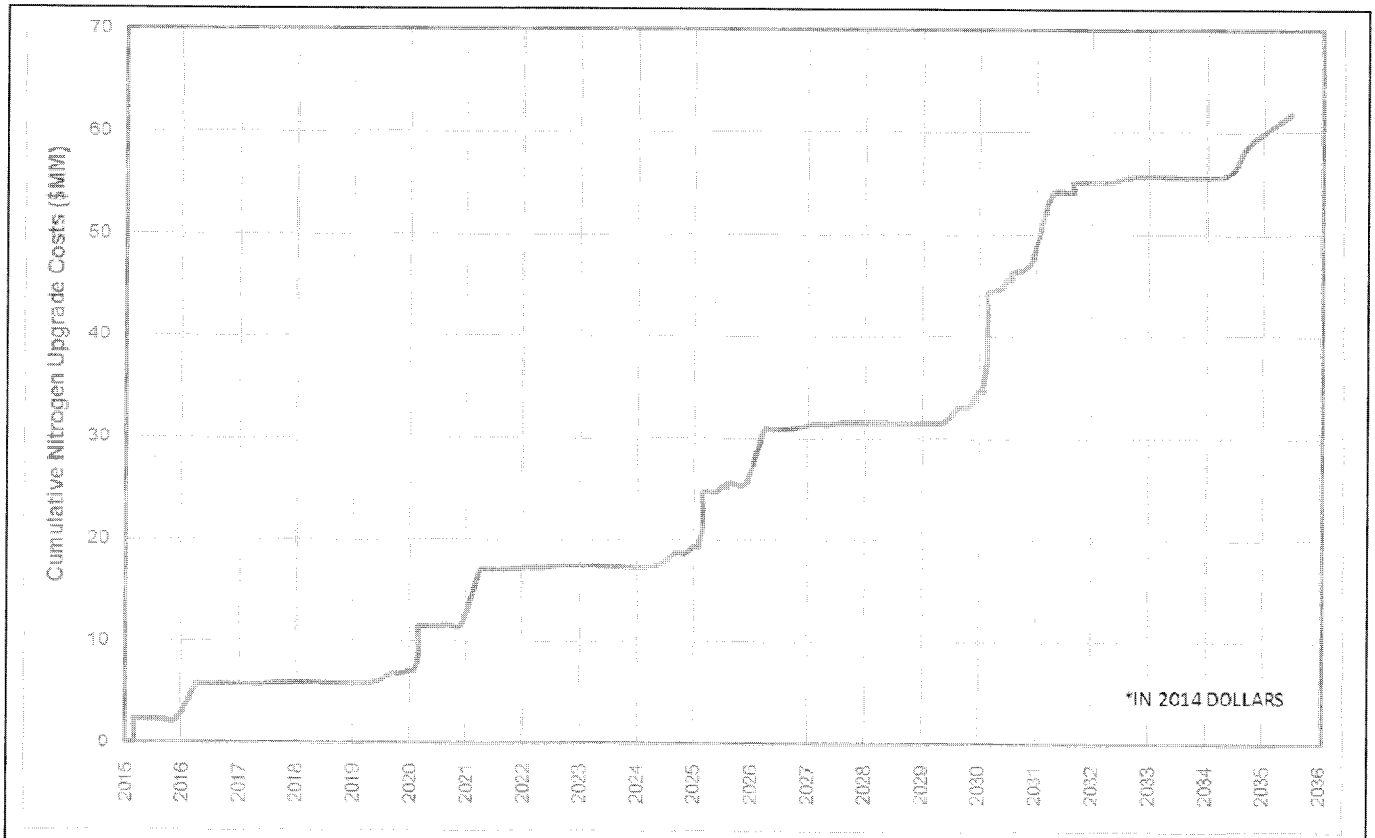
Cumulative Demand

3-6

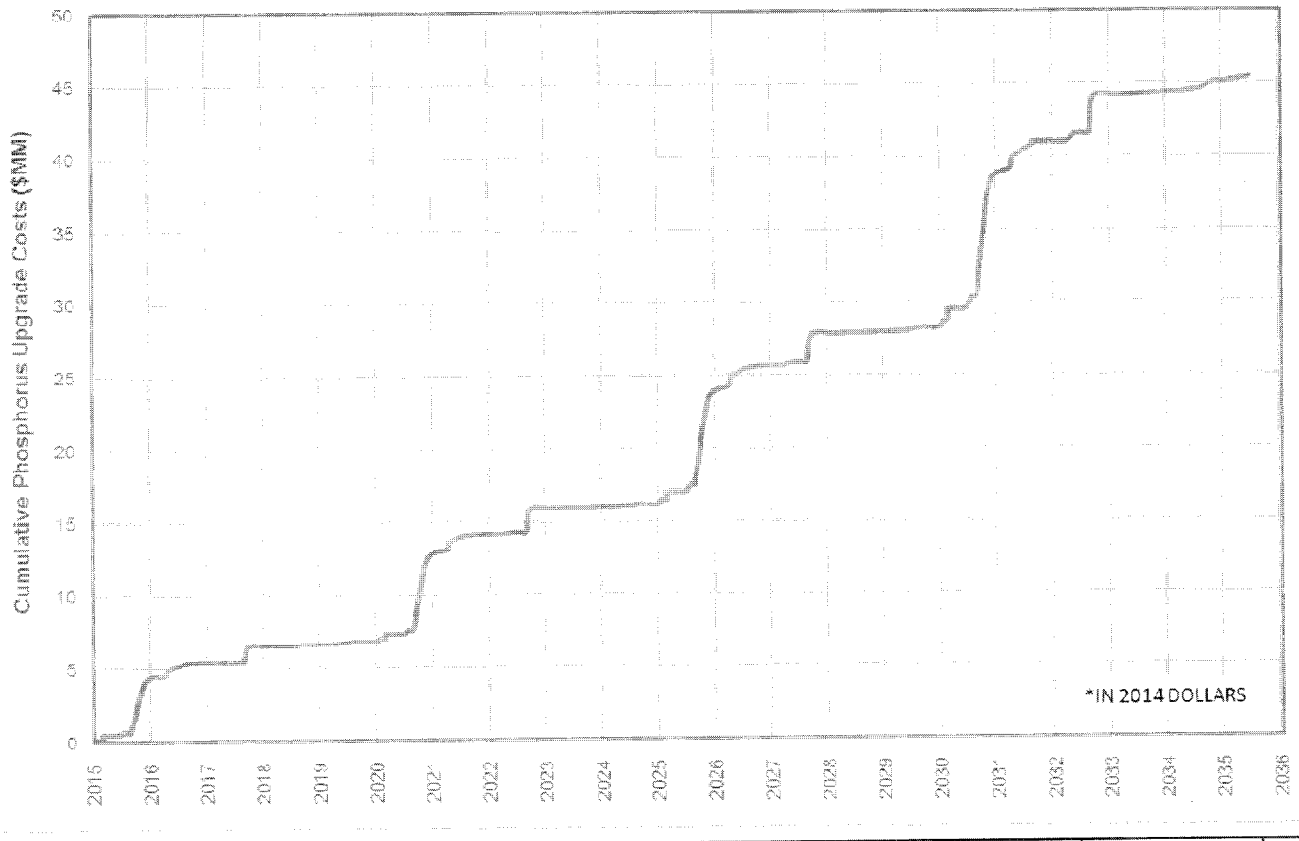
Table 3-2: Upgrade Cost Summary

Description	Population	Final (4th) Permit Date	Average Flow (mgd)	TN total Demand (lb/season)	TN Uprade Cost (NPV)*	Annualized TN Upgrade Cost ($/yr)	Seasonal TN Upgrade Cost ($/lb)	Seasonal TN Upgrade Cost ($/person)	TP total Demand (lb/season)	TP Uprade Cost (NPV)*	Annualized TP Upgrade Cost ($/yr)	Seasonal TP Upgrade Cost ($/lb)	Seasonal TP Upgrade Cost ($/person)
STILLWATER E BOULDER		1/1/2030	0.23	0	$0	$0	N/A	N/A	788	$333,450	$29,072	$37	N/A
WESTERN SUGAR COOP		1/1/2030	0.73	3,140	$1,473,484	$101,809	$32	N/A	0	$0	$0	N/A	N/A
ELKHORN HEALTH CARE		2/1/2030	0.004	42	$207,066	$14,307	$338	N/A	6	$2,562	$223	$37	N/A
MISSOULA	66,788	3/1/2030	7.06	18,558	$3,418,153	$236,173	$13	$3.5	956	$144,574	$12,605	$13	$0.2
EAST HELENA	1,984	3/1/2030	0.37	2,004	$1,276,862	$88,223	$44	$44.5	501	$212,073	$18,489	$37	$9.3
DILLON	4,134	3/1/2030	0.36	6,901	$4,445,948	$307,187	$45	$74.3	1,179	$499,029	$43,508	$37	$10.5
KALISPELL	19,927	6/1/2030	2.70	4,516	$416,941	$28,808	$6	$1.4	0	$0	$0	N/A	$0.0
LAUREL*	6,718	8/1/2030	0.94	0	$0	$0	N/A	$0.0	1,647	$697,245	$60,789	$37	$9.0
BIGFORK	4,270	8/1/2030	0.22	981	$790,032	$54,586	$56	$12.8	0	$0	$0	N/A	$0.0
MANHATTAN	1,520	9/1/2030	0.13	263	$70,486	$4,870	$19	$3.2	32	$2,432	$212	$7	$0.1
GREAT FALLS*	58,505	12/1/2030	10.00	15,931	$815,896	$56,373	$4	$1.0	15,931	$7,924,084	$690,858	$43	$11.8
MILES CITY	8,410	4/1/2031	1.13	15,932	$6,141,726	$424,355	$27	$50.5	1,980	$838,177	$73,076	$37	$8.7
HAVRE*	9,310	5/1/2031	1.55	2,469	$825,727	$59,522	$24	$6.4	1,975	$836,154	$74,875	$38	$8.0
HAMILTON	4,348	9/1/2031	0.64	0	$0	$0	N/A	$0.0	1,943	$822,533	$73,655	$38	$16.9
CONRAD	2,570	9/1/2031	0.23	1,126	$892,031	$62,760	$56	$24.4	436	$184,493	$16,521	$38	$6.4
BUTTE*	33,525	4/1/2032	3.78	0	$0	$0	N/A	$0.0	0	$0	$0	N/A	$0.0
BOZEMAN	37,280	6/1/2032	5.55	2,651	$176,989	$14,879	$6	$0.4	3,534	$534,449	$50,130	$14	$1.3
MT BEHAVIORAL HEALTH		8/1/2032	0.00	67	$326,946	$22,657	$339	N/A	16	$6,608	$592	$38	N/A
LEWISTOWN	5,901	9/1/2032	1.88	0	$0	$0	N/A	$0.0	300	$23,091	$2,313	$8	$0.4
HELENA	28,190	10/1/2032	3.06	1,219	$106,346	$8,567	$7	$0.3	5,119	$2,546,008	$227,091	$44	$8.1
DEER LODGE*	3,111	3/1/2033	1.27	0	$0	$0	N/A	$0.0	708	$54,596	$5,468	$8	$1.8
ROCKER	100	6/1/2033	0.02	177	$401,586	$27,924	$158	$279.2	175	$74,175	$6,642	$38	$66.4
YELLOWSTONE ENERGY		5/1/2034	0.12	0	$0	$0	N/A	N/A	593	$250,846	$22,463	$38	N/A
LOLO	3,892	9/1/2034	0.21	2,884	$2,356,036	$165,671	$57	$42.6	611	$258,533	$23,151	$38	$5.9
BILLINGS*	104,170	11/1/2034	15.10	24,056	$1,023,464	$94,771	$4	$0.9	2,406	$363,784	$34,122	$14	$0.3
ABSAROKEE	1,150	2/1/2035	0.26	1,387	$1,042,714	$73,432	$53	$63.9	204	$86,313	$7,729	$38	$6.7
RED LODGE	2,125	7/1/2035	0.59	3,055	$1,577,634	$112,060	$37	$52.7	658	$278,493	$24,938	$38	$11.7
TOTALS	**407,928**		**58.1**	**107,359**	**27,786,068**	**$2,027,204**	**$19**	**$5.0**	**41,698**	**16,973,703**	**$1,521,543**	**$36**	**$3.7**

*20 Year NPV at 3.3% inflation. Cost is Ultimate Cost to Meet Limits in the Fourth Permit Cycle (Total 20-year cost to meet variance limits)



MORRISON MAIERLE, INC.	KIESER & ASSOCIATES	Point Source Nitrogen Cost	PROJECT NO
		Cumulative Upgrade Cost	FIGURE NUMBER 3-7



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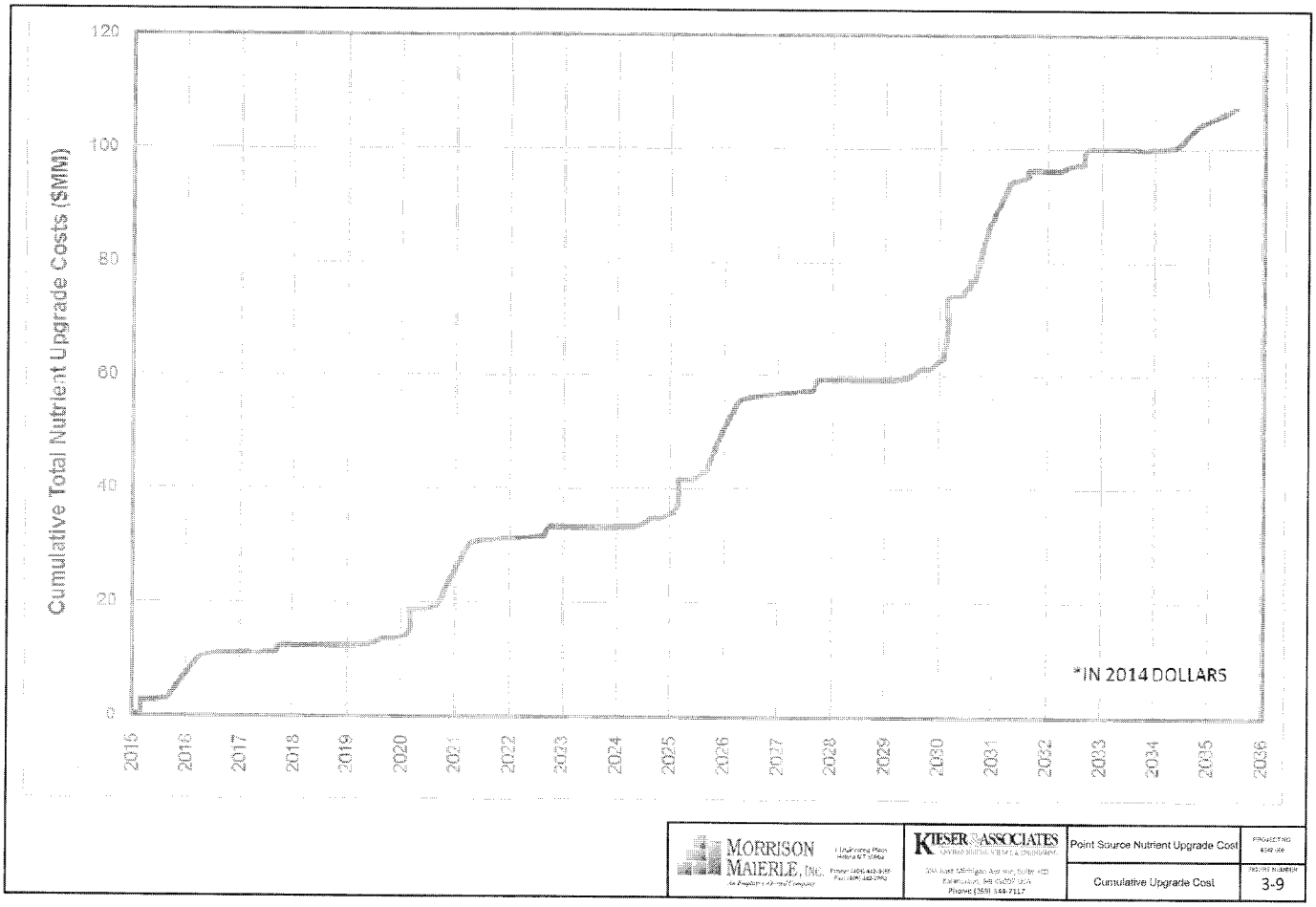
Point Source Phosphorus Cost

Cumulative Upgrade Cost

3-8



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Point Source Nutrient Upgrade Cost

Cumulative Upgrade Cost

3-9

4.0 ASSESSMENT OF CREDIT SUPPLY

4.1 Overview

This section of the Business Case presents the methods and results of the credit supply analysis. Annual nonpoint source nutrient loads for TN and TP were first estimated for all the HUC-12 watersheds in the state based on land cover. Designated Wilderness Areas were removed from consideration as directed by MDEQ. An empirical method was used to calculate pollutant loads using event mean concentrations (EMCs), monthly average precipitation values, and imperviousness percent coverage values per land use category. This method provides a very coarse estimate of nutrient loads delivered by surface runoff for each land use category in a watershed. These calculated loads do not consider fate and transport in overland flow or in channel processes and are therefore characterized as coarse estimates of TN and TP delivered to downstream areas by each tributary. Preliminary loading calculations are used here to: 1) estimate the nonpoint load from various land uses at the HUC-12 level; and, 2) assess the potential for nonpoint source credit generation of nutrients from agricultural and forest lands. Nonpoint source loads are manipulated to derive credits for direct comparison to WWTP demand.

4.2 Supply Assessment Modeling Methodology

The analysis used EMC values from available literature[3] (Table 4-1). Land use/land cover data were obtained from the 2011 National Land Use Dataset which are illustrated in Figure 4-1 (including the 27 PSs with the potential to trade).[4] Default imperviousness values (Table 4-2) were derived from the USGS 2011 National Land Use Dataset and the Rouge River National Wet Weather Demonstration Project[5]. Average monthly precipitation values (1981-2010) were

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[3] Average EMCs for this application were derived from various sources including: Baldys, S., Raines, T.H., Mansfield, B.L., and Sandlin, J.T. (1998). "Urban stormwater quality, event-mean concentrations, and estimates of stormwater pollutant loads, Dallas-Fort Worth area, Texas, 1992-1993," U.S. Geological Survey, Water-Resources Investigation Report 98-4158. Brezonik, P.L., and Stadelmann, T.H. (2001). "Analysis and predictive models of stormwater runoff volumes, loads, and pollutant concentrations from watersheds in the Twin Cities Metropolitan Area, MN, USA," Water Research 36, 1743-1757. Cave et al. (1994). Rouge River National Wet Weather Demonstration Project Technical Report: Nonpoint Source Data Assessment and Field Investigation RPO-NPS-TR03.00. Wayne County, MI. Guerard, P., and Weiss, W.B. (1995). "Water quality of storm runoff and comparison of procedures for estimating storm-runoff loads, volume, event-mean concentrations, and the mean load for a storm for selected properties and constituents for Colorado Springs, Southeastern Colorado, 1992," U.S. Geological Survey, Water-Resources Investigations Report 94-4194, Denver, CO. Harper, H.H. (1998). "Stormwater chemistry and water quality." Available at: http://infohouse.p2ric.org/ref/41/40258.pdf. Line, D.E., White, N.M., Osmond, D.L., Jenning, G.D., and Mojonnier, C.B. (2002). "Pollutant export from various land uses in the Upper Neuse River Basin," Water Environment Research 74(1), 100-108. Los Angeles County Department of Puhlic Works [LACDPW] (1999). Stormwater Monitoring Report: 1998-1999. Available at: http://ladpw.org/wmd/NPDES/9899TC.cfm. Omernik, J.M. (1997). "Nonopoint sources-stream nutrient level relationships: A nationwide study," U.S. EPA Report No. EPA-600/3-77-105, U.S. Environmental Protection Agency, Corvallis, OR. Pitt, R. (2011). The National Stormwater Quality Database, Version 3.1. Schueler, T., Hirschman, D., Novotney, M., Zielinski,J. (2007). "Manual 3: Urban Stormwater Retrofit Practices Manual:Urban Subwatershed Restoration Manual Series" Center for Watershed Protection, Ellicott City, MD. Smullen, J.T., Shallcross, A.L., and Cave, K.A. (1999). "Updating the U.S. nationwide urban runoff quality database," Water Science Technology 39(12), 9-16.

[4] USGS. 2014. National Land Cover Database 2011. Product Legend. Available from http://www.mrlc.gov/nlcd11_leg.php.

[5] Cave, K., Quasebarth, T., and E. Harold. 1994. Technical Memorandum: Selection of Stormwater Pollutant Loading Factors. Rouge River National Wet Weather Demonstration Project RPO-MOD-TM 34.00. Available from: http://rougeriver.com/proddata/modeling.html#MOD-TM34.00.

obtained from the national PRISM coverage with an 800m × 800m resolution.[6] One average monthly precipitation value for each HUC-12 watershed was calculated based on the number of PRISM coverage cells and the values of these cells. For this study, monthly precipitation values for July, August, and September were obtained. Monthly rainfall is illustrated in Figures 4-2a-c. Annual PRISM precipitation for the state is shown in Figure 4-3 as a comparison to monthly figures further illustrating the arid nature of most land covers in the state.

TABLE 4-1
EVENT MEAN CONCENTRATION[1]
VALUES USED IN LOAD CALCULATIONS

Land use	Event Mean Concentration (mg/L)	
	TN	TP
Open water	1.32	0.1
Developed, open space	2.76	0.39
Developed, Low intensity	3.37	0.42
Developed, Medium intensity	3.15	0.43
Developed, High intensity	2.21	0.31
Barren Land	1.74	0.11
Deciduous Forest	1.74	0.11
Evergreen Forest	1.74	0.11
Mixed Forest	2.32	0.24
Shrub	3.16	0.23
Grassland	3.16	0.23
Pasture/Hay	4.41	1
Cultivated crops	3.57	0.36
Wetlands	1.49	0.135

[6] PRISM (PRISM (Parameter-elevation Relationships on Independent Slopes Model) 30-Year Normals, http://prism.nacse.org/normals/

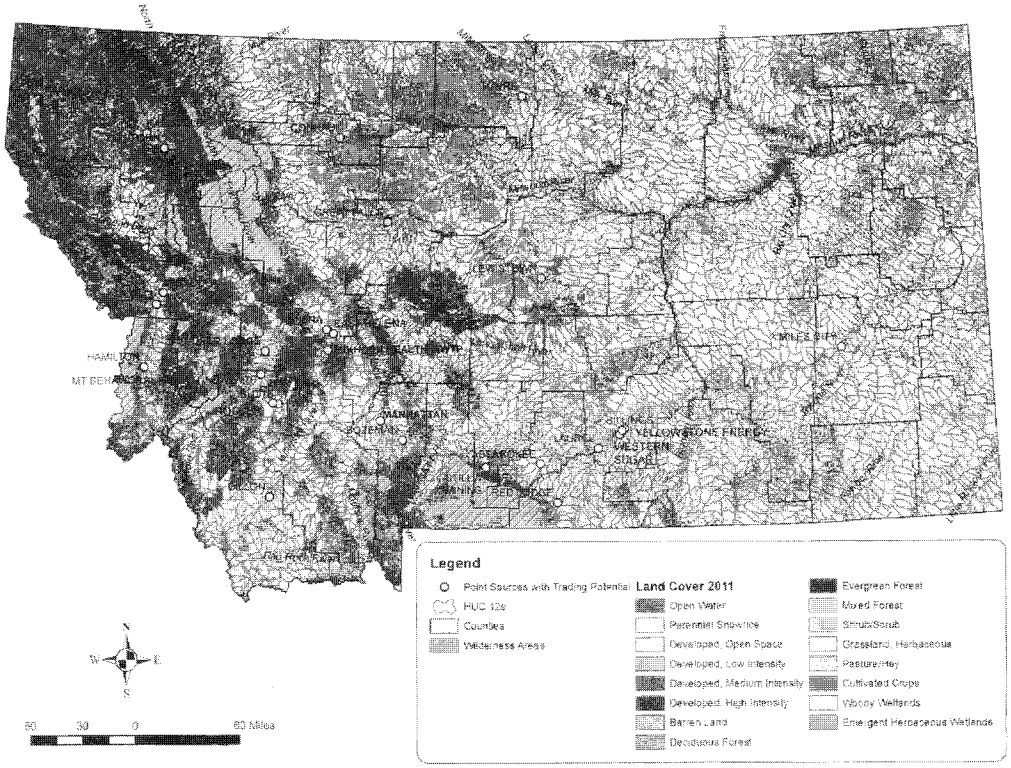
TABLE 4-2
IMPERVIOUSNESS COEFFICIENTS
(USGS, 2014[2]; CAVE ET AL., 1994[3])

Land Use	IMP_L	C_I	C_P
Open water	1	0.95	0.2
Developed, open space	0.05	0.95	0.2
Developed, Low intensity	0.30	0.95	0.2
Developed, Medium intensity	0.65	0.95	0.2
Developed, High intensity	0.90	0.95	0.2
Barren Land	0.05	0.95	0.2
Deciduous Forest	0.05	0.95	0.2
Evergreen Forest	0.05	0.95	0.2
Mixed Forest	0.05	0.95	0.2
Shrub	0.05	0.95	0.2
Grassland	0.05	0.95	0.2
Pasture/Hay	0.05	0.95	0.2
Cultivated crops	0.05	0.95	0.2
Wetlands	1	0.95	0.2

IMP_L = fractional imperviousness off land use

C_I = impervious runoff coefficient

C_P = pervious area runoff coefficient



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Land Cover Used for NPS Loading Analysis for TP and TN by HUC-12s

PROJECT NO.
4942.006

FIGURE NUMBER
4-1

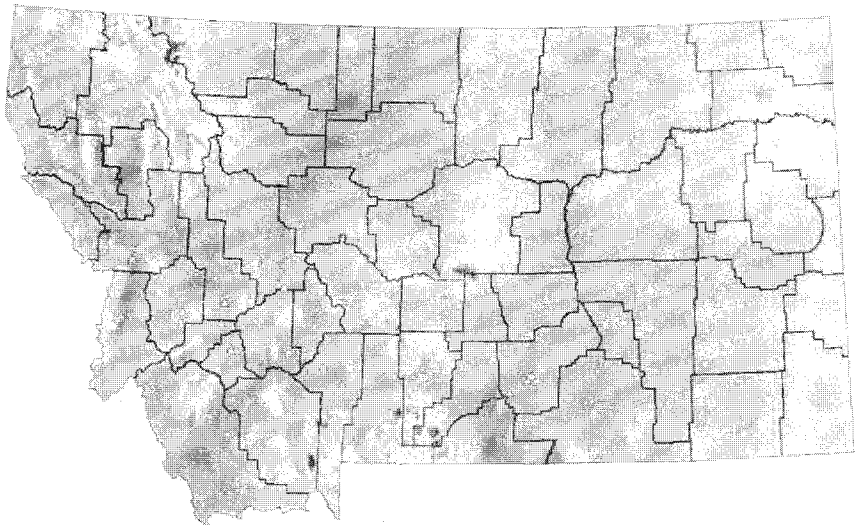


Fig. 4-2a. July

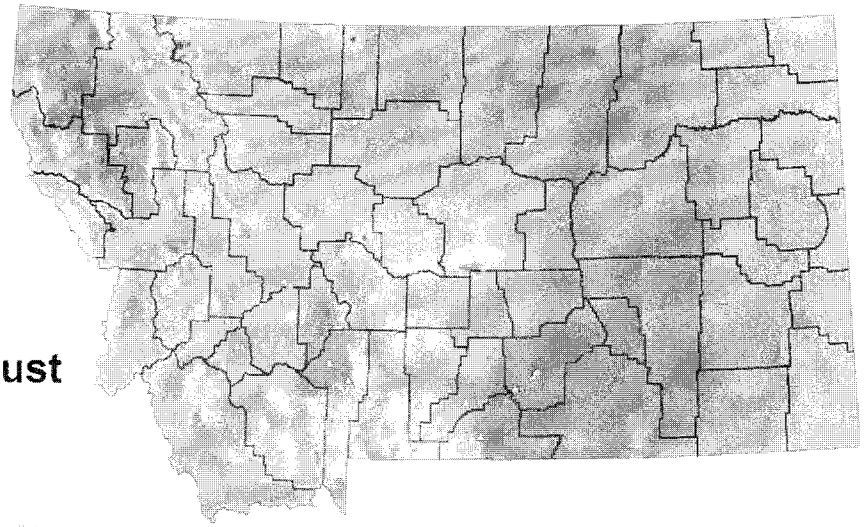


Fig. 4-2b. August

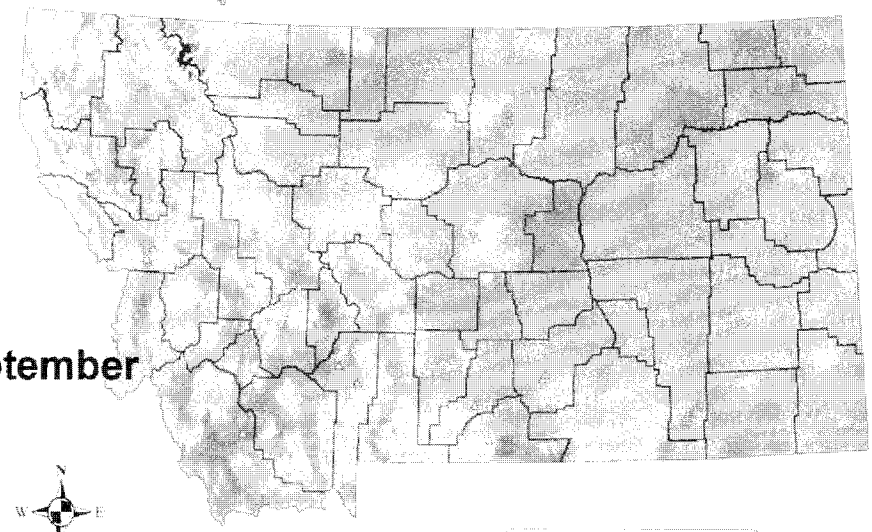
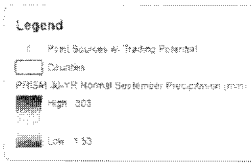


Fig. 4-2c. September



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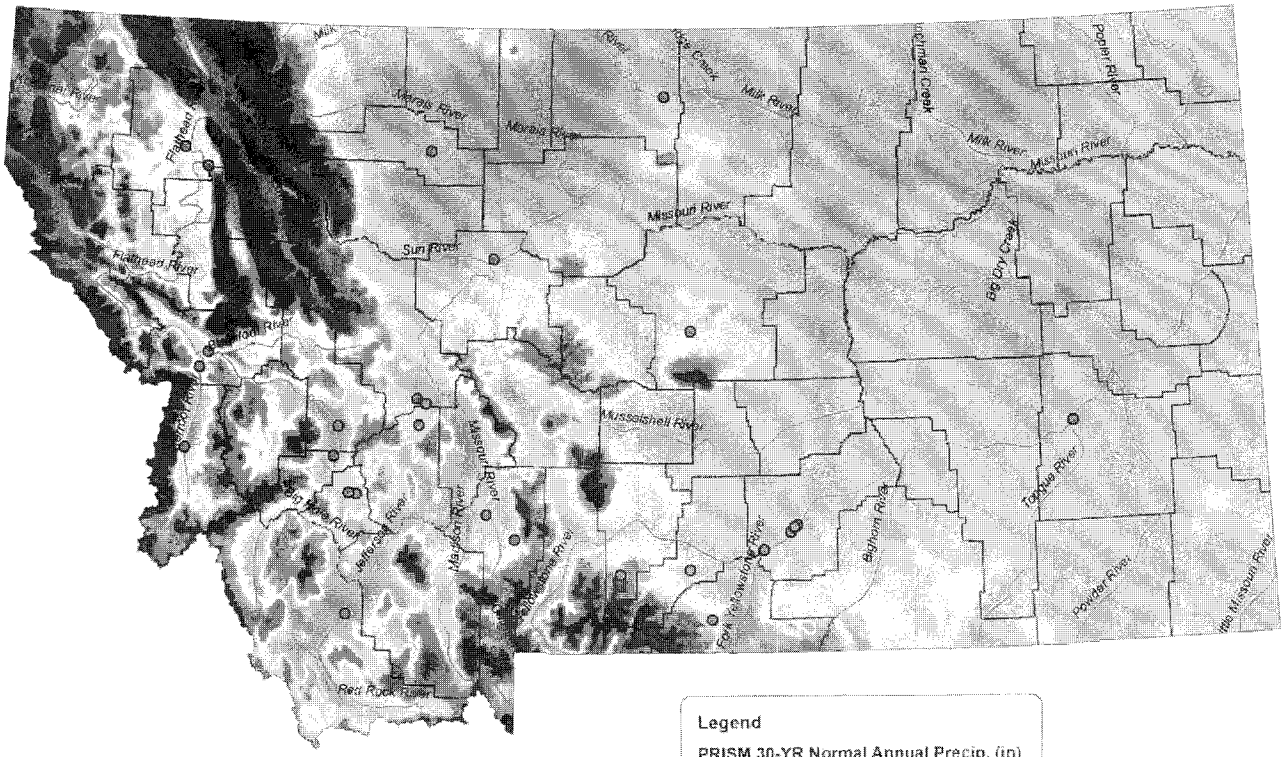
30-Yr Average Monthly Precipitation (inches) (PRISM data)

PROJECT NO.
4842.006

FIGURE NUMBER
4-2.a-c



Legend

PRISM 30-YR Normal Annual Precip. (in)

High : 111.9

Low : 6.3

Point Sources with Trading Potential

Counties

N
W E
S

60 30 0 60 Miles

MORRISON MAIERLE, INC. An Employee-Owned Company 1 Engineering Place Helena MT 59602 Phone: (406) 442-3050 Fax: (406) 442-7862	KIESER & ASSOCIATES ENVIRONMENTAL SCIENCE & ENGINEERING 538 East Michigan Avenue, Suite 300 Kalamazoo, MI 49007 USA Phone: (269) 344-7117	30-Yr Average Annual Precipitation (inches) (PRISM data)	PROJECT NO. 4842.005
			FIGURE NUMBER 4-3

4.3 Pollutant Load Analysis

Loads from surface runoff were estimated by coupling estimated runoff volumes with EMC data described in the previous section. Runoff is calculated as follows using Equation 1.

$$R_L = [IMP_L \times C_I + (1\text{-}IMP_L) \times C_P)] \times A_L \times I$$

$$= [C_P + (C_I - C_P) \times IMP_L] \times A_L \times I \qquad \textit{(Eq. 1)}$$

Where:

R_L	=	Total average annual surface runoff from land use L (acre-inch/month)
C_P	=	Pervious area runoff coefficient (0.20)
C_I	=	Impervious area runoff coefficient (0.95)
IMP_L	=	Fractional imperviousness of land use L
A_L	=	Area of drainage unit (acre)
I	=	Long term average monthly precipitation (inch/month)

The calculated runoff from Equation 1 is used to find the monthly pollutant loads using Equation 2.

$$M_L = EMC_L \times R_L \times K \qquad \textit{(Eq. 2)}$$

Where:

M_L	=	Loading factor from land use L (pound/month)
EMC_L	=	Event mean concentration of runoff from land use L (mg/L)
R_L	=	Total average surface runoff from land use L computed in Eq. 1 (acre-inch/month)
K	=	Unit conversion factor of 0.2266

Equation 1 was used to calculate the monthly runoff (R_L) for each land use ($_L$) as the product of the annual rainfall, the area of land use $_L$, the percent imperviousness of land use $_L$, and the default coefficients C_P and C_I. The surface runoff was then multiplied by the respective EMCs and a unit conversion factor to compute the loading factor (M_L), from Equation 2. Monthly results from the three month period of July through September were aggregated to obtain loadings of TP and TN for each of the 4,180 HUC-12 watersheds in the state excluding the designated Wilderness areas.

4.4 Nonpoint Source Nutrient Credit Derivation

Two simple scenarios were applied to preliminarily estimate potential water quality trading credit volume from agricultural and forestry management BMP implementation. It was assumed that BMPs (or a suite of BMPs) with a 50% load reduction efficiency for both TP and TN were applied to 10% and 25% of the agricultural land use (Cultivated Crops, Pasture, and Grassland) areas in each HUC-12 watershed. (Grassland was assumed here to reflect rangeland.) The 10% and 25% values can be regarded as the potential rates of participation by landowners in a trading program. Due to the uncertainties associated with forest BMPs and landowner participation potential, 10% of the evergreen forest land was assumed as the potential credit generation area

with an 85% load reduction efficiency for TP and 70% for TN, respectively, from this land cover[7]. These reflect BMPs for forest roads.

In both Ag and forestry NPS crediting applications, we do not assume where BMPs would be applied. Rather, the assumption is that BMPs are applied where they do not already exist. This portends the need for on-the-ground technical assistance in finding sites for actual trades. BMP assumptions are discussed further is Section 5 under credit costs while Section 6 discusses the trading framework to accommodate technical needs for trading.

Water quality trading in Montana usually typically requires that credits be generated upstream of the buyer; downstream credit generation may be considered on a case-by-case basis in the trading policy. Credits from NPS runoff reductions above PSs were only considered in this application. This was considered sufficient for to address nutrient losses downstream due to fate and transport processes in delivery of credits to the buyer location. Factors to estimate loading reductions attributed to fate and transport are often included as a part of the trading ratios. These ratios can also account for uncertainty, net environmental benefits to the river and pollutant equivalency. For this analysis, a commonly used trading ratio of 2:1 was used to simplify assumptions that otherwise would require specific knowledge of NPS crediting projects and locations. This trading ratio means that for every two pounds of load reduction achieved by a NPS, only one pound can be used as credit for point sources in trading.

4.5 Nonpoint Source Credit Supply

Land cover loading data (provided electronically and separate from this report) and modified as noted above (participation rates, BMPs efficiencies and 2:1 trade ratio), yielded seasonal (July – September) credit values as shown in Table 4-3 for TN and TP. The table includes the number of HUC-12s upstream of these PSs that would be available to provide credits. In watersheds with multiple PSs, these are presented in an upstream to downstream order.

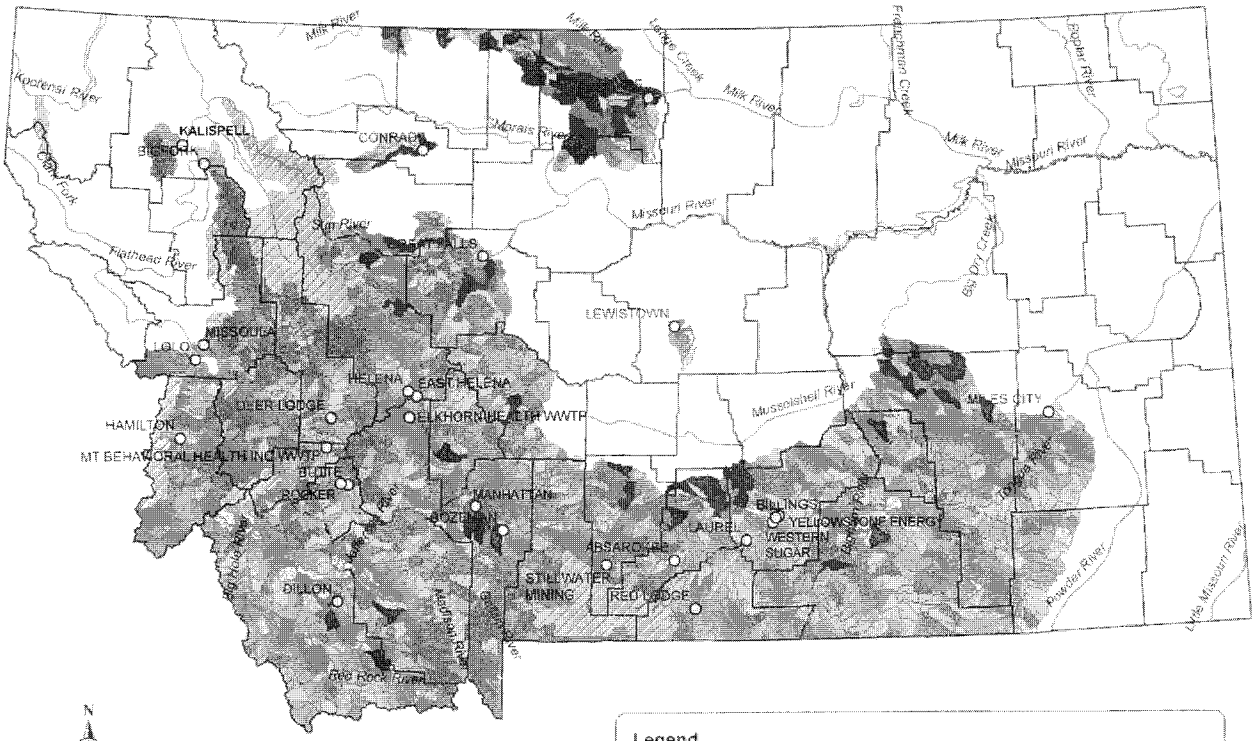
[7] National Level Assessment of Water Quality Impairments Related to Forest Roads and Their Prevention by Best Management Practices - Final Report, Prepared by: Great Lakes Environmental Center for: U.S. Environmental Protection Agency Office of Water, Contract No. EP-C-05-066, December 2008.
Task Order 002

TABLE 4-3
TN AND TP CREDITS UPSTREAM OF POINT SOURCES
(IN WATERSHEDS WITH MULTIPLE SOURCES; UPSTREAM TO DOWNSTREAM)

			Total Nitrogen			Total Phosphorus		
NPDES #	Facility Name	Number of All Upstream HUC-12s	10%Total Upstream Ag Credit Supply (lbs/season)	25% Total Upstream Ag Credit Supply (lbs/season)	10% Total Upstream Forestry Credit Supply (lbs/season)	10%Total Upstream Ag Credit Supply (lbs/season)	25% Total Upstream Ag Credit Supply (lbs/season)	10% Total Upstream Forestry Credit Supply (lbs/season)
Yellowstone River								
MT0026808	Stillwater Mining Company - East Boulder	1	63	158	524	5	12	40
MT0021750	Absarokee	8	942	2,356	531	100	251	41
MT0020478	Red Lodge	5	160	400	532	12	30	41
MT0020311	Laurel	213	31,671	79,176	14,205	3,009	7,523	1,090
MT0000281	Western Sugar Cooperative	224	33,786	84,464	14,315	3,201	8,004	1,099
MT0022586	Billings	226	34,077	85,193	14,337	3,224	8,061	1,101
MT0030180	Yellowstone Energy Limited Partnership Facility	227	34,258	85,645	14,378	3,242	8,106	1,104
MT0020001	Miles City	692	133,220	333,049	27,503	11,091	27,729	2,111
Missouri River								
MT0021458	Dillon	102	17,932	44,831	5,228	1,533	3,832	401
MT0022608	Bozeman	8	1,072	2,681	1,571	138	345	121
MT0021857	Manhattan	51	6,971	17,427	7,939	922	2,305	609
MT0023566	Elkhorn Health Care WWTP	4	178	445	665	14	35	51
MT0022560	East Helena	9	616	1,539	1,691	51	127	130
MT0022641	Helena	10	643	1,608	1,826	53	132	140
MT0021920	Great Falls	692	118,479	296,197	68,313	10,997	27,493	5,244
Clark Fork								
MT0027430	Rocker	4	495	1,236	516	39	98	40
MT0022012	Butte	4	495	1,236	516	39	98	40
MT0021431	MT Behavioral Health Inc WWTP	23	2,507	6,267	3,254	243	607	250
MT0022616	Deer Lodge	32	4,161	10,401	4,759	448	1,120	365
MT0022594	Missoula	221	14,832	37,079	32,716	1,541	3,853	2,511
Bitterroot River								
MT0020028	Hamilton	52	2,806	7,015	8,709	275	687	669
MT0020168	Lolo	84	4,963	12,408	12,920	580	1,450	992
Milk River								
MT0022535	Havre	80	30,886	77,214	439	2,883	7,207	34
Big Spring Creek								
MT0020044	Lewiston	5	1,000	2,500	593	114	285	46
Dry Fork Marias River								
MT0020079	Conrad	10	3,286	8,216	14	299	747	1
Flathead Lake								
MT0020397	Bigfork	23	731	1,827	5,693	112	280	437
Ashley Creek								
MT0021938	Kalispell	7	331	828	1,542	42	105	118

To graphically illustrate these estimates, Figures 4-4 through 4-7 present supply in relation to each PS in corresponding to TN and TP for Ag (at 10% participation) and TN and TP for forestry (also assuming 10% of the evergreen forest roads receive management), respectively. These figures illustrate fairly clear opportunities for credit generation between Ag land covers and forestry reflecting supplies denoted in Table 4-3. One of the more obvious examples of this credit distribution is in the Milk River Basin above the City of Havre in north central Montana.

These calculated credits and their distribution are used for assessing potential volume of NPS credits to meet PS demand in Section 5. Such estimates are then be used to determine whether these would be cost-effective for point source compliance in comparison to wastewater treatment plant upgrade costs to meet compliance with variance limits for TN and TP. These cost comparisons are also presented in Section 5.



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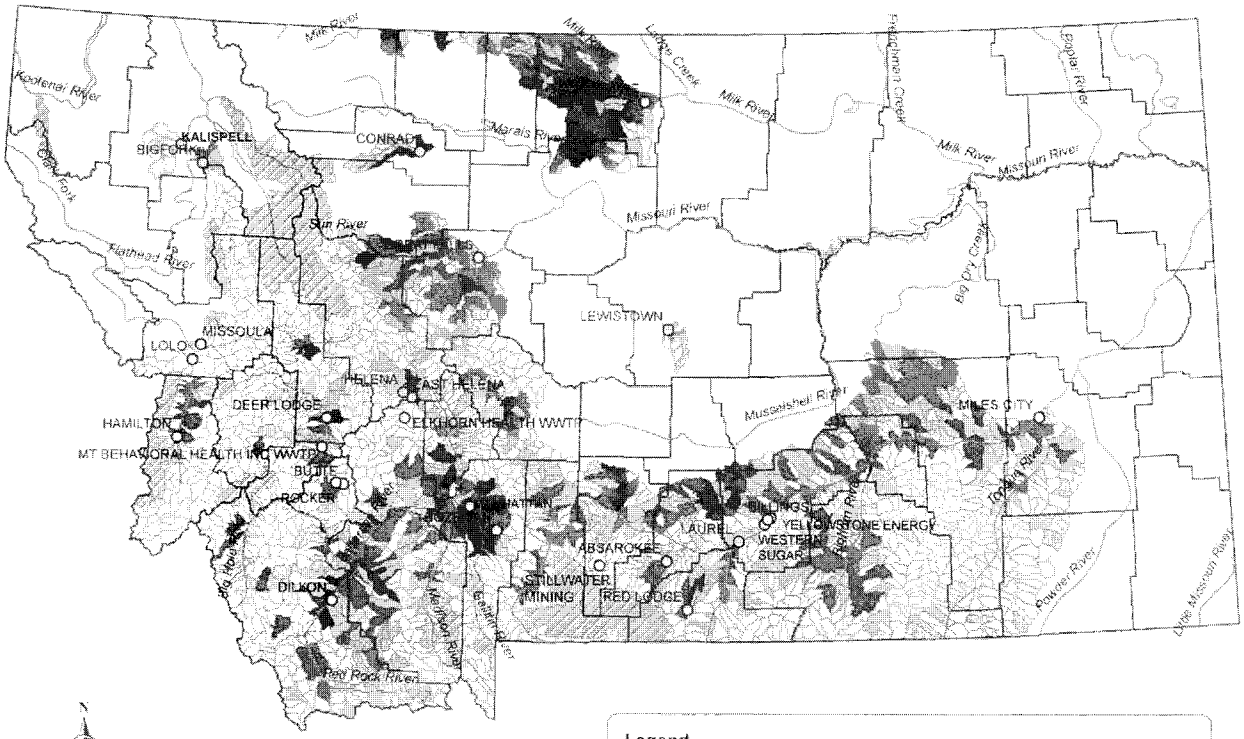
July-September TN Ag Credits With 10% Farmer Participation

PROJECT NO. 4942.006

FIGURE NUMBER 4-4



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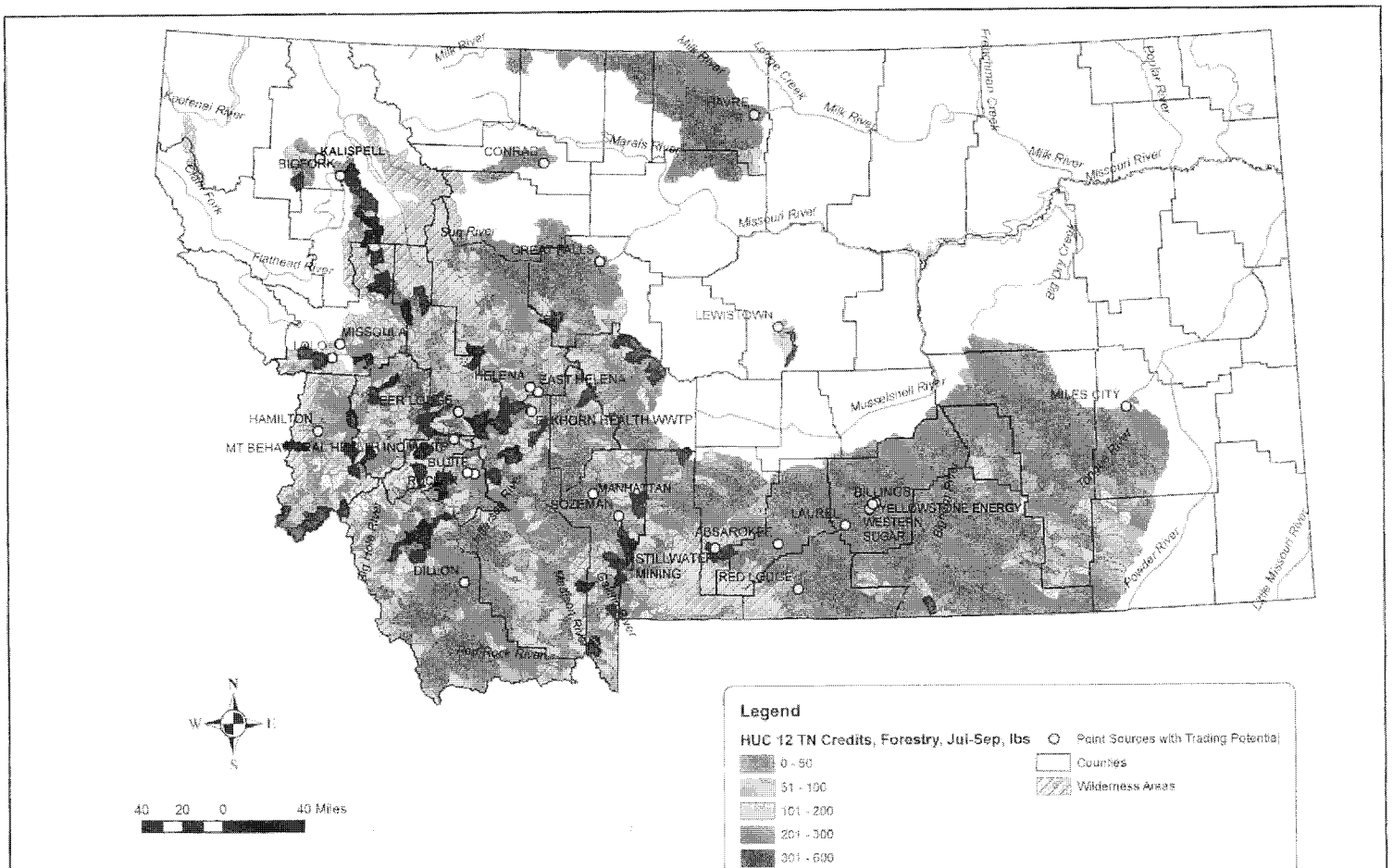
July-September TP Ag Credits
With 10% Farmer Participation

PROJECT NO.
4842.038

FIGURE NUMBER
4-5



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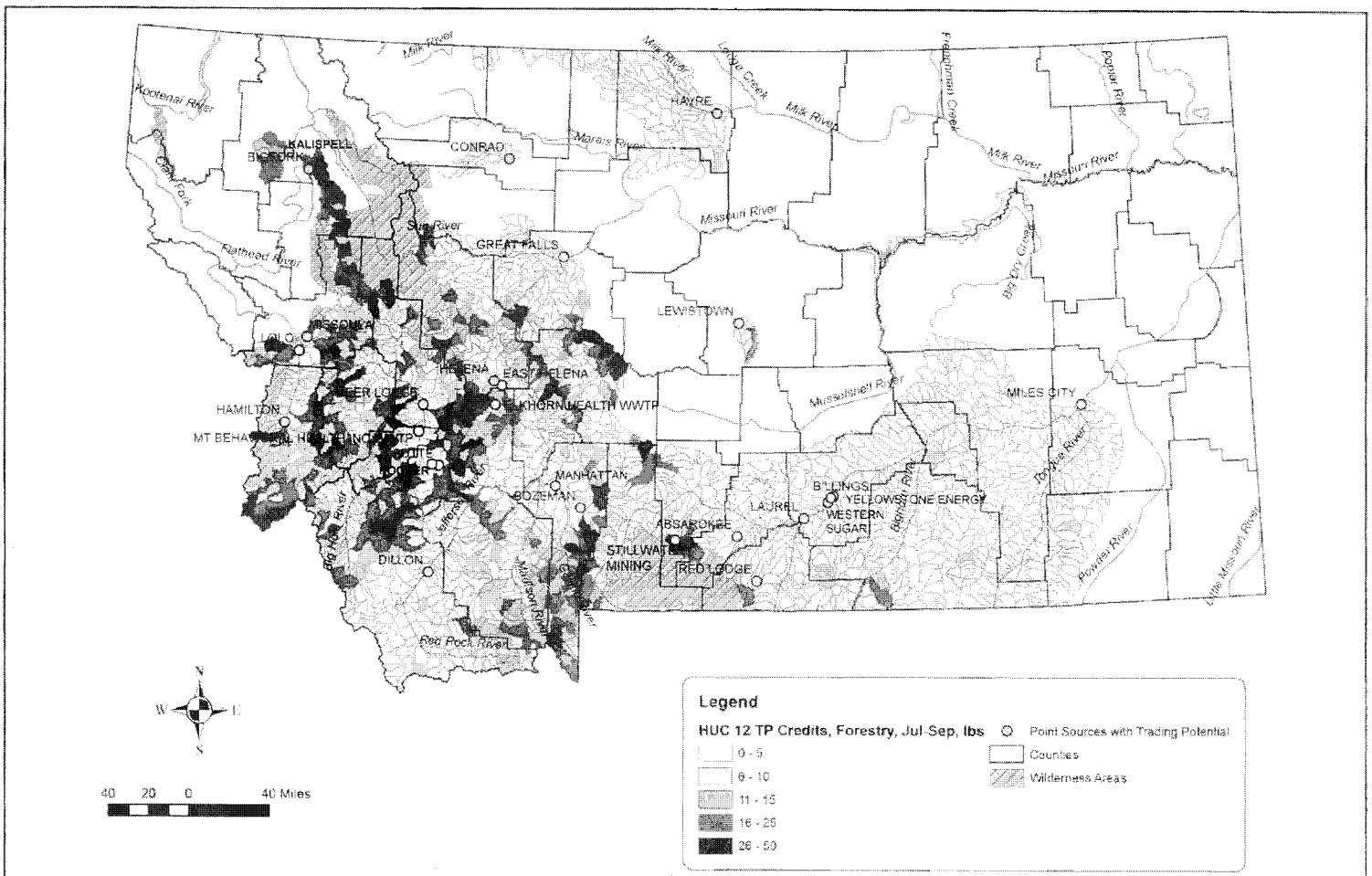
July-September TN Forestry Credits at 10% of Evergreen Land Cover

PROJECT NO. 4842.006

FIGURE NUMBER 4-6



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July-September TP Forestry Credits at 10% of Evergreen Land Cover

PROJECT NO.
4842.009

FIGURE NUMBER
4-7

4.6 Septic System Supply Assessment

A preliminary evaluation of potential nitrogen offset supply was conducted for six of the larger municipal settings where septic system disconnect program opportunities may exist. Table 4-4 illustrates the number of potential opportunities and potential seasonal nitrogen reduction benefits using the Montana trading policy calculation method. Figures 4-8 through 4-13 illustrate growth boundaries and locations of septic systems for these six municipalities where disconnects may be possible. Estimates for septic system disconnects may be between $3,000 to $5,000. Using the lower figure of $3,000, this results in a cost of $1,667 per pound of TN. The credit value of 0.02 lbs/day per septic tank used in Table 4-4 is based on typical nitrogen loads to septic tanks and is equivalent to a trade ratio of 4:1, which is based on generalized averages where septic trading ratios have been calculated for a few municipalities in Montana using the method described in DEQ Circular 13. The value of 0.006 lbs/days per septic tank used for Missoula is based on the septic trading analysis completed specifically for the Missoula draft wastewater discharge permit.

TABLE 4-4
SEPTIC TANK NITROGEN CREDITS AVAILABLE WITHIN GROWTH BOUNDARY

City	Septic Tanks within Growth Boundary	Approximate Nitrogen Credits (lbs/season)*	Nitrogen Demand (lbs/season)**	Percent of Demand Met if all Septic Tanks are Connected
Billings	6,070	10,926	24,056	45%
Bozeman	1,554	2,797	2,651	106%
Great Falls	3,245	5,841	15,931	37%
Helena***	1,239	2,230	1,219	183%
Kalispell	5,528	9,950	4,516	220%
Missoula****	5,165	2,789	18,558	15%

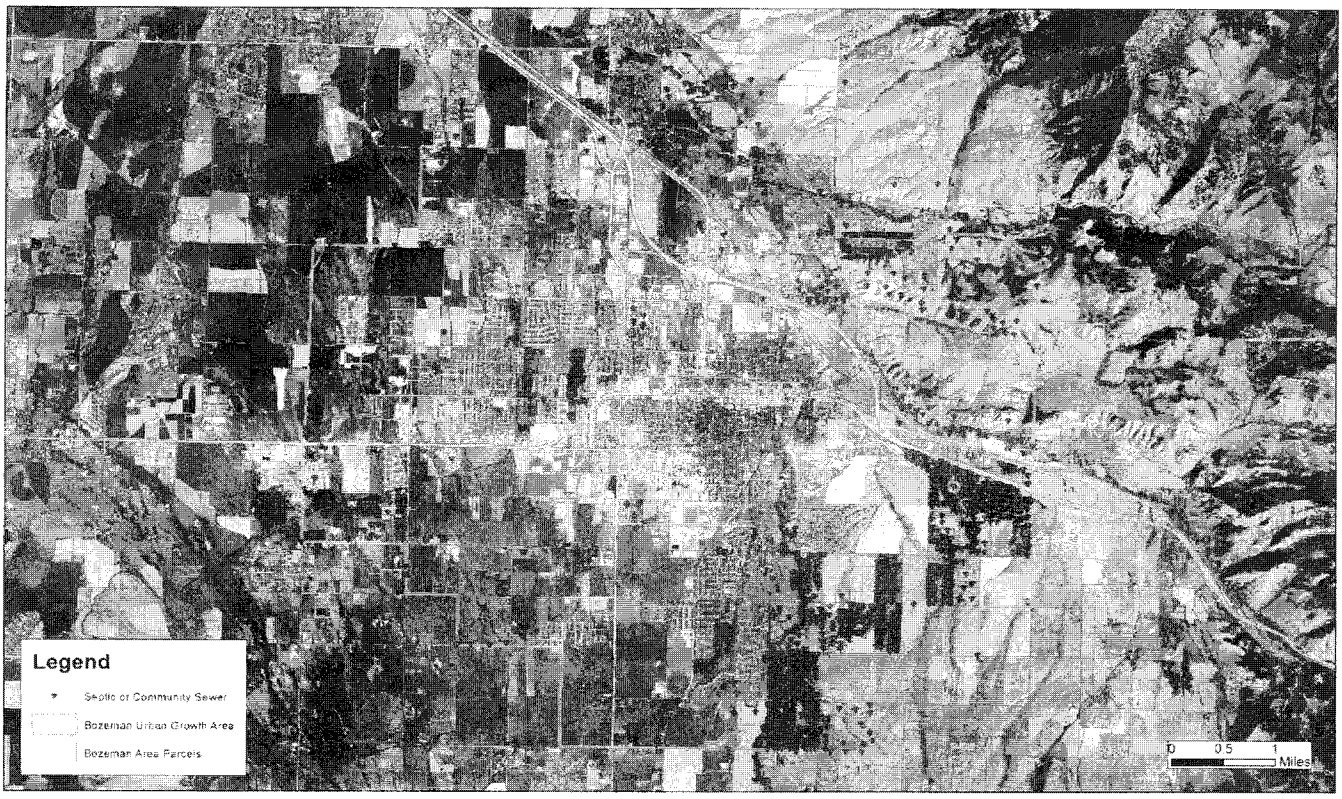
*Assuming 0.02 lbs/day of TN credit per septic tank, season assumed to be 90 days

**From the Demand Calculations: Demand after the 4th Permit Cycle

***The Helena Growth Boundary is not an adopted annexation plan, just an estimation of the area that could be annexed without requiring major infrastructure improvements

****This assumes Missoula has already met its obligation under the VNRP TMDL

****For Missoula, 0.006 lbs/day of TN credit per septic tanks was used, consistent with their permit

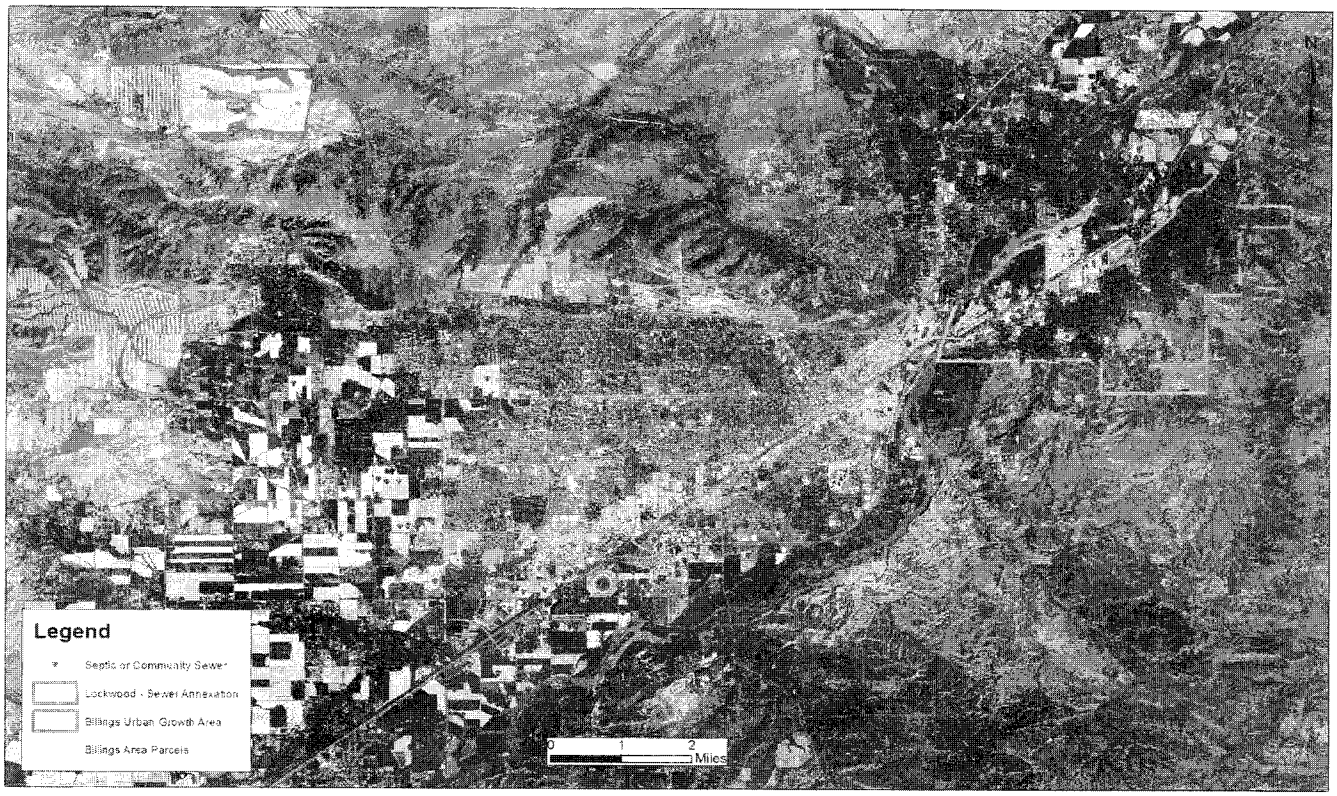


Bozeman Population (2012): 38,695
Septic Tanks in Growth Boundary: 1,554

MORRISON MAIERLE, INC.	KIESER & ASSOCIATES	City of Bozeman	FIGURE NUMBER 4-8
		Septic Tanks in Growth Boundary	

Missoula Population (2012): 68,394
Septic Tanks in Growth Boundary: 5,165

MORRISON MAIERLE, INC.	KIESER & ASSOCIATES	City of Missoula	PROJECT NO.
		Septic Tanks in Growth Boundary	FIGURE NUMBER 4-9

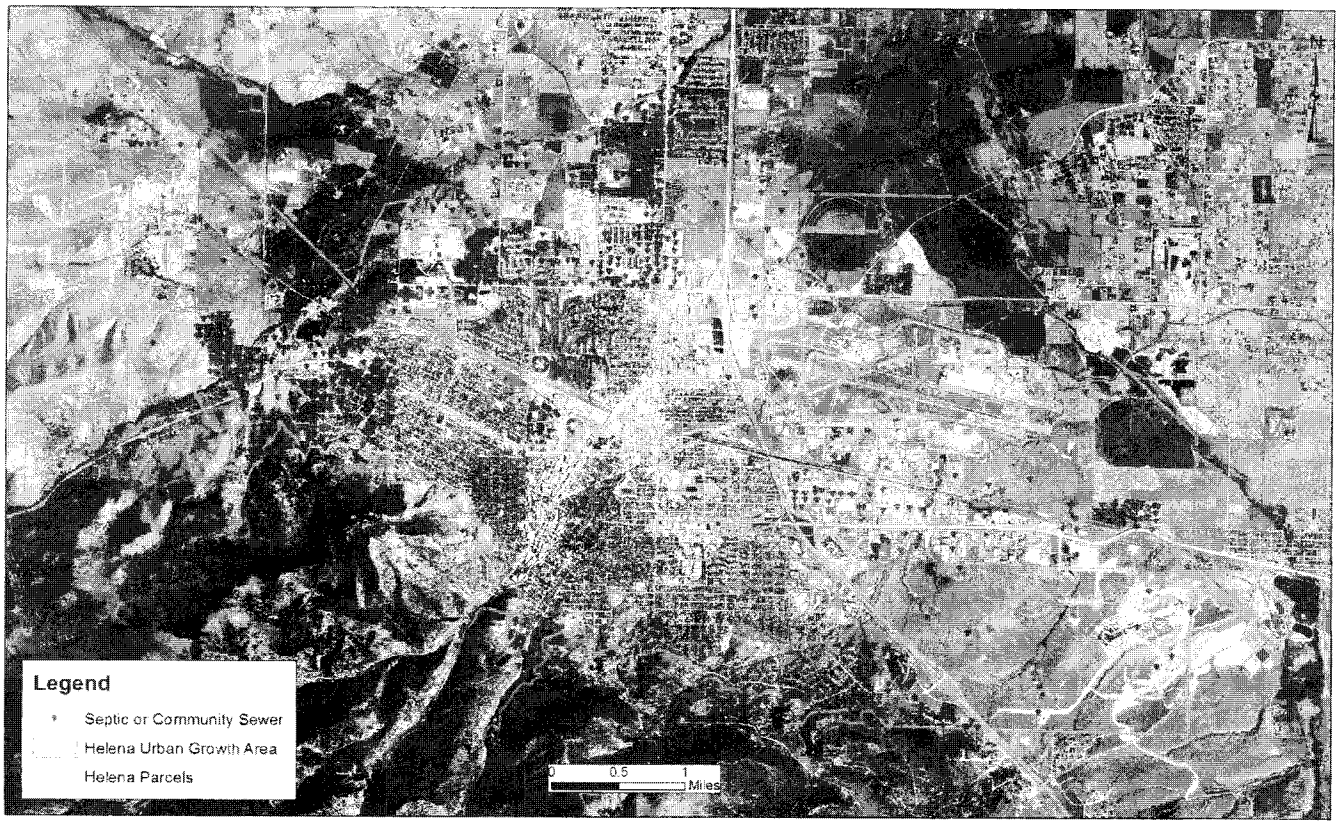


Billings and Lockwood Population (2012): 113,751
Septic Tanks in Growth Boundary: 6,070

MORRISON MAIERLE, INC.	KIESER ASSOCIATES	City of Billings	PROJECT NO. 4442.02
		Septic Tanks in Growth Boundary	FIGURE NUMBER 4-10

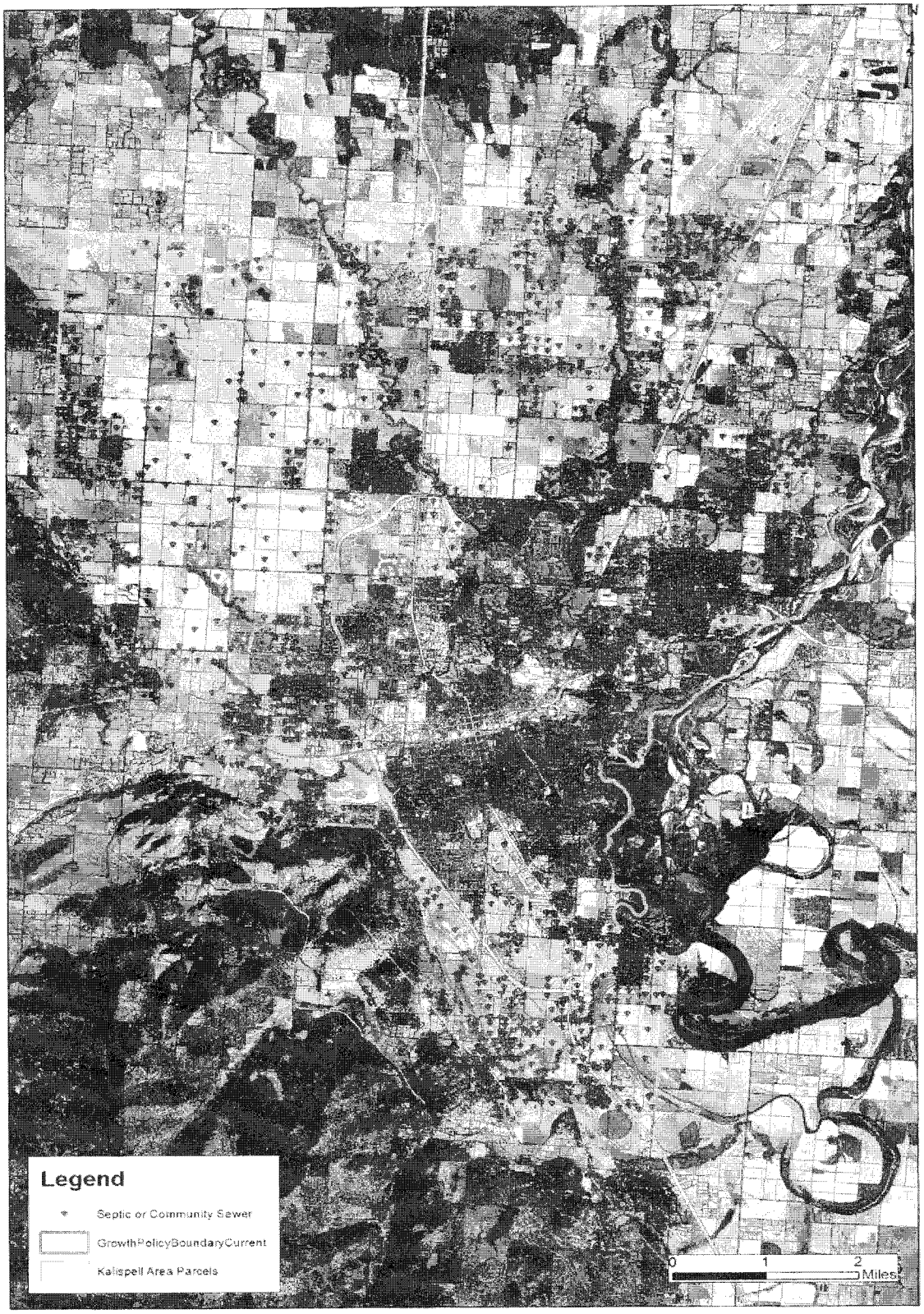
Great Falls Population (2012): 58,893
Septic Tanks in Growth Boundary: 3,245

MORRISON MAIERLE, INC	KIESER ASSOCIATES	City of Great Falls	PROJECT NO
		Septic Tanks in Growth Boundary	PROJECT NUMBER 4-11



Helena Population (2012): 28,381
Septic Tanks in Growth Boundary: 1,239

MORRISON MAIERLE, INC.	KIESER & ASSOCIATES	City of Helena	PROJECT NO.
		Septic Tanks in Growth Boundary	FIGURE/PLANSHEET 4-12



Kalispell Population (2012): 20,016

Septic Tanks in Growth Boundary: 5,528

MORRISON MAIERLE, INC. An Employee-Owned Company	KIESER & ASSOCIATES ENVIRONMENTAL SCIENCE & ENGINEERING 536 East Michigan Avenue, Suite 300 Kalamazoo, MI 49007 USA Phone: (269) 344-7117	City of Kalispell Septic Tanks in Growth Boundary	PROJECT NO. 4542.005 FIGURE NUMBER 4-13

5.0 COMPARISON OF DEMAND AND SUPPLY

5.1 Overview

Evaluating the viability of a trading market is based on: 1) the determination of whether there is ample credit supply from NPSs to meet the demand of PSs, and 2) whether there are substantial cost savings with trading versus WWTP upgrades. This section presents the results of comparing Section 3 WWTP demand and Section 4 NPS credit supply in these regards. Credit supply comparisons are presented first, followed by a more detailed example of the demand/supply comparison for Miles City to illustrate trading considerations with NPSs. Cost comparisons conclude the section. The overall demand/supply results presented here are the basis for Section 6 recommendations for the Montana business case for trading, future MDEQ investments costs and related considerations.

5.2 Demand and Supply Comparisons

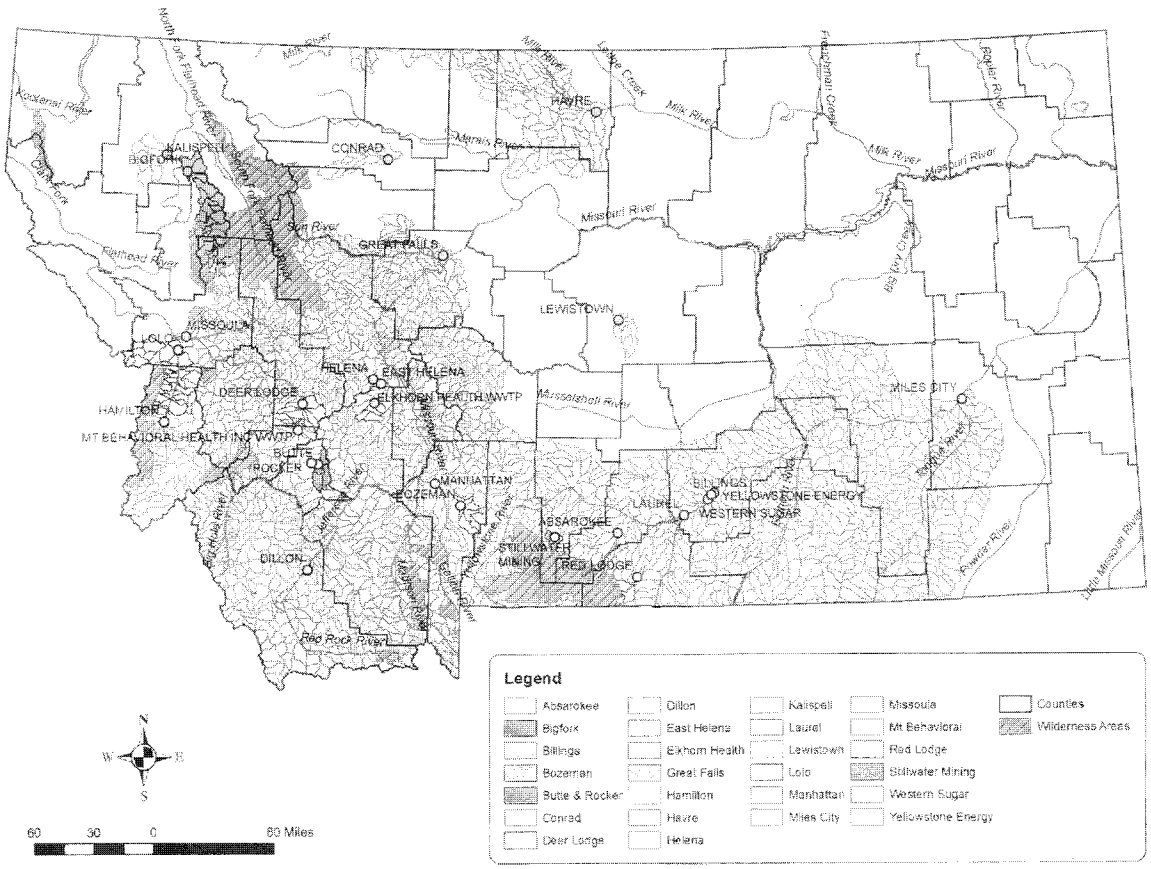
Montana trading policy usually requires buyers to purchase credits from upstream sellers. For the 27 PSs that were identified is Section 3 for having the potential to trade, upstream HUC-12 watersheds were delineated. These are illustrated for each facility in Figure 5-1 (color-coding is solely to help illustrate corresponding upstream areas for trading supply).

Tables 5-1 and 5-2 present a comparison of PS credit demand from the 27 targeted PSs with results of the credit supply analysis for potential TN and TP credits (from Section 4), respectively. Supply estimates are derived from theoretical NPS conservation actions in agriculture and forestry. TN and TP demand in Tables 5-1 and 5-2, respectively is presented as the most conservative (maximum demand) scenario that would occur in the fourth permit cycle examined in this study. The corresponding dates for these permit cycles are also included in these tables. Such information was extracted from Table 3-1 of this report. PSs in Tables 5-1 and 5-2 are clustered by watershed to best illustrate where about 80% of these point sources share overlapping upstream areas from which, at some level, they will need to derive credits.

As most upstream watershed areas above PSs are relatively large in Montana, the Project Team assumed here that it is most likely that credit buyers will first seek credits from upstream HUC-12s in close proximity to many of the discharges. This will reduce the need for high trade ratios that might otherwise require discounting for far upstream credits. This will also facilitate local credit exchanges through local contacts and community connections with rural areas.

As such, credit supply presented in Tables 5-1 and 5-2 first reflects scenarios with credits provided by upstream HUC-12s that could only produce credits for their location. These are referred to as "Exclusive" HUC-12s whereby none of the other 26 PSs that might look to trading in this study could obtain credits. (These are illustrated with color-coding in Figure 5-1.) This approach not only simplifies the demand/supply comparisons, it also portends that in many cases examined herein, credit competition will likely not be a substantial concern in the trading marketplace for these facilities. If exclusive credit supply is insufficient for demand, credit supply from all upstream areas is also considered (minus that already exclusively allocated to other upstream PSs).

A hypothetical trade scenario for Miles City, presented later in this section, will illustrate how buyers might more readily seek closer proximity credit opportunities in these exclusive upstream HUC-12s. For example, despite the fact that Miles City would still have a substantial portion of 692 upstream HUC-12s in the Yellowstone Basin (e.g., Table 5-1) to produce credits, logistics and administrative costs might dictate trying to find credits in more immediate areas of theirs and an adjacent, upstream county.



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Potential WWTPs for WQT with Exclusive Upstream HUC-12 Credit Supply

5-1

TABLE 5-1
TOTAL NITROGEN UPSTREAM CREDIT AVAILABILITY
UPSTREAM TO DOWNSTREAM PS DISTRIBUTION IN WATERSHEDS WITH MULTIPLE SOURCES

		WWTP TN Credit Demand		SCENARIO #1 Exclusive Upstream Ag Credit Supply (10% Participation)			SCENARIO #2 Exclusive Upstream Ag Credit Supply (35% Participation)		SCENARIO #3 Exclusive Upstream Ag Supply (25% Participation) plus Forest Credit Supply			SCENARIO #4 Total Upstream Ag Credit Supply (10% Participation)				SCENARIO #5 Total Upstream Ag Supply (25% Participation) plus Forest Credit Supply				Total Available Supply
NPDES #	Facility Name	Highest Potential Demand (lbs/season)	Highest Demand Permit Cycle (Date)	Number of Exclusive Upstream HUC-12s	Exclusive Upstream Ag Credit Supply (lbs/season)	Credit Supply Meets Demand? (Y/N)	Exclusive Upstream Ag Credit Supply (lbs/season)	Credit Supply Meets Demand? (Y/N)	Exclusive Upstream Forest Credit Supply (lbs/season)	Exclusive Upstream Ag plus Forest Credit Supply (lbs/season)	Credit Supply Meets Demand? (Y/N)	Number of All Upstream HUC-12s	Total Upstream Ag Credit Supply (lbs/season)	Total Upstream Ag Credit Supply Minus Total Upstream Demand (lbs/season)	Credit Supply Meets Demand? (Y/N)	Total Upstream Ag Credit Supply (lbs/season)	Total Upstream Forestry Credit Supply (lbs/season)	Total Upstream Ag and Forestry Credits minus Total Upstream Demand (lbs/season)	Credit Supply Meets Demand? (Y/N)	Credit Supply Meets Demand? (Y/N)
Yellowstone River																				
MT0026808	Stillwater Mining Company - East Boulder	0	2/1/2030	1	83	Y														Y
MT0021750	Absarokee	1,387	2/1/2035	8	942	N	2,358	Y												Y
MT0020476	Red Lodge	3,055	7/2/2035	5	160	N	400	N	532	933	N	5	160	160	N	400	532	933	N	N
MT0020311	Laurel	0	8/1/2030	264	30,665	Y														Y
MT0000281	Western Sugar Cooperative	3,140	1/1/2030	11	2,115	N	5,287	Y												Y
MT0022586	Billings	24,056	11/1/2034	2	292	N	729	N	22	751	N	226	34,077	28,485	Y					Y
MT0030180	Yellowstone Energy Limited Partnership Facility	0	5/1/2034	1	181	Y														Y
MT0020001	Miles City	15,932	4/1/2031	495	98,962	Y														Y
Missouri River																				
MT0021458	Ditton	6,901	3/1/2030	102	17,932	Y														Y
MT0022608	Bozeman	2,851	6/1/2032	8	1,072	N	2,681	Y												Y
MT0021857	Manhattan	293	9/1/2030	43	5,898	Y														Y
MT0023566	Elkhorn Health Care WWTP	42	2/1/2030	4	178	Y														Y
MT0022380	East Helena	2,004	3/1/2030	5	437	N	1,094	N	1,968	2,119	Y									Y
MT0022841	Helena	1,210	10/1/2032	1	27	N	68	N	135	204	N	10	943	-1,403	N	1,920	1,828	1,387	Y	Y
MT0021920	Great Falls	15,931	12/1/2030	566	81,067	Y														Y
Clark Fork																				
MT0027430	Rocker	177	8/1/2033	4	495	Y														Y
MT0022012	Butte	0	4/1/2032	4	495	Y														Y
MT0021431	MT Behavioral Health Inc WWTP	67	8/1/2032	19	2,012	Y														Y
MT0022816	Deer Lodge	101	3/1/2033	9	1,654	Y														Y
MT0022594	Missoula	16,558	3/1/2030	189	10,671	N	26,678	Y												Y
Bitterroot River																				
MT0020025	Hamilton	0	9/1/2031	52	2,806	Y														Y
MT0020168	Lolo	2,884	9/1/2034	35	2,157	N	5,393	Y												Y
Milk River																				
MT0022535	Havre	2,469	5/1/2031	80	30,986	Y														Y
Big Spring Creek																				
MT0020044	Lewiston	0	9/1/2032	5	1,000	Y														Y
Dry Fork Marias River																				
MT0020075	Conrad	1,128	2/1/2032	10	3,286	Y														Y
Flathead Lake																				
MT0020397	Bigfork	981	8/1/2030	23	731	N	1,827	Y												Y
Ashley Creek																				
MT0021938	Kalispell	4,516	6/1/2030	7	331	N	828	N	1,542	2,370	N	7	331	331	N	828	1,542	2,370	N	N

TABLE 5-2
TOTAL PHOSPHORUS UPSTREAM CREDIT AVAILABILITY
UPSTREAM TO DOWNSTREAM PS DISTRIBUTION IN WATERSHEDS WITH MULTIPLE SOURCES

		WWTP TP Credit Demand		SCENARIO #1 Exclusive Upstream Ag Credit Supply (10% Participation)			SCENARIO #2 Exclusive Upstream Ag Credit Supply (25% Participation)		SCENARIO #3 Exclusive Upstream Ag Supply (25% Participation) plus Forest Credit Supply			SCENARIO #4 Total Upstream Ag Credit Supply (10% Participation)				SCENARIO #5 Total Upstream Ag Supply (25% Participation) plus Forest Credit Supply				Total Available Supply
NPDES #	Facility Name	Highest Potential Demand (lbs/season)	Highest Demand Permit Cycle (Date)	Number of Exclusive Upstream HUC-12s	Exclusive Upstream Ag Credit Supply (lbs/season)	Credit Supply Meets Demand? (Y/N)	Exclusive Upstream Ag Credit Supply (lbs/season)	Credit Supply Meets Demand? (Y/N)	Exclusive Upstream Forest Credit Supply (lbs/season)	Exclusive Upstream Ag plus Forest Credit Supply (lbs/season)	Credit Supply Meets Demand? (Y/N)	Number of All Upstream HUC-12s	Total Upstream Ag Credit Supply (lbs/season)	Total Upstream Ag Credit Supply Minus Total Upstream Demand (lbs/season)	Credit Supply Meets Demand? (Y/N)	Total Upstream Ag Credit Supply (lbs/season)	Total Upstream Forestry Credit Supply (lbs/season)	Total Upstream Ag and Forestry Credits minus Total Upstream Demand (lbs/season)	Credit Supply Meets Demand? (Y/N)	Credit Supply Meets Demand? (Y/N)
Yellowstone River																				
MT0028859	Stillwater Mining Company - East Boulder	768	2/1/2030	1	3	N	12	N	40	52	N	1	5	5	N	12	40	52	N	N
MT0021750	Absarokee	204	2/1/2035	8	190	N	251	Y												Y
MT0020478	Red Lodge	658	7/2/2036	5	12	N	30	N	41	71	N	5	12	12	N	203	41	244	N	N
MT0020311	Laurel	1,647	8/1/2030	204	2,994	Y														Y
MT0000281	Western Sugar Cooperative	0	1/1/2030	11	192	Y														Y
MT0022985	Billings	2,406	11/1/2034	2	33	N	57	N	2	59	N	228	3,224	-779	N	8,051	1,101	5,865	Y	Y
MT0030180	Yellowstone Energy Limited Partnership Facility	593	5/1/2034	1	18	N	43	N	3	46	N	227	3,242	-3,481	N	8,105	1,104	3,507	Y	Y
MT0020001	Miles City	1,980	4/1/2031	465	7,349	Y														Y
Missouri River																				
MT0021456	Dillon	1,179	2/1/2030	102	1,533	Y														Y
MT0022606	Bozeman	3,594	8/1/2032	8	138	N	345	N	121	466	N	8	138	138	N	345	121	466	N	N
MT0021857	Manhattan	92	9/1/2030	43	794	Y														Y
MT0022565	Elkhorn Health Care WWTP	9	2/1/2030	4	14	Y														Y
MT0022560	East Helena	551	3/1/2030	5	37	N	92	N	79	171	N	9	51	46	N	127	139	251	N	N
MT0020841	Helena	5,119	10/1/2032	1	2	N	5	N	10	15	N	10	53	-454	N	132	149	-235	N	N
MT0021920	Great Falls	15,531	12/1/2030	508	9,257	N	20,718	Y												Y
Clark Fork																				
MT0027410	Rocker	175	8/1/2033	4	38	N	98	N	40	138	N	4	39	39	N	98	40	138	N	N
MT0022012	Butte	0	4/1/2032	4	39	Y														Y
MT0021431	MT Behavioral Health Inc WWTP	16	3/1/2032	19	204	Y														Y
MT0022616	Deer Lodge	708	2/1/2033	8	295	N	513	N	115	628	N	32	448	257	N	1,120	398	1,294	Y	Y
MT0022594	Missoula	956	3/1/2030	186	1,293	Y						221	1,541							Y
River																				
MT0020028	Hamilton	1,941	9/1/2031	52	275	N	667	N	569	1,356	N	52	275	275	N	667	569	1,356	N	N
MT0020185	Lolo	611	8/1/2034	32	305	N	783	Y				84	590	-1,363	N					Y
Milk River																				
MT0022535	Havre	1,975	5/1/2031	80	2,883	Y						1								Y
Creek																				
MT0020044	Lewiston	300	8/1/2032	5	114	N	285	N	46	330	Y									Y
Marias River																				
MT0020079	Conrad	438	2/1/2032	10	296	N	747	Y	1	748	Y									Y
Flathead Lake																				
MT0020397	Bigfork	0	8/1/2030	23	112	Y														Y
Ashley Creek																				
MT0021938	Kalispell	0	8/1/2030	7	42	Y														Y

Recognizing this areal distribution for upstream credit supply, NPS credit generating scenarios in Tables 5-1 and 5-2 include a sequence of five crediting options to compare available credits to satisfy potential demand as follows:

1. Exclusive upstream Ag credit supply assuming that 10% of farmers in these select HUCs would participate in trading
2. Exclusive upstream Ag credit supply assuming that 25% of farmers might participate in trading
3. Exclusive upstream Ag supply at 25% participation plus credits from forestry conservation practices that would collectively produce an overall 10% load reduction from upstream forested areas (excluding wilderness areas)
4. Total upstream Ag credit supply with 10% Ag participation
5. Total Upstream Ag supply at 25% participation plus forestry credit supply

As noted in the previous Section 4, Ag and forestry NPS credits may in some cases be in relatively short supply due to very limited rainfall in the critical trading months of July – September. As such, a greater number of landowners participating in trades will be necessary for NPS runoff generated credit supply. Ag participation rates of 10% and 25% may be quite high for typical PS/NPS programs where there are much larger reductions per acre expected given more temperate conditions in other trading settings compared to Montana's largely arid conditions. Thus, each successive scenario, starting with 10% Ag participation in exclusive upstream HUC-12s, generally offers more credits than the previous. For each scenario, a column identifies whether there are sufficient credits to meet demand with a "yes" (Y) or not, signified by a "no" (N). If demand is met for a PS, no further crediting scenarios are offered. Successive scenarios are applied until demand is met. If after the application of all five potential crediting scenarios, PS demand cannot be met by proposed NPSs, an "N" in the final column means that the PS may not be a likely candidate for trading with agriculture and/or forestry.

Towards these ends, the following observations are made from demand/supply comparisons in Tables 5-1 and 5-2 for TN and TP, respectively.

Overall Observations

- Of the 27 PSs identified with potential trading demand, only 19 realize ample credit supply considering both TN and TP. (Red Lodge falls short for both TN and TP supply; Stillwater Mining, Bozeman, East Helena, Helena, Rocker, Hamilton and Kalispell have one or the other nutrient credits with insufficient supply)
- Considering just TN (Table 5-1), all but 2 (Red Lodge and Kalispell) have sufficient credit supply. TN supply for Helena is only satisfied with the final and most generous credit scenario #5. Sixteen of the facilities will find sufficient TN supply in their exclusive upstream HUC-12 watersheds (scenario #1).
- The TP supply (Table 5-2) is a substantially different picture than TN. Even with the most generous crediting scenario #5, 7 facilities are unable to meet TP supply needs to fully offset demand (Stillwater mining, Red Lodge, Bozeman, East Helena, Helena, Rocker and Hamilton). Three other facilities meet TP supply needs with scenario #5 (Billings, Yellowstone Energy and Deer Lodge).

Yellowstone River

- Insufficient TN and TP supply for Red Lodge is most likely a function of only 5 upstream HUC-12s that could potentially deliver NPS credits. The same is true for TP supply shortage for Stillwater Mining with only 1 upstream HUC-12; a function of its location in a headwater stream.
- As noted above, Billings and Yellowstone Energy are short TP supply but not TN. The former has 226 upstream HUC-12s from which to potentially draw TP credits, though their demand (the largest of any of the 8 potentially trading discharges in the Yellowstone) still falls short under all proposed NPS crediting scenarios. Stillwater Mining's location in a headwater leaves it at a distinct disadvantage with only the HUC-12 in which it is located to generate credits.

Missouri River

- In the Missouri Basin, all 7 potentially trading PSs have ample TN supply from NPSs, though Helena requires scenario #5 to meet TN demand.
- Three point sources (Bozeman, Helena and East Helena) have insufficient TP credits in this basin. All have a relatively small number ($\leq$10) available upstream HUC-12s from which to draw credits.

Clark Fork

- Of the 5 potentially trading PSs in the Clark Fork, only Missoula shows some additional Ag credit need (scenario #2) to achieve TN supply beyond scenario #1.
- Rocker, with only 4 upstream HUC-12s to supply credits, has insufficient TP credit supply under all crediting scenarios. Deer lodge will need scenario #5 to meet TP demand.

All Other River Basins

- Kalispell, with only 7 upstream HUC-12s for credit supply has insufficient TN credits for trading under the 5 NPS supply scenarios. This is also a function of the large expected TN demand. Kalispell'sTP demand is zero, so TP credit supply is unnecessary for this plant.
- Hamilton TN supply is more than ample to meet demand, however, their substantial TP demand cannot be satisfied even with 52 upstream HUC-12s.

This comparative analysis of demand and supply represents a reasonable but conservative assessment of potential opportunities for trading amongst these 27 identified PSs. The next portion of this section uses these data and applies costs for WWTP upgrades versus cost for NPSs. Such an analysis will provide a more definitive picture for the economic case for trading.

What we address here, before moving to a specific demand/supply comparison for Miles City and then cost comparisons, is the recognition that this supply analysis makes no consideration for site-specific credit availability. Trading certainly cannot be explicitly ruled out for these particular PSs given localized upstream opportunities that simply cannot be known or discovered in the course of this rudimentary analysis. It is thus fully acknowledged in this report that other upstream crediting alternatives are possible (e.g., streambank restoration, cattle removal from streams,

irrigation management, septic system disconnection, as well as other discharge alternatives including effluent reuse and to a very likely limited extent, PS/PS trading). Section 6 identifies approaches whereby PSs in limited credit situations can look to other support options to find credits. As with any future trading scenario, both PS and NPS conditions are site-specific and as such, every entity will need to specifically evaluate their particular conditions at a much greater level of detail to determine their benefits with trading. Here again, the proposed trading framework will outline solutions for how such conditions can best be evaluated. The following Miles City example will illustrate the considerations of seeking local credit supplies.

5.3 Miles City Demand/Supply Example Trading Analysis

A more detailed analysis of credit availability for the Miles City WWTP is presented here to illustrate an example trading scenario using the Project Team's assumptions for demand and supply reported herein. In general, a PS buyer will likely prefer engaging local landowners and/or conservation district staff in exploring credit opportunities. Even in situations where a point source is located at the downstream end of a large watershed and hence has ample upstream areas to purchase credits from, working with nearby landowners would provide a level of comfort and certainty for the buyer in a non-traditional permit compliance setting using WQT. Moreover, with increased distances between buyer and seller, greater is the potential for having to increase a trade ratio to account for fate and transport losses.

Miles City is located on the Yellowstone River in Custer County in the southeast part of the state (refer to Figure 5-1). The Yellowstone River at Miles City WWTP's discharge point has 692 upstream HUC-12s, excluding the Abasatoka-Beartooth Wilderness area. Among these HUC-12s, load reductions from 465 are exclusively available for Miles City as these are upstream only to this city. This analysis therefore focuses on the question that, without using the assumed 10% or 25% landowner participation rate, how likely it would be that Miles City WWTP would be able to find enough credits (and from how many landowners) in upstream HUC-12s to meet its increasingly stringent nutrient discharge limit.

The analysis therefore examined:

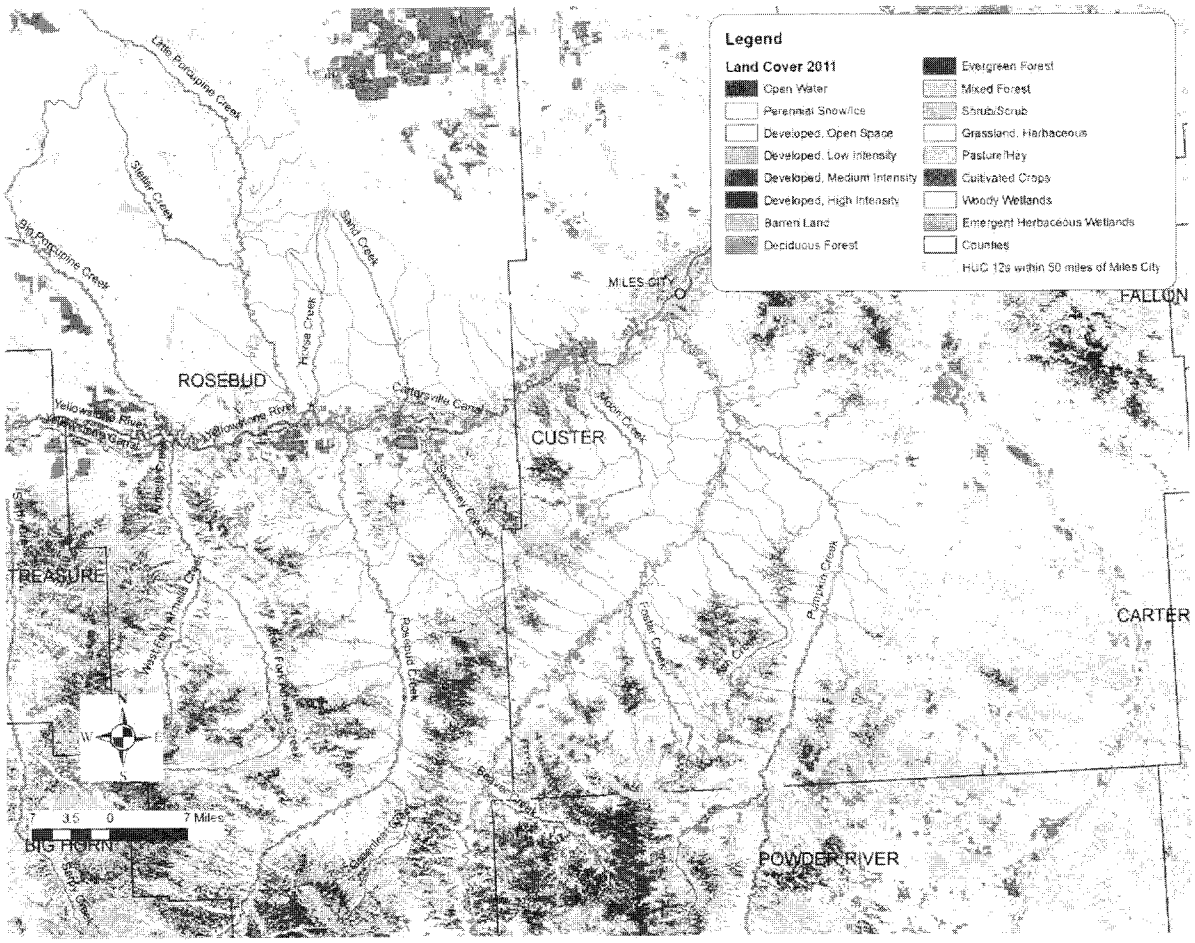
- Potential nutrient load reductions from agricultural sources (rangeland, pasture, and cropland) in the 75 HUC-12 watersheds within 50 miles upstream of the Miles City WWTP and within the area of the two counties of Custer and Rosebud (Figure 5-2)

- Available nutrient load reduction credits to Miles City WWTP from each of the 75 HUC-12 watersheds after an assumed trading ratio of 2:1 is applied but without an assumed participation (see Figure 5-3 for TN supply and Figure 5-4 for TP supply)

- The credit generation capability of each of the agricultural land uses in the 75 HUC-12s on a per acre basis

- The estimated number of farms in each of the three agricultural land uses based on the farm size obtained or derived from the 2012 Census of Agriculture by USDA and the total area of the land use from the 2011 USGS land cover dataset

- The potential credit demand of Miles City WWTP for each of its next four permit cycle and the corresponding area of each of the agricultural land uses required to meet this demand based on its per acre credit generation capability



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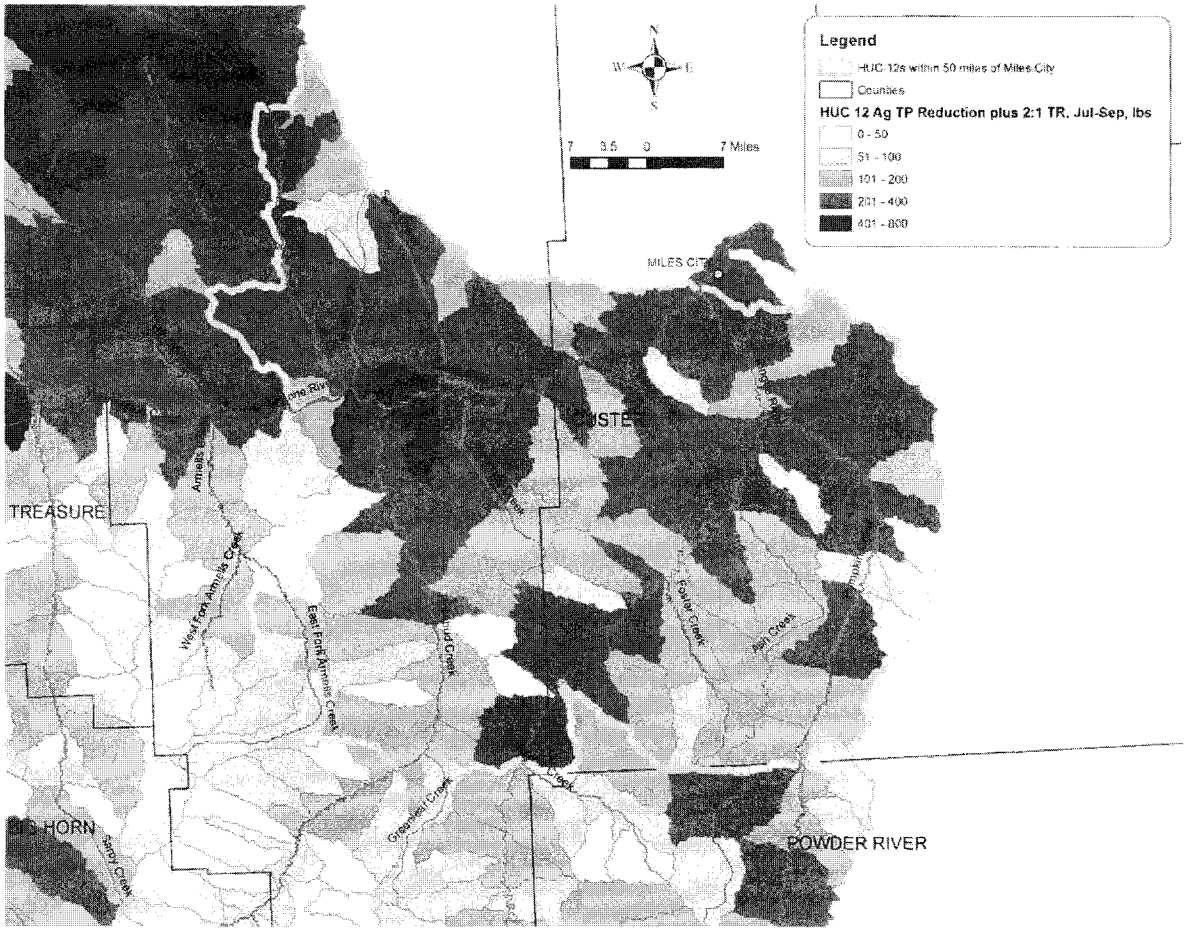
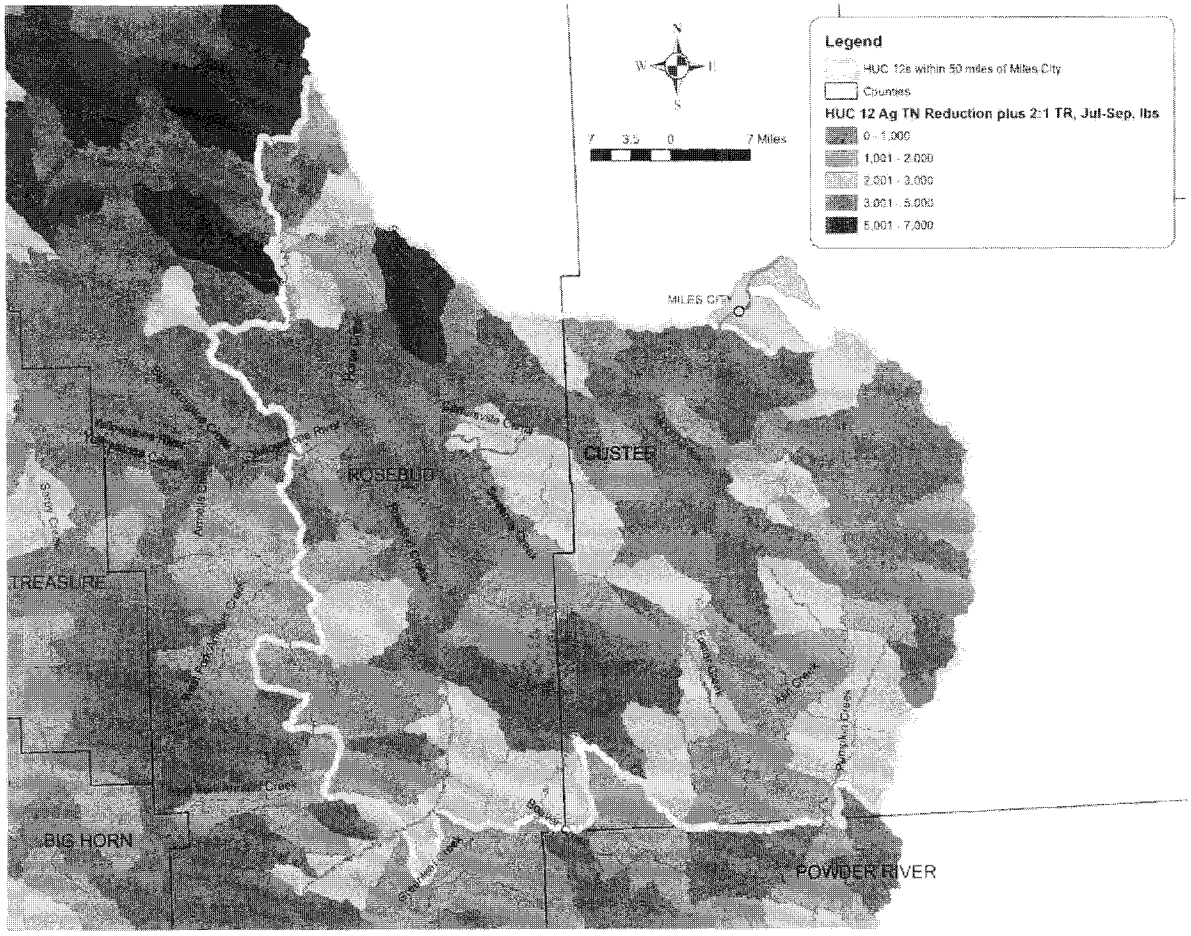
Land Cover in HUC-12s within 50 Miles Upstream of Miles City

PROJECT NO. 4842.008

FIGURE NUMBER 5-2



MORRISON MAIERLE, INC. An Employee-Owned Company 1 Engineering Place Helena MT 59602 Phone: (406) 442-3050 Fax: (406) 442-7862	KIESER & ASSOCIATES ENVIRONMENTAL SCIENCE & ENGINEERING 536 East Michigan Avenue, Suite 300 Kalamazoo, MI 49007 USA Phone: (269) 344-7117	TP Credits by HUC-12s within 50 Miles Upstream of Miles City	PROJECT NO. 4542.005 FIGURE NUMBER 5-3



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TN Credits by HUC-12s within 50 Miles Upstream of Miles City

PROJECT NO. 4842.006

FIGURE NUMBER 5-4

The Miles City supply analysis then compared the required land use area for credits that would be available in the 75 upstream HUC-12s to determine if sufficient supply existed. It further estimated the number of farms (hence number of landowners, assuming one landowner per farm) based on the required area and farm size. Comparing that number of landowners to the total number of landowners in the HUC-12s suggests an actual participation rate potentially necessary to generate sufficient credits to meet demand.

Tables 5-3 to 5-5 present the results of this analysis for rangeland, pastures and croplands, respectfully in these regards. It can be seen that due to their predominant presence in the nearby upstream HUC-12s, rangeland (ranches) alone would be able to generate sufficient credits to meet demands for both nutrients (Table 5-3). This is true in spite of the fact that rangeland has the lowest potential nutrient credits per acre (0.012 TP lbs/ac and 0.218 lbs TN/ac) among the three agricultural land uses. The participation rate required for ranches ranges from 10.6% for the most immediate permit cycle to 16.5% for the most remote. These values are well within the 10% and 25% participation rates assumed for the state-wide analysis.

Neither pastures (Table 5-4) nor croplands (Table 5-5) alone could generate sufficient credits to meet the demand from Miles City WWTP using the BMP application efficiencies assumed in this study. The arid conditions in this part of the state likely confine pastures and crop farms to river corridors where irrigation water is available (e.g., see Figure 5-5). This makes these two land uses far less common in the area than ranches. Thus, it is not surprising that available credits from pastures and croplands are limited in this particular setting. Nevertheless, croplands and/or pasture would still be able to generate a portion of the required credits. Therefore, these areas would remain as viable options for potential credits. And as noted above, site-specific opportunities will no doubt become a target for future buyers as opposed to an assumption that such substantial numbers of landowners would participate. Overall, this Miles City example helps illustrate the rationale for targeting "exclusive" upstream HUC-12s in the broader analysis for PSs.

TABLE 5-3
MILES CITY CASE ANALYSIS
RANCHES

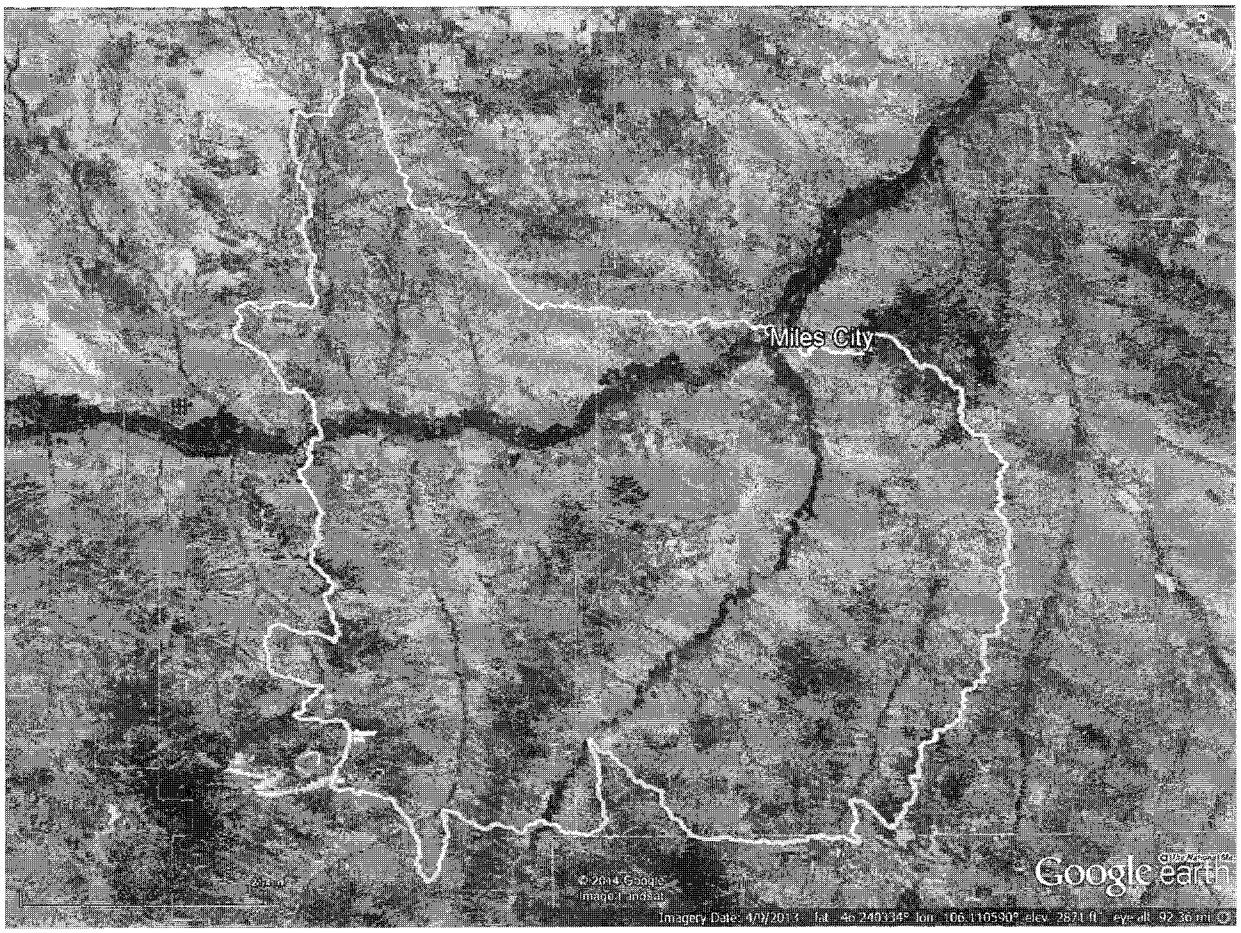
Permit Cycle	Permit Date	TP Seasonal Demand (lbs)	TN Seasonal Demand (lbs)	TP based Acres Needed	TN based Acres Needed	Total Ranch Acres in the HUC-12s	Sufficient Ranch Acreage?	Estimated Total Number of Ranches in the HUC-12s	# of Ranches Required	Ranch Particip. Rate Required	Portion of Demand Met by Ranches
1	4/1/2016	1,272	11,620	109,727	72,943	1,037,250	Yes	134	15	10.6%	100%
2	4/1/2021	1,471	13,583	126,844	85,265		Yes		17	12.2%	100%
3	4/1/2026	1,765	13,854	152,213	86,966		Yes		20	14.7%	100%
4	4/1/2031	1,980	15,932	170,783	100,011		Yes		23	16.5%	100%

TABLE 5-4
MILES CITY CASE ANALYSIS
PASTURES

Permit Cycle	Permit Date	TP Seasonal Demand (lbs)	TN Seasonal Demand (lbs)	TP based Acres Needed	TN based Acres Needed	Total Pasture Acres in the HUC-12s	Sufficient Pasture Acreage?	Total Number of Pastures in HUC-12s	# of Pasture Farms Required	Pasture Particip. Rate Required	Portion of Demand Met by Pastures
1	4/1/2016	1,272	11,620	25,688	53,201	12,467	No	52	222	--	23.4%
2	4/1/2021	1,471	13,583	29,695	62,189		No		260	--	20.0%
3	4/1/2026	1,765	13,854	35,635	63,429		No		265	--	19.7%
4	4/1/2031	1,980	15,932	39,982	72,943		No		305	--	17.1%

TABLE 5-5
MILES CITY CASE ANALYSIS
CROP FARMS

Permit Cycle	Permit Date	TP Seasonal Demand (lbs)	TN Seasonal Demand (lbs)	TP based Acres Needed	TN based Acres Needed	Total Cropland Acres in HUC-12s	Sufficient Cropland Acreage?	Total Number of Cropland in HUC-12s	# of Crop Farms Required	Cropland Particip. Rate Required	Portion of Demand Met by Cropland
1	4/1/2016	1,272	11,620	70,826	65,231	51,334	No	120	166	--	72.5%
2	4/1/2021	1,471	13,583	81,875	76,251		No		192	--	62.7%
3	4/1/2026	1,765	13,854	98,250	77,772		No		230	--	52.2%
4	4/1/2031	1,980	15,932	110,237	89,438		No		258	--	46.6%



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Aerial Photo Illustrating Arid Conditions Upstream of Miles City

PROJECT NO. 4842.006

FIGURE NUMBER 5-5

5.4 Cost Comparisons

Comparison of credit volume demand and supply presented in Tables 5-1 and 5-2 is used here to compare costs for WWTP upgrades versus Ag and/or forestry credits to determine whether there are economic benefits for trading in the various Montana settings. WWTP upgrade cost assumptions for this analysis are presented first followed by the approach used to estimate credit scenario costs. This section is concluded with a comparison of costs of upgrades versus use of nutrient credits to meet compliance needs.

For both sets of supply and demand costs, Net Present Values are used. This provides the most reasonable 20-year equivalent comparison of costs; the 20 years also just happening to correspond with the four permit cycles examined herein. NPV is the sum of the present values of the capitalization, operation and maintenance, replacement costs and transaction fees. The method adjusts future values based on an interest rate of 3.3% compounded annually. All current day values are left as is. The method allows you to compare different cost options in today's dollar.

WWTP Cost Assumptions

Point source unit values from Table 3-2 were calculated based on an NPV approach by assuming:

- Net Present Value allows different treatment options to be compared in current dollar estimates
- Future costs are all adjusted for inflation at a rate of 3.3 percent
- WWTP upgrade costs are evaluated based on a 20-year project life.
- Cost estimates for upgrades consider both the capitalization and operation and maintenance

Credit Cost Assumptions

For Ag credits, unit values were calculated on an NPV approach by assuming the following:

- A 50% TN and TP reduction
- Cost estimates for Ag settings based on doubling the implementation price for a Riparian Herbaceous Cover of grasses and forbs, NRCS practice standard 390 payment schedule[8] of $716.62/acre (assuming the full cost of the practice implementation was twice the payment schedule allowed under the Environmental Quality Incentive Program as NRCS support is typically 50% of the project costs; for trading applications, 100% of the costs are assumed here for credit pricing)
- A project life of practice standard 390 of 5 years
- The practice implemented four times to generate a 20-year project life in order to be compared against the point source NPV values
- In order to minimize channelized flow breaching the buffer, one acre of riparian herbaceous cover is assumed to effectively treat runoff from:
    - 500 acres of rangeland
    - 100 acres of pasture
    - 100 acres of cropland

[8] USDA-NRCS, Montana Practice Payment Schedule, Fiscal Year 2014, EQIP, Effective Date: January 31, 2014

- Per acre treated field reductions are derived as:
    - Rangeland: TN = 0.658 lbs/acre; TP = 0.029 lbs/acre
    - Pasture: TN = 2.507 lbs/acre; TP = 0.124 lbs/acre
    - Cropland: TN = 0.961 lbs/acre; TP = 0.045 lbs/acre
- Unit costs are based on credit values which require:
    - Implementing a 2:1 trade ratio to the reduction estimate
    - Adding an assumed 20% transaction cost

For forestry credits, unit values were calculated on a NPV approach by assuming:

- A 70% TN and an 85% TP reduction
- Cost estimates for forestry settings are based on doubling the implementation cost of the non-regulated per acre estimates for $403.34 per acre treated
- Forestry roads are assumed to be treated based on a list of general practices
- Project life of practices are 1 year
- Practices are implemented 20 times to generate a 20-year project life in order to be compared against the point source NPV values
- One acre of forestry road protection is assumed to serve 220 acres of forested land
- Per acre treated field reductions were derived as:
    - TN = 0.302 lbs/acre; TP = 0.023
- Unit costs are based on credit values which require:
    - Implementing a 2:1 trade ratio to the reduction estimate
    - Adding an assumed 20% transaction cost

These NPV assumptions and related calculations yielded unit costs for TN and TP credits as presented Table 5-6. The unit cost of a credit reflects how many conservation practice units (acres) have to be implemented to yield a credit that is appropriate for offsetting a pound of nutrient discharged. Therefore, for some practices, over two pounds of reduction per acre will take place with implementation. For this setting, a fraction of the acre unit cost is applied. When the practice generates less than two pounds of reduction, then multiple acres of implementation are required to generate a credit and the unit cost of a credit escalates accordingly.

TABLE 5-6
TN AND TP CREDIT COSTS
FOR VARIOUS BMP APPLICATIONS BY LAND COVER

	Cost ($/credit)	
BMP application	**TN**	**TP**
Rangeland	2.18	50.34
Pasture	2.87	57.95
Crop	7.48	160.93
Forestry	10.09	131.33

These estimated unit costs for credits appear much more effective for TN than for TP. This observation is born out with comparison of these with unit costs of upgrading WWTPs as presented in Table 5-7 (all as NPV).

TABLE 5-7
COMPARISON OF WWTP COSTS
WITH TN AND TP CREDIT COSTS

	Projected July-Sept Demand		Total Nitrogen Comparison							Total Phosphorus Comparison					Liklihood to Trade	
Description	TN Demand (lbs/ season)	TP Demand (lbs/ season)	TN Upgrade Cost (NPV)*	TN Upgrade Cost (Max Permit Cost Seasonal $/lb)**	Max Unit Cost Permit Cycle	TN Upgrade Cost (Full Build Out Permit Seasonal $/lb)**	TN Trading Cost (NPV)	TN Credit Cost (Seasonal $/lb)	TN WQT Cost-effective-ness (<75%)	Maximum TP Upgrade Cost (NPV)	Maximum TP Upgrade Unit Cost (Seasonal $/lb)	TP Trading Cost (NPV)	TP Credit Cost (Seasonal $/lb)	TP WQT Cost-effective-ness (<75%)	Likely to Trade TN	Likely to Trade TP
Western Sugar	3,140	0	$ 1,473,484	$ 23.46	4	$ 23.46	$ 180,236	$ 2.87	12%	$ -	$ -	$ -	$ -		Y	N
Elkhorn Health	43	6	$ 207,066	$ 244.32	4	$ 244.32	$ 2,411	$ 2.87	1%	$ 2,562	$ 21.16	$ 6,954	$ 57.44	271%	Y	N
Missoula	18,558	956	$ 3,418,153	$ 9.21	4	$ 9.21	$ 1,065,229	$ 2.87	31%	$ 144,574	$ 7.56	$ 2,859,749	$ 149.57	1978%	Y	N
East Helena	2,004	501	$ 1,276,862	$ 31.86	4	$ 31.86	$ 115,030	$ 2.87	9%	$ 212,073	$ 21.16	Credit<Demand	Credit<Demand	N/A	Y	N
Dillon	6,901	1,179	$ 4,445,948	$ 32.21	4	$ 32.21	$ 396,117	$ 2.87	9%	$ 499,029	$ 21.16	$ 1,366,461	$ 57.95	274%	Y	N
Laurel*	0	1,647	$ -	$ -			$ -	$ -		$ 697,245	$ 21.16	$ 6,123,279	$ 185.86	878%	N	N
Bigfork	981	0	$ 790,032	$ 40.25	4	$ 40.25	$ 56,329	$ 2.87	7%	$ -	$ -	$ -	$ -		Y	N
Manhattan	263	32	$ 70,468	$ 40.46	3	$ 13.41	$ 15,096	$ 2.87	21%	$ 2,432	$ 3.85	$ 37,088	$ 58.79	1525%	Y	N
Great Falls*	15,931	15,931	$ 815,896	$ 2.56	4	$ 2.56	$ 914,420	$ 2.87	112%	$ 7,924,084	$ 24.87	$ 18,464,029	$ 57.95	233%	N	N
Miles City	15,931	1,980	$ 6,141,728	$ 19.62	2	$ 19.28	$ 914,497	$ 2.87	15%	$ 838,177	$ 21.16	$ 2,294,820	$ 57.94	274%	Y	N
Havre*	2,469	1,975	$ 825,727	$ 16.72	4	$ 16.72	$ 141,721	$ 2.87	17%	$ 836,154	$ 21.16	$ 2,289,518	$ 57.95	274%	Y	N
Conrad	1,126	436	$ 892,031	$ 39.61	4	$ 39.61	$ 64,632	$ 2.87	7%	$ 184,493	$ 21.16	$ 505,171	$ 57.95	274%	Y	N
Bozeman	2,651	3,534	$ 176,989	$ 3.34	4	$ 3.34	$ 151,167	$ 2.87	85%	$ 534,449	$ 7.56	Credit<Demand	Credit<Demand	N/A	N	N
Mt Behavioral Health	67	16	$ 326,964	$ 244.32	4	$ 245.22	$ 3,846	$ 2.87	1%	$ 6,608	$ 21.16	$ 18,544	$ 59.39	281%	Y	N
Lewistown	0	300	$ -	$ -			$ -	$ -		$ 23,091	$ 3.85	$ 451,138	$ 75.19	1954%	N	N
Helena	1,219	5,119	$ 106,346	$ 4.36	4	$ 4.36	$ 182,362	$ 2.87	171%	$ 2,546,008	$ 24.87	Credit<Demand	Credit<Demand	N/A	N	N
Deer Lodge*	0	708	$ -	$ -			$ -	$ -		$ 54,596	$ 3.85	$ 820,572	$ 57.95	1503%	N	N
Rocker	177	175	$ 401,586	$ 113.45	4	$ 113.45	$ 10,166	$ 2.87	3%	$ 74,175	$ 21.16	$ 10,141	$ 57.95	274%	Y	N
Yellowstone Energy	0	593	$ -	$ -			$ -	$ -		$ 250,846	$ 21.16	$ 1,908,630	$ 160.93	761%	N	N
Lolo	2,884	611	$ 2,356,036	$ 40.85	4	$ 40.85	$ 165,578	$ 2.87	7%	$ 258,533	$ 21.16	$ 707,904	$ 57.93	274%	Y	N
Billings*	24,055	2,406	$ 1,023,464	$ 2.13	4	$ 2.13	$ 1,380,814	$ 2.87	135%	$ 363,784	$ 7.56	$ 4,404,382	$ 91.53	1211%	N	N
Absarokee	1,367	204	$ 1,042,714	$ 37.60	4	$ 37.60	$ 79,614	$ 2.87	8%	$ 86,313	$ 21.16	$ 656,594	$ 160.93	761%	Y	N

*Currently upgrading facility (either in design or construction). TN and TP adjusted to expected performance after upgrade.
**The difference between TN Upgrade Cost ("Max Permit Cost Seasonal $/lb") and TN Upgrade Cost ("Full Build-Out Permit") reflects whether the entity upgrades early (i.e., before growth and corresponding increased influent flows) or for upgrade costs of the full build-out divided by the existing reduced pounds of TN. See text for additional narrative.

No associated demand need

Insuffient Credits

N/A = Not Applicable due to supply limitation

WWTP exclusion from the Table 5-7 comparative cost analysis was based on the following rationale as to why five facilities of the originally identified 27 would not likely engage in trading:

- Red Lodge and Kalispell did not have sufficient upstream TN credit supply
- Stillwater Mining and Hamilton had no TN demand but for their TP demand, supply was insufficient
- Butte is expected to have no future demand for either TN or TP credits based on their ability to otherwise meet variance limits with anticipated upgrades

The final two columns in Table 5-7 reveal that there may only be 14 PSs that would find trading (and then only for TN), cost-effective using Project Team assumptions for Ag and forestry NPS credits. These are based on the comparison of unit costs of WWTP upgrades for both TN and TP versus costs of credits. Four facilities in this comparison (Great Falls, Bozeman, Helena and Billings), though having ample TN credit supply, still appear to have greater efficiencies to meet TN limits with plant upgrades despite relatively low TN credit costs. This is denoted by WQT percent effectiveness exceeding a 75% threshold expressed as a function of credit costs divided by upgrade costs. In all cases for TP, trading is quite ineffective.

Worth noting in this table is the difference between TN Upgrade Cost ("Max Permit Cost Seasonal $/lb") and TN Upgrade Cost ("Full Build-Out Permit"). If the entity upgrades early (i.e., before the influent flow is there) then the upgrade cost are for full build-out divided by the existing reduced pounds of TN. Therefore, trading can be used to delay the upgrade for a permit cycle which will make the unit cost of the upgrade lower. The full build-out costs reflect the maximum NPV divided by the maximum reduction. The maximum is used for TN because it is a biologically-treated parameter, and it needs to have the treatment units reflect modifications. TP is a chemically treated parameter, and can be added to existing units using an outside tank and pump as a source, and then modifying the plumbing. Extra biosolids from the addition of precipitant for TP is not assumed here to exceed the existing clarifier capacity. Thus, increases in TP most often reflect minor upgrades for equipment and then addition of more chemicals. This is why the TN columns compare maximum cost versus full build-out where TP does not.

Most notably, those facilities that decide to use trading to fully offset TN demand will also get some TP credits produced from Ag and/or forestry practices. The TP unit prices in this example are not cost-effective by themselves, but are essentially "free" if the PSs have already purchased TN credits (i.e., paid for practices to produce TN credits). This would reduce the TP chemical costs in an almost linear fashion, but not necessarily achieve TP compliance in and of themselves absent some chemical treatment at the plant.

Because of various assumptions used in the NPS credit calculations, and especially with no readily available runoff data for corroborating EMCs, the Project Team believes that the first and most appropriate indicator of trading potential in Montana should focus on the demand analysis. This is the identified potential trading need for 27 PSs that likely cannot meet variance limits with current treatment technology. Next in the sequence for assessing trading potential are unit upgrade costs for these WWTPs. Lastly in the consideration are credit costs used for comparison to unit upgrade costs. NPS credit costs, as extrapolated in this comparative analysis, suggest that other conservation practices should be considered. The current, broadly applied landscape practices yield cost-effective TN credits, but not so for TP credits. Most importantly, upstream site-specific condition assessments will most likely be needed to help buyers better determine local NPS options that may have high and much more consolidated crediting potential. Such is the case for actual PS/NPS trades in all WQT programs.

It is therefore important to recognize the limitations of relying upon NPS runoff-based credits used in this analysis to meet demand, particularly in the driest time of the year (July – September) and in an arid setting. This again points to the inherent need for local knowledge of other exacerbating conditions in upstream watershed settings for PSs considering trades. Tapping into locally knowledgeable staff of Conservation Districts (CDs) for example, will be an important consideration for buyers seeking higher more concentrated crediting opportunities. CDs have unique experience in these regards, knowing areas with water quality concerns, and knowing and often having the trust of landowners to be able to cost-effectively engage them in dialogue.

There will also be large (non-wadeable) river settings for a portion of the 27 identified PSs where dilution considerations and TMDLs will ultimately drive permit limits. As such, current extrapolations from wadeable streams may not apply in the manner in which these have been used in these non-wadeable settings. In either setting, however, trading to meet high credit needs potentially requiring tens to hundreds of landowners to participate may simply be unrealistic. Thus, consideration for upgrades to interim variance limit treatment capacities and then completion of compliance needs with trading should be independently considered by each discharger with substantial demand.

The WWTP and NPS credit cost projections in this section should be taken as indicative of general trading conditions, and not be considered definitive. Approaches used in these regards are potentially sensitive to key parameters such as practice costs for TN and TP reduction, and obviously subject to improvement given more site and practice-specific data. Thus, these results should not be construed as the last word, but rather combined with full analysis of each WWTP setting, upstream watershed conditions and permit schedule impact on costs to more clearly address specific trading opportunities.

All of these particular conditions set the backdrop for the Business Case discussion for trading presented in the next and final section of this report.

6.0 THE BUSINESS CASE FOR WQT IN MONTANA

6.1 Overview

The business case analysis for a WQT program in Montana is presented in this section. The focus of business case development was on the potential volume of trades and the economic viability of WQT under Montana's trading policy Circular DEQ-13. To best facilitate the potential level of nutrient trading that might occur in Montana, the business case was to recommend the development of a formal trading framework under the trading policy to be supported by a one-time MDEQ investment. The business case analysis therefore explicitly focuses on findings of Sections 3 to 5 of this report. These analyses revealed a limited number of potentially viable PS/NPS trades in Montana. As such, the Project Team is recommending that MDEQ not invest in the development of a formal trading framework. Alternatively, we identify potential MDEQ investment opportunities that could better facilitate the limited expected trading as well as simplify associated MPDES permitting needs under the existing policy. Products of such investments could be addressed via appendices to the trading policy. These could also include simple tracking tools used by permit writers and PSs, and stakeholder outreach. We elaborate on these findings and recommendations in the remainder of this section.

6.2 WQT Potential in Montana

More than 200 WWTPs in the state were initially considered for trading potential as buyers of NPS credits from agriculture and forestry conservation practices. Only larger PSs and others with mechanical treatment capabilities were ultimately considered relevant for trading based on applicability under Circular DEQ-12B (Nutrient Standards Variances) and/or TDMLs. This resulted in 27 PSs subsequently identified with potential treatment upgrade needs to meet projected effluent limits (refer to Table 3-1). All treatment upgrade needs considered effluent limits projected by MDEQ in response to instream nutrient standards Circular DEQ-12A concentration limits and their period of application.

Of the 27 PS candidates for trading, only two facilities (Red Lodge and Kalispell) would not likely find sufficient Ag and/or forestry NPS credits to meet their TN demand as a function of geographically-limited upstream areas (refer to Table 5-1). Six facilities did not have sufficient NPS credits for TP to meet demand also largely as a function of limited upstream areas (i.e., $\leq$10 upstream HUC-12s for credit generation per PS). These PSs included Stillwater Mining, Red Lodge, Bozeman, Helena, East Helena, and Rocker (Table 5-2). TP demand for one facility (Hamilton) exceeded supply even with 52 upstream HUC-12s. TP supply limitations in all seven cases occurred even with a scenario of higher levels of Ag participation (at 25% of all upstream areas) and forestry (with 10% of upstream areas implementing forestry conservation practices). In total, NPS credit supply for TN and TP was only sufficient for 19 of the 27 PSs.

When ultimately comparing unit costs of NPS credits ($/credit) with equivalent unit costs for TN and TP facility upgrades ($/pound), even fewer trades appeared likely. In this analysis, only 14 WWTPs appear to have demand, supply and economic conditions that may lead them to consider trading, and then only for TN (refer to Table 5-7). These facilities (and their discharge classification) include:

- Western Sugar Cooperative (major)
- Missoula (major)
- Dillon (major)
- Bigfork (major)
- Miles City (major)
- Havre (major)

- Elkhorn Health Care (minor)
- East Helena (minor)
- Manhattan (minor)
- Conrad (minor)
- Montana Behavioral Health (minor)
- Rocker (minor)
- Lolo (minor)
- Absarokee (minor)

Of the six major dischargers, Missoula is the largest that might benefit from TN trades where credit costs are 31% of upgrade costs. Miles City would stand to save nearly 85% or $5M of projected upgrade costs with TN trading. Potential nitrogen treatment savings with NPS credits for all 14 potential buyers range from 1-31% of upgrade costs based on Table 5-7 cost assumptions. Of the more than $23M in projected upgrade costs for these 14 PSs to meet TN limits, equivalent TN trading costs are estimated at $3.2M, an approximate $20M savings over 20 years, at about an average of 14% of the cost of upgrades for all. From Table 3-2, these $23M upgrade costs represent over 85% of all projected upgrades for TN treatment at the 27 originally targeted facilities for trading.

Because NPS phosphorus credits considered herein ranged from an estimated $58-161/credit compared to equivalent unit upgrade costs of approximately $4-25/pound, trading for TP is not considered cost-effective for these facilities (nor any others).

Of particular note for any potential PS/NPS trading scenario in Montana is the limitation of NPS runoff-generated credits largely due to very low rainfall during the critical months of July to September (typically <2 inches) when instream nutrient standards must be met. In some cases as noted above, facilities are located in headwater areas where there is insufficient upstream land to generate such credits. For others, beneficial cost differentials between WWTP upgrades and NPS credits considered herein do not exist. Notably in some settings with larger facilities (see Section 4-6), the potential to obtain additional nitrogen offsets from septic system disconnects, though expensive, is possible and may be a feasible alternative where NPS TN credits are in short supply or too difficult to aggregate. Though not considered in this study because of a paucity in available research findings and/or site-specific details needed for credit calculations, nitrogen reductions from improved irrigation practice management are a possibility in select areas where upstream irrigation is present above a WWTP. Such options would need to be identified on a case-to-case basis.

There are perhaps, certain trading options that should be considered by any PS considering trading. For example, purchasing credits initially for TN could provide compliance for one or more permit cycles before plant upgrades necessary to meet future more stringent TN effluent limits would need to be implemented. Conversely, it might be advisable for certain facilities to upgrade in earlier permit cycles to meet second or third permit cycle nutrient targets, then use trading for a much smaller incremental level of required reductions with latter permit cycles. Such considerations revealed in the cost analysis for demand and supply (Table 5-7), reinforce a fundamental premise of trading; all potential buyers must each carefully examine their own particular needs and opportunities.

Based on these study findings, there appears to be a relatively limited number of potential PS/NPS trading opportunities in Montana. These are also likely to be spread out over four permit cycles. As such, we recommend that MDEQ:

- Not invest in formally developing any specific and/or prescriptive WQT program framework under CIRCULAR DEQ-13. Rather, MDEQ should simply allow PSs that might choose to trade, to best determine how they should each proceed under CIRCULARS DEQ-12A, 12B and 13 absent a formal WQT framework.
- Alternatively consider limited investments to write appendices to DEQ-13 that clarify and facilitate credit calculation methods, provide standardized forms for trading participants and lay out expectations for crediting project verification and aggregator participation.
- Consider limited investments in expenditures for public outreach and/or workshops related to DEQ-13 suggested appendices.

The remainder of this report discusses additional details of these recommendations.

6.3 Consideration of WQT Framework Elements

To facilitate potential PS/NPS trading in Montana, the Project Team originally proposed consideration of four WQT framework structures that could be developed with additional MDEQ investment to address the potential level of nutrient trading that might occur in Montana. Based on the limited number of potentially viable PS/NPS trades (and then just for TN), considerations for a WQT business case do not portend substantial benefits with formal framework development by MDEQ. In this light, it is still useful to elaborate on rationale for why frameworks would not apply, and alternatively, why various elements of select trading structures would still be useful for trading participant use and application. These framework element considerations are as follows:

- Bilateral trading: With a limited number of likely buyers in the Montana WQT market, building a prescriptive bilateral trading framework within the existing trading policy will not necessarily provide greater cost savings and/or facilitate more trades. Rather, the Project Team simply emphasizes here that bilateral trades will be the default approach for future credit exchanges under the current policy. This is appropriate and likely sufficient for the limited number of potentially participating PSs over the next four permit cycles (i.e., next 20 years). In this manner, buyers will negotiate directly with sellers. These trading conditions can best be stipulated in the MPDES permit with standard permit writing and specific regulatory review per the Montana trading policy. Thus, the basis for trading would still remain within individual MPDES permits with reporting requirements and other trading policy elements remaining as the responsibility of the point source.

- Brokerage/aggregator models: Where Montana PSs have significant credit demand (particularly for TN), there will be opportunities for brokers and aggregators to assist buyers to find credits. The Miles City example is illustrative of where a PS might find it difficult or undesirable to attempt to find and negotiate with several different individual landowners. They would potentially need to secure credits where there could likely be hundreds of potential credit generators depending on the types of practices or projects considered for generating credits. Third parties may therefore be sought out by buyers to find and/or sell aggregated credits. Local knowledge of farming operations and landowners would likely be a key element to the success of third party brokers and/or aggregators. The basis for trading contracts would remain as a bilateral negotiation between a buyer and third party with the permit still representing the trading instrument. With the limited number of potential buyers, and with the trading policy already recognizing intermediaries, creation of a new framework around aggregator/broker participation does not appear to be necessary.

- Clearinghouse structure: The geographically sparse demand for credits, and the variable timing of need, coupled with the challenge of securing sufficient credit seller interest in a

limited demand market, does not justify MDEQ investment in a clearinghouse program structure. This is particularly true for a state-run clearinghouse that might be similar to PennVEST in Pennsylvania where there is one authorized public entity that holds and manages all credits for buyers and sellers in larger market settings for the entire state. This does not necessarily exclude the opportunity for private investment in such a functioning structure that would otherwise still operate under Montana trading policy. However, the substantial costs to MDEQ to create a separate entity, or to integrate this into a currently operating state governance structure, do not appear warranted at this time.

- Watershed-based program plans: It is possible that in a few instances in the upper Yellowstone and the central section of the Missouri River around Helena, that collaboration between point sources could facilitate trading. PS collaboration to jointly pursue and secure credits could provide buyer cost-savings through reduced transaction costs. (Analyses in this study assumed 20% transaction costs with credits.) This trading plan approach could be similar to Ohio's WQT Rules where one trading plan is established to address multiple potential buyers in a watershed where there is collective need for credits amongst multiple buyers, though principally driven by a TMDL. This would not, however, necessarily require a MDEQ investment or modification of the trading policy. The opportunity for point sources to collaborate to secure credits is not necessarily precluded by the policy now. Thus, a WQT plan that would involve multiple point sources in a specific basin could provide a means to pool resources and provide cost-savings through collaboration. This again is where a credit aggregator or other third-party entity could help manage such an effort. Regardless of pooled resources, the basis for trading would still remain within individual MPDES permits, and/or with these reflecting TMDL wasteload allocations. As there are numerous uncertainties as to what circumstances and where such pooled resources could be beneficial, PSs would need to specifically and jointly examine these opportunities. Thus, a one-time MDEQ investment in supporting such coalitions or advancing any particular framework structure in these regards is speculative at this time and is not recommended.

In summary, MDEQ recognition of bilateral exchanges as the default mechanisms for trades with the MPDES permit serving as the legal instrument, does not require MDEQ trading framework/program investment. Opportunities for broker or aggregator participation already exist under the trading policy. Thus, there are no obvious benefits for MDEQ investments to develop some prescriptive or enabling aggregator framework under the policy for supporting future trades in what evidence suggests will be a thin market.

That said the Project Team identifies here alternative options for MDEQ investments to support the trading policy that would encourage trading participation and ease administrative burdens and uncertainty for participants and MDEQ. In turn, these should reduce administrative costs of trading for participants and MDEQ. These are defined in the following section with estimated costs for development and institutionalization along with long-term sustainability considerations. These sustainability considerations for one-time MDEQ investments are based on the likely limited market size projected by this study. Costs are best professional estimates assuming MDEQ retention of outside experts to assist in development of recommended elements to support the trading policy.

6.4 Recommendations for Potential MDEQ Investments to Support Circular DEQ-13

Bilateral trades through MPDES permits should include the necessary checks and balances to ensure credibility of trade transactions. Assurances are necessary for regulators and regulated entities that compliance goals are being met through NPS trades, as well as public assurances that water quality is being protected. Methods for ensuring trading credibility include providing

transparency through regular reporting and requiring third-party verification of credit-generating practices. We describe here the essential elements for these mechanisms to illustrate why the Project Team recommendations merit MDEQ consideration for one-time investments. Fundamentally, trading under Montana policy should be reflected in each MPDES permit with standardized approaches that would provide for consistent and repeatable applications. Investment recommendations therefore focus on:

- Standardized verification, tracking and reporting of trades
- Standardized credit estimation
- Clearly defined aggregator/broker roles
- Outreach workshops for potential market participants
- Outreach training for potential aggregators/brokers on relevant policy considerations.

We provide here, additional considerations for developing these recommended elements to support trading. Where appropriate, such information might best be developed as recognized appendices to CIRCULAR DEQ-13.

6.4.1 Verification, Tracking and Reporting

Bilateral trading under the WQT policy should provide the mechanisms and/or guidelines for credit verification, tracking of credit use, and reporting to ensure trading credibility and provide transparency.

Verification of credit generating practices is a crucial component which ensures credibility, transparency, and maintenance of best practices in water quality trading programs. Verifiers are typically accredited experts who act as third party reviewers or auditors. They work directly, in the field with credit generating project developers to ensure that practices are implemented and functioning as planned. While specific roles and responsibilities may vary in form between programs or even project sites, general verification processes typically follow the same patterns. Verification objectives under the Montana trading policy should define the roles, function, protocols and requirements for third-party verifiers. Roles should consider: 1) reviewing credit estimations; 2) verifying measurement accuracy; and 3) submitting a verification report. Throughout the verification process, verifiers will likely complete summary reports which may or may not be fully disclosed to the public, as well as field notes with opinions of credit estimates, activities, and any other relevant findings. Thorough recording of verification activities, again, supports trading transparency and the accurate application of crediting values.

For tracking water quality trades, the creation of a simple and consistent format for relevant information through the development of standardized tracking forms. Tracked activities of trades could be performed by the buyer and/or their aggregator representative to document, for example:

- Credit generation
  - Practice type
  - Types of implemented crediting practices
  - Acres treated by each practice
  - Nutrient reductions generated by each practice
  - Cost of practice implementation
  - Location of each practice

    - Landowner contact information
    - Unit cost of reductions
- Trade transaction
    - Buyer contact information
    - Seller contact information
    - Credit sale price
    - Number of credits associated with trade agreement
- Practice verification information
    - Verifier's identification
    - Practice inspection dates
    - Status of implemented practices
    - Identification of practice deficiencies

For program reporting, it is necessary to maintain a balance between the need for public transparency and maintaining confidential, private information. Not all information that is tracked and managed by the buyers, sellers and/or aggregators will necessarily need to be made public. Reports on select trading activities provided to the public will, however, balance the need for transparency with the desire to maintain the privacy of participants. Many agricultural producers, for example, may be reluctant to participate in a program that will disclose information about the individual or farm operations. As such, care should be taken to respect the privacy of program participants. In some instances, private information (such as names and contact information) can be excluded from public documentation. In addition, certain information can be aggregated to address privacy concerns.

Public reporting of activities must be consistent with Montana trading policy while specific actions or activities can be more efficiently captured and reported in standardized forms which might include the following:

- Total BMPs implemented by practice type
- Total credits generated
- Number of credit transactions
- Total number of buyers
- Total number of sellers

Monthly trading credits used for compliance should be reported on monthly DMRs. MDEQ should produce an annual summary of trades conducted within each permit. This can be accomplished by tracking these in a spreadsheet based on DMR information. The MDEQ would maintain this simple "registry" of trade transactions to track and document credit exchanges.

Recommended elements for MDEQ investment under these topics therefore include development of:

1. Draft permit language for defining these trading expectations in permits
2. Recommended buyer tracking elements and forms
3. Third-party verification requirements, forms and protocols
4. Modifications for DMRs to include trading credit use
5. Simple MDEQ tracking format for MDEQ use and public disclosure

Given the general availability of these types of trading elements from other established programs, anticipated one-time MDEQ investment costs for these would likely range from $25,000-$50,000.

6.4.2 Credit Estimation Methods

Consistent and standardized methods for calculating nutrient reduction credits should be defined and adopted by MDEQ under CIRCULAR DEQ-13. In all trades, it is necessary to estimate/quantify the nutrient reductions generated from each implemented practice intended to produce TN and TP reductions. One set of tested and approved credit calculation methods will help streamline assessment of trading opportunities by buyers as well as permit reviews by MDEQ. Documentation and training on proper application of credit calculators are necessary for trading participants. In addition, a standardized method for calculating trade ratios to address buyer/seller location considerations as outlined in the trading policy, should be established.

Recommended elements for MDEQ investment under this topic therefore include development of:

1. A list of readily acceptable practices expected to generate credits
2. Selection, review and documentation of acceptable methods currently in use in Montana and/or elsewhere as they apply to potential credit-generating practices
3. Development of use protocols to ensure consistent application and interpretation of assumptions used in the calculation methods
4. Development of a standardized approach to calculate trade ratios
5. Training workshops for use and proper application of these methods

Numerous other methods, models and protocols exist from other trading programs that will bolster application of existing Montana calculation methods and/or provide options where these do not already exist. As such, recommended methods should be evaluated for their appropriate use and application in Montana, properly vetted and ultimately accepted for use by MDEQ. These could be provided for use in an appendix to DEQ-13 and be periodically updated as part of other ongoing development within other existing MDEQ program applications. Anticipated one-time MDEQ investment costs for these efforts would likely range from $75,000 - $125,000.

6.4.3 Defining Broker/Aggregator Roles

Bilateral trades are commonly executed through brokers and/or aggregators in existing WQT programs. These third party roles can simplify buyer needs for finding disaggregated NPS credits and facilitate a number of contractual and regulatory requirements of trades. Trading brokers typically negotiate with credit generators (e.g., landowners), can verify management practice installation and operation, and establish trading contracts between participating landowners and the buyers. They provide support for, but do not typically retain any contractual obligations with credit generation or maintenance of credits for a buyer. Such are the typical roles for credit aggregators.

A credit aggregator in PS/NPS trading programs is an entity that purchases credits from multiple nonpoint sources, and re-sells them to an interested buyer(s). The aggregating individual or entity finds, purchases, and compiles credits from multiple individual credit generators (typically NPSs) to bundle and sell to permitted facilities seeking trading credits. Credit aggregation in WQT programs is becoming an increasingly popular method for bolstering trading markets, particularly in easing access to the market for both nonpoint and point source participants. Aggregators are

typically trusted purchasers of credits and can take much of the risk out of participation in nonpoint source credit generating projects, thereby encouraging participation in the market. Further, aggregators, often having already performed the work of collecting or securing credits from existing or proposed projects, make it much easier for point sources such as WWTPs looking to buy credits by purchasing a bundle of credits they need. By performing these roles, aggregators can reduce both costs and risks of participation in water quality trading markets.

Specific roles and duties of aggregators (and to a much lesser degree, of brokers) may include:

1. Understanding program policies, including approval processes and contracting standards
2. Understanding basic market factors, including the ability to undertake baseline and market viability analyses
3. Completing sales transactions, including comparative cost analyses, certification processes, market pricing discovery, regulatory sales approvals, negotiating contracts and working with verifiers
4. Entering into trading contracts, including scheduling payments, establishing prices and durations of trades, insuring credits in case of deficits, transferring civil contract liability, understanding monitoring and maintenance needs, and other program regulations
5. Funding and managing the project, including managing landowner payments and ensuring cash flow to cover implementation
6. Managing a diverse credit portfolio, including multiple generators and inherent structural differences
7. Assuming and managing market risks and insuring projects

Relevant benefits of these market participants, particularly aggregators, can include the following.

Reducing Risks:

Incorporating aggregators into WQT markets can reduce inherent market risks for credit generators and purchasers. This reduced risk results primarily from delinking contractual liability between regulated entities and unregulated nonpoint sources. Thus, the aggregator absorbs both delivery and performance risks, thereby easing buyer and seller access to markets. An aggregator's credit portfolio diversifies the quantity and character of projects while reserve credits absorb the risks of delivery or implementation failure.

Reducing Program Costs

Transaction costs tend to increase with the involvement of nonpoint sources. This is due in part to their broader spatial distribution, limited knowledge for credit generation capacity, and unfamiliarity or distrust of environment markets and/or regulations. Costs for buyers in settings with disaggregated NPS credits may therefore include site-specific project identification, contractor search and negotiation, management and policing of multiple contracts from a variety of sellers, and more.

Aggregators, however, can reduce capital costs through economies of scale. In an aggregated scheme, transaction costs are initially covered by the aggregator. Thus, point sources are not responsible for the costs of finding enough NPS credit generators to fulfill their demand needs, NPSs can work with a trusted entity, the aggregator, to more easily enter into market transactions. Though there are costs associated with using aggregators (who typically recoup all costs, including profit in the case of private sector aggregators) these should be relatively lower overall than expenses associated with a disaggregated system of credit purchases.

Easing Access to Trading

Just as aggregators and/or brokers can reduce program transaction costs, so do these roles ease access to trading. By helping a scattered group of smaller projects to function like on large project through credit bundling or buyer consolidaton, the typical barriers inhibiting investments into small projects are mitigated. This eases access for both NPS credit generators and point source offset purchasers, who no longer need to establish a relationship between one another.

As such, recommended elements for MDEQ investment under this topic include development of:

1. Establishment of MDEQ expectations and/or qualifications of potentially eligible brokers/aggregators
2. Development of protocols, documentation and reporting requirements for these third parties consistent with and in addition to above recommendations
3. Workshops to promote broker/aggregation opportunities in select watersheds where trading might be pursued, and to train potential third party interests in the use and application of established protocols.

There are a number of aggregators and functioning broker/aggregator models from other trading programs to allow for the sufficient development of MDEQ expectations of these potential roles in Montana. Any documentation prepared by MDEQ could remain as recommendations without any formal approval requirements, or be captured as an appendix to DEQ-13. As such, anticipated investment costs for these efforts are estimated at $25,000 - $45,000.

6.5 Business Case Summary

Based on analyses presented in this report, the market for nutrient trading in Montana appears to be thin. A limited number of WWTPs may find that the demand, supply and economic efficiencies of trading are suitable for their settings. These conditions will also vary over the next 20 years and corresponding four permit cycles. In such cases, trading may provide substantial cost savings over more expensive facility upgrades. Thus, this study recommends limited MDEQ investments to facilitate WQT by enhancing and standardizing opportunities that already exist under Montana trading policy. This study is not recommending MDEQ investment in more prescriptive requirements for development of a formal WQT framework to implement the policy.

Formal trading frameworks may be appropriate where higher trading volumes are anticipated. This is not necessarily the case in Montana. Bilateral trades within the context of the MPDES permit instrument and existing trading policy will be the most likely mechanism for such transactions. These can, however, be facilitated under the existing policy with standardization of information tracking, reporting and credit estimation methods, as well as clarification of roles for credit verifiers and third-party trading facilitation (i.e., aggregators and brokers). These efforts would provide consistency in trading policy applications for both buyers and MDEQ. They would also ease access to trading participation for buyers and sellers without unnecessarily creating long-term programmatic burdens on MDEQ. The Project Team recommends MDEQ consider one-time investment in supporting the development of these additional elements under existing trading policy.

These recommended investments are estimated to minimally range from $150,000-$220,000 assuming outside contractor assistance. Future obligations such as any annual public reporting by MDEQ of trading activity can be facilitated by development of a simple, spreadsheet-like registry as part of MDEQ investments. Associated annual costs would be recurrent if there was

trading activity, though these could most likely be integrated into existing staff and related program responsibilities. Decision-making on protocols and participation in recommended workshops and outreach would require additional staff time commitments from MDEQ.

Overall, this investment strategy facilitates what will likely be limited trading through bilateral exchanges between buyers and sellers and/or buyers and aggregators. It eliminates the need for formal program development and management. Trading integrated into the existing permit process should be within the current purview of permit writers. Buyers and sellers will therefore bear the bulk of responsibilities for trading. Aggregators and/or brokers can negotiate their own contractual arrangements with buyers, though operating within consistent and recommended roles that would be set forth with additional MDEQ investments.

MDEQ investment at this time is not deemed as essential by the Project Team for future WWTP application and use of the trading policy. MDEQ investment in some or all of the recommended elements will simply help facilitate trades and reduce future costs associated with transactions and administration of potential trades. Fundamentally, all additional elements developed to facilitate trades under the existing policy, could be documented in appendices to DEQ-13, and readily integrated into existing MDEQ program functions.

APPENDIX A

LIST OF POINT SOURCE DISCHARGERS IN MONTANA
UNDER PERVUE OF MONTANA DEQ
and
DMR ANALYSIS SHEET FOR EACH DISCHARGER
FROM JANUARY 2010 THROUGH AUGUST 2014

List of All Montana Point Source Dischargers under MDEQ pervue with Nutrients in Effluent

(blue shaded, also astericked, discharges were removed from study - see text for explanation)

Large River Dischargers

NPDES ID	Description	Population	Latitude	Longitude	Effective Date	Expire Date	Design Flow	Actual Flow	Size	Type	HUC12 Watershed	Large River
MT0022586	BILLINGS	104,170	45.802500	-108.466944	11/1/2014	10/31/2019	26	15.8	Major	M	100700041006	Yellowstone
MT0021920	GREAT FALLS	58,505	47.519889	-111.300778	12/1/2010	11/30/2015	21	9.51	Major	M	100301021201	Missouri
MT0020001	MILES CITY	8,410	46.430550	-105.830900	4/1/2011	3/31/2016	1.98	1.16	Major	M	101000012602	Yellowstone
MT0020435*	LIVINGSTON	7,044	45.576389	-110.537500	11/1/2009	10/31/2014	2	1.048	Major	M	100700020504	Yellowstone
MT0020311	LAUREL	6,718	45.657500	-108.752222	7/1/2009	6/30/2014	0.5	0.92	Major	M	100700040602	Yellowstone
MT0030358*	HARDIN	3,505	45.735000	-107.581111	10/1/2011	9/30/2016	1	0.59	Major	M	1008001506090	Big Horn
MT0020494*	LIBBY	2,628	48.376639	-115.556044	9/1/2009	8/31/2014	0.511	0.26	Major	M	170101011005	Kootenai
MT0020397	BIGFORK	4,270	48.063780	-114.083100	8/1/2010	7/31/2015	0.69	0.23	Major	M	170102080501	Flathead
MT0021628*	GLENDIVE	4,933	47.137222	-104.680000	12/1/2007	11/30/2012	1.8	0.23	Major	M	101000041206	Yellowstone
MT0000396*	CORETTE THERMAL PLANT		45.776230	-108.480870	4/1/2000	3/31/2005	131		Major		100700041008	Yellowstone
MT0000507*	MDU - LEWIS & CLARK PLANT		47.676080	-104.160920	12/1/2000	11/30/2005	42.43		Major		101000042209	Yellowstone
MT0028921*	EXXON MOBIL BILLINGS REFINERY SUCTION DREDGE		45.813904	-108.433295	6/1/2008	5/31/2013	5.86		Minor		100700070403	Yellowstone
MT0000477*	EXXONMOBIL REFINING & SUPPLY		45.813904	-108.433295	11/1/2003	10/31/2008	2.71		Major		100700070403	Yellowstone
MT0000256*	CONOCOPHILLIPS - BILLINGS REFINERY		45.776389	-108.484444	12/1/2009	11/30/2014	2.66		Major		100700041006	Yellowstone
MT0000264*	CENEX HARVEST STATES COOP		48.659230	-108.757780	11/1/1999	4/30/2004	2.174		Major		100700040602	Yellowstone
MT0030180	YELLOWSTONE ENERGY LIMITED PARTNERSHIP FACILITY		45.813333	-108.440278	5/1/2014	4/30/2019	0.25		Minor		100700070403	Yellowstone
MT0030066*	COLUMBIA FALLS ALUMINUM CO		48.387778	-114.135556	9/1/2014	8/31/2019	0.6		Major		170102080102	Flathead
MT0000388*	MONTANA RAIL LINK -LIVINGSTON RAIL YARD		45.674444	-110.536111	9/1/2017	8/31/2017	0.13		Minor		100700020504	Yellowstone
MT0020066*	SUPERIOR	812	47.105667	-114.905528	7/1/2014	6/30/2019	0.187	0.024	Minor	L	170102040701	Clark Fork
MT0021555*	ALBERTON	420	47.002889	-114.484167	9/1/2013	8/31/2018	0.0793	0.12	Minor	L	170102040601	Clark Fork
MT0030465*	PLAINS	1,046	47.467880	-114.927490	10/1/2005	9/30/2014	0.217	0.106	Minor	L	170102130100	Clark Fork
MT0580035*	THOMPSON FALLS	2,313	47.594870	-115.357050	1/1/2013	12/31/2017	0.144	0.046	Minor	L	170102130902	Clark Fork
MT0021401*	THREE FORKS	1,860	45.898889	-111.525889	1/1/2009	12/31/2013	0.45	0.22	Minor	L	100200071505	Madison
MT0021601*	FORT BENTON	1,464	47.825556	-110.647778	10/1/2013	9/30/2018	0.28	0.13	Minor	L	100301021502	Missouri
MT0580019*	FORT PECK	233	48.017778	-105.441944	1/1/2013	12/31/2017	0.0475	0.004	Minor	L	100600010102	Missouri
MT0580020*	TOWNSEND	1,878	46.329444	-111.535278	1/1/2013	12/31/2017	0.6	0.25	Minor	L	100301010906	Missouri
MT0020752*	BIG TIMBER	1,941	45.843056	-109.929167	5/1/2017	4/30/2017	0.29	0.07	Minor	L	100700020909	Yellowstone
MT0021768*	FORSYTH	1,777	46.276667	-106.658889	5/1/2014	4/30/2019	0.54	0.34	Minor	L	101000011202	Yellowstone
MT0021709*	HYSHAM	312	46.308889	107.248056	1/1/2010	12/31/2014	0.1	0.011	Minor	L	101000010307	Yellowstone
MT0031845*	SIDNEY	5,191	47.697780	-104.118889	3/1/2014	2/28/2019	1.4	0.92	Major	L	101000042704	Yellowstone
MT0022705*	GARDINER	875	45.045361	-110.743528	8/1/2007	7/31/2012	0.23	0.26	Minor	L	100700010902	Yellowstone
MT0024783*	SAVAGE	75	47.455000	-104.331667	10/1/2013	9/30/2018	0.0195	0.041	Minor	L	101000042202	Yellowstone
MT0580007*	PARK CITY	983	45.672222	-108.391111	1/1/2013	12/31/2017	0.18	0.19	Minor	L	100700040601	Yellowstone
MT0580017*	TERRY	605	46.902680	-105.399190	1/1/2013	12/31/2017	0.171	0.0508	Minor	L	101000040105	Yellowstone
MT0580018*	COLUMBUS	1,893	45.624111	-109.232306	1/1/2013	12/31/2017	0.25	0.13	Minor	L	100700040401	Yellowstone
MT0580025*	FALLON	164	46.843056	-105.118611	1/1/2013	12/31/2017	0.03	0	Minor	L	101000040705	Yellowstone

Industrial Dischargers to Wadeable Streams

NPDES ID	Description	Population	Latitude	Longitude	Effective Date	Expire Date	Design Flow	Actual Flow	Size	Type	HUC12 Watershed
MT0000281	WESTERN SUGAR COOPERATIVE		45.770000	-108.500833	12/1/2009	11/30/2014	9.36		Major		100700041006
MT0000191*	MONTANA RESOURCES		46.007588	-112.501703	9/1/2012	8/31/2017	5.04		Major		170102010203
MT0000130*	MONTANA SULPHUR & CHEMICAL CO		45.813530	-108.428100	4/1/2014	3/31/2019	3.3		Minor		100700070403
MT0000884*	BIG SKY COAL COMPANY - BIG SKY MINE		45.800833	-106.666667	7/1/2011	6/30/2016	3.05		Minor		101000020302
MT0030774A	FIDELITY - TONGUE RIVER PROJECT WTP		45.004944	-106.827980	11/14/2010	11/13/2015	2.44		Minor		100901010301
MT0029891*	BARRETTS MINERALS INC		45.129444	-112.308833	6/1/2014	5/31/2019	1.9		Minor		100200020804
MT0000249*	SIDNEY SUGARS INCORPORATED		47.717500	-104.120278	12/1/2009	11/30/2014	1.3		Major		101000042704
MT0029950*	REC ADVANCED SILICON MATERIALS LLC		45.972611	-112.689750	11/1/2010	10/31/2015	1.15		Minor		170102010203
MT0000892*	DECKER COAL CO (WEST MINE)		45.053778	-106.822055	5/1/2012	4/30/2017	1.12		Major		100901010501
MT0024716*	STILLWATER MINING COMPANY		45.381052	109.877124	11/1/2008	10/31/2013	0.94		Minor		100700050204
MT0024210*	DECKER COAL CO (EAST MINE)		45.063830	-106.788930	5/1/2012	4/30/2017	0.89		Major		100901010501

MT0026808	STILLWATER MINING COMPANY		45.502500	-110.083889	8/1/2000	7/31/2005	0.648		Minor		100700020701		
MT0033604*	WESTMORELAND SAVAGE CORP - SAVAGE MINE		47.471100	-104.427750	2/1/2011	1/31/2016	0.576		Minor		101000042202		
MT0028953*	BULL MOUNTAIN MINE #1		46.272810	-108.423520	5/1/2013	4/30/2018	0.36		Minor		100402012301		
MT0031593*	JAMES GUSBCID - DW RANCH		45.136278	-106.476750	2/1/2011	1/31/2016	0.19		Minor		100901010703		
MT0030147*	ASARCO INC		46.591600	-111.918300	8/1/2010	7/31/2015	0.14		Minor		100301011310		
MT0027821*	BEAVERHEAD TALC MINE		45.210446	-112.344642	1/1/2007	12/31/2011	0.1		Minor		100200020604		
MT0021431	MT BEHAVIORAL HEALTH INC WWTP		46.237222	-112.776528	8/1/2012	7/31/2017	0.1		Minor		170102010405		
MT0000019*	DN WHITEFISH FACILITY		48.411944	-114.144167	11/1/2009	10/31/2014	0.1		Minor		170102100508		
MT0023639*	BOULDER HOT SPRINGS WWTP		46.206330	-112.083910	8/1/2009	7/31/2014	0.1		Minor		100200060402		
MT0023566	ELKHORN HEALTH CARE WWTP		46.449444	-111.985278	11/1/2009	10/31/2014	0.02		Minor		100301011303		
Municipal Dischargers to Wadeable Streams > 1,000 populatioin													**Disharge**
NPDES ID	**Description**	**Population**	**Latitude**	**Longitude**	**Effective Date**	**Expire Date**	**Design Flow**	**Actual Flow**	**Size**	**Type**	**HUC12 Watershed**		**Months/Yr**
MT0022594	MISSOULA	66,788	46.874160	-113.994600	11/1/2006	10/31/2011	8.99	7.06	Major	M	170102040104		12
MT0022608	BOZEMAN	37,280	45.722778	-111.067778	6/1/2012	5/31/2017	5.784	5.546	Major	M	100200081301		12
MT0022012	BUTTE	33,525	45.996960	-112.553600	4/1/2012	3/31/2017	8.5	3.784	Major	M	170102010204		12
MT0022641	HELENA	28,190	46.619167	-112.005000	10/1/2012	9/30/2017	6	3.06	Major	M	100301011310		12
MT0021938	KALISPELL	19,927	48.176690	-114.309360	9/1/2008	8/31/2013	5.4	2.7	Major	M	170102080208		12
MT0020044	LEWISTOWN	5,901	47.064060	-109.424980	9/1/2012	8/31/2017	2.83	1.87	Major	M	100401030706		12
MT0022535	HAVRE	9,310	48.559444	-109.662500	5/1/2011	4/30/2016	1.8	1.55	Major	M	100500040404		12
MT0020028	HAMILTON	4,348	46.253300	-114.175790	9/1/2011	8/31/2016	1.984	0.642	Major	M	170102051007		12
MT0020036*	COLUMBIA FALLS	4,688	48.356111	-114.214167	5/1/2010	4/30/2015	0.55	0.415	Minor	M	170102080103		12
MT0022713*	STEVENSVILLE	1,909	46.511940	-114.104440	7/1/2012	6/30/2017	0.35	0.421	Minor	M	170102051305		12
MT0022560	EAST HELENA	1,984	46.589460	-111.921020	10/1/2009	9/30/2014	0.631	0.372	Minor	M	100301011310		12
MT0021458	DILLON	4,134	45.230556	-112.618611	3/1/2010	2/28/2015	1.1	0.361	Major	M	100200020603		12
MT0020168	LOLO	3,897	46.774670	-114.070210	8/1/2007	7/31/2012	0.25	0.213	Minor	M	170102051603		12
MT0020079	CONRAD	2,570	48.204444	-111.919167	2/1/2012	1/31/2017	0.65	0.169	Minor	M	100302030705		12
MT0021857	MANHATTAN	1,520	45.877080	-111.332420	9/1/2010	8/31/2015	0.4	0.132	Minor	M	100200081401		12
MT0022616	DEER LODGE	3,111	46.429167	-112.739167	3/1/2013	2/28/2018	2.4	1.27	Major	(M)	170102010707		12
MT0020478	RED LODGE	2,125	45.213389	-109.240861	3/1/2009	2/28/2014	0.285	0.59	Minor	L	100700060906		12
MT0021211*	GLASGOW	3,250	48.180278	-106.624167	9/1/2013	8/31/2018	1	0.39	Minor	L	100500121001		12
MT0021750	ABSAROKEE	1,150	45.531111	-109.440000	2/1/2010	1/31/2015	0.35	0.256	Minor	L	100700050406		12
MT0020052*	CHOTEAU	1,684	47.795556	-112.178333	12/1/2010	11/30/2015	0.3	0.486	Minor	(M)	100302050401		12
MT0031488*	SHELBY	3,575	48.483333	-111.834722	5/1/2014	4/30/2019	0.254	0.19	Minor	L	100302030802		9
MTG580032*	EUREKA	1,037	48.890556	-115.080833	1/1/2013	12/31/2017	0.35	0.075	Minor	L	170101010306		9
MT0023078*	BOULDER	1,183	46.224722	-112.103333	3/1/2010	2/28/2015	0.2	0.065	Minor	(M)	100200060503		12
MT0027430	ROCKER	100	46.004167	-112.623611	6/1/2013	5/31/2018	0.035	0.022	Minor	M	170102010204		12
MT0020656*	HINSDALE	217	48.396667	-107.083056	8/1/2012	7/31/2017	0.03	0.017	Minor	M	100500100401		12
MT0020295*	ROUNDUP	1,788	46.448389	-108.521944	11/1/2013	10/31/2018	0.35	0.09	Minor	L	100402020401		0
MT0020141*	CUT BANK	2,869	48.637222	-112.309722	3/1/2012	2/28/2017	0.04	0.075	Minor	L	100302020704		4
MTG580029*	BAKER	1,741	46.368720	-104.307830	1/1/2013	12/31/2017	0.35	0.011	Minor	L	101000050501		2
MT0020389*	MALTA	1,997	48.373333	-107.854444	6/1/2010	5/31/2015	0.37	0	Minor	L	100500041001		0
MT0020133*	WHITEHALL	1,033	45.869386	-112.095278	3/1/2009	2/28/2014	0.251	0	Minor	L	100200050204		0
Municipal Dischargers to Wadeable Stream < 1,000 population													
NPDES ID	**Description**	**Population**	**Latitude**	**Longitude**	**Effective Date**	**Expire Date**	**Design Flow**	**Actual Flow**	**Size**	**Type**	**HUC12 Watershed**		
MT0030732*	LINCOLN	838	46.854722	-111.715833	5/1/2014	4/30/2019	0.1	0.23	Minor	L	100300071205		
MTG580004*	MSH / WARM SPRINGS	980	46.185556	-112.777222	1/1/2013	12/31/2017	0.19	0.16	Minor	L	170102010401		
MT0020354*	HARLOWTON	997	46.425417	-109.799167	10/1/2009	9/30/2014	0.3	0.17	Minor	L	100402011004		
MT0020699*	WHITE SULPHUR SPRINGS	939	46.553722	-110.917500	5/1/2007	4/30/2012	0.18	0.102	Minor	L	100301030206		
MT0031500*	PHILIPSBURG	820	46.348056	-113.317500	8/1/2007	7/31/2012	0.16	0.077	Minor	L	170102020203		
MTG580011*	DARBY	720	46.020790	-114.177770	2/1/2013	12/31/2017	0.15	0.063	Minor	L	170102050306		
MT0020303*	BRIDGER	708	45.295556	-108.900278	8/1/2010	7/31/2015	0.124	0.058	Minor	L	100700060801		
MTG580016*	GERALDINE	261	47.600300	-110.253810	1/1/2013	12/31/2017	0.116	0.058	Minor	L	100401020503		
MT0021270*	HARLEM	898	48.502778	-108.792056	3/1/2013	12/31/2017	0.11	0.057	Minor	L	100300041302		
MTG580003*	FAIRFIELD	708	47.624167	-111.991778	1/1/2013	12/31/2017	0.11	0.056	Minor	L	100302050402		

MT0020249*	JOLIET	595	45.485556	-108.956250	9/1/2007	8/31/2017	0.67	0.054	Minor	L	100700060608	
MT0021571*	BELT	597	47.391500	-110.922508	6/1/2011	8/31/2016	0.155	0.035	Minor	L	100901050401	
MT0022462*	DENTON	355	47.322778	-109.333333	6/1/2010	7/31/2015	0.05	0.004	Minor	L	100401001204	
MT0020796*	CIRCLE	615	47.421944	-105.572778	6/1/2010	7/31/2015	0.071	0.032	Minor	L	100603020505	
MT0022454*	BIG SANDY	598	48.182500	-110.150833	7/1/2012	6/30/2017	0.0	0.032	Minor	L	100503060703	
MT0021792*	VALIER	569	48.315472	-111.239389	6/1/2010	7/31/2015	0.144	0.024	Minor	L	100802030102	
MTG580015*	BROADUS	468	45.449444	-105.597778	1/1/2013	12/31/2017	0.1	0.024	Minor	L	100902070305	
MT0021285*	JORDAN	543	47.316944	-106.885111	10/1/2011	9/30/2016	0.0465	0.017	Minor	L	100401050901	
MT0022080*	HIGHWOOD	176	47.585833	-110.810556	11/1/2010	10/31/2015	0.0258	0.016	Minor	L	100301021304	
MTG580033*	FROMBERG	428	45.395833	-108.901667	1/1/2013	12/31/2017	0.072	0.009	Minor	L	100700060801	
MT0020091*	STOCKETT	169	47.470278	-111.158333	9/1/2010	8/31/2015	0.054	0.005	Minor	L	100301020902	
MTG580034*	NASHUA	290	48.124167	-106.354167	1/1/2013	12/31/2017	0.05	0.0037	Minor	L	100500170002	
MTG580024*	MEDICINE LAKE	225	48.496920	-104.510170	1/1/2013	12/31/2017	0.045	0.0032	Minor	L	100600061306	
MT0020702*	WINNETT	182	47.009167	-108.343611	5/1/2012	4/30/2017	0.12	0.00505	Minor	L	100402040604	
MTG580012*	SACO	197	48.456519	-107.342432	1/1/2013	12/31/2017	0.067	0.0017	Minor	L	100500140704	
MT0020938*	CHESTER	847	48.500606	-110.962000	8/1/2012	7/31/2016	0.168	0	Minor	L	100300021703	
MT0020516*	WISAUX	383	48.994722	-104.184444	6/1/2012	5/31/2017	0.07	0	Minor	L	101102000207	
MT0021181*	STANFORD	401	47.155278	-110.199444	11/1/2009	10/31/2014	0.06	0	Minor	L	100401031202	
MT0021679*	SUNBURST	375	48.868056	-111.896667	11/1/2011	10/31/2017	0.051	0	Minor	L	100302020204	
MTG580023*	DUTTON	316	47.350083	-111.701389	1/1/2013	12/31/2017	0.07	0	Minor	L	100302050904	
MTG580002*	DRUMMOND	309	46.678056	-113.185278	1/1/2013	12/31/2017	0.075	0	Minor	L	170102020602	
MT0021636*	HOBSON	215	47.001944	-109.865833	11/1/2012	10/31/2017	0.029	0	Minor	L	100401030503	
MT0025038*	WILLOW CREEK	210	45.829667	-111.642417	9/1/2012	8/31/2017	0.03	0	Minor	L	100203050805	
MT0021452*	WINIFRED	208	47.561944	-109.374278	4/1/2012	3/31/2017	0.02	0	Minor	L	100401050504	
MTG580013*	LAVINA	187	46.290278	-108.929444	1/1/2013	12/31/2017	0.0210	0	Minor	L	100302012304	
MTG580028*	FROID	185	48.136833	-104.459722	1/1/2013	12/31/2017	0.04	0	Minor	L	100600061604	
MT0030244*	KEVIN	254	48.748667	-111.950472	10/1/2011	9/30/2016	0.03	0	Minor	L	100302010304	
MTG580022*	BRADY	147	48.043611	-111.847778	1/1/2013	12/31/2017	0.02	0	Minor	L	100302051001	
MT0030309*	GRASS RANGE	110	47.043889	-108.810000	9/1/2011	8/31/2016	0.04	0	Minor	L	100402040405	
MTG580026*	OUTLOOK	96	48.876111	-104.761389	1/1/2013	12/31/2017	0.012	0	Minor	L	100600060501	
MT0031437*	SWEET GRASS	75	48.998556	-111.953833	11/1/2013	10/31/2015	0.014	0	Minor	L	100302030201	

*Removed from study, see text for explanation.

Miles City WWTP				MT0020001
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.91	1.09		2.92
02/28/2010	1.02	1.13		2.43
03/31/2010	1.12	1.24		2.44
04/30/2010	1.13	1.29		1.37
05/31/2010	1.28	2.23		2.79
06/30/2010	1.35	1.61		2.36
07/31/2010	1.32	1.73		2.16
08/31/2010	1.26	1.36		2.53
09/30/2010	1.24	1.35		2.23
10/31/2010	1.1	1.27		3.08
11/30/2010	1.02	1.08		3.25
12/31/2010	1.07	1.14		2.4
01/31/2011	1.11	1.29		2.4
02/28/2011	1.07	1.35		2.38
03/31/2011	1.18	1.55		2.39
04/30/2011	1.26	2.23	21.5	2.3
05/31/2011	1.96	3.22	14.2	1.01
06/30/2011	2.12	2.39	16.3	1.25
07/31/2011	1.82	20.5	15.9	1.76
08/31/2011	1.44	1.55	16.1	2.05
09/30/2011	1.25	1.35	20.9	2.27
10/31/2011	1.13	1.27	27.7	2.34
11/30/2011	1.04	1.12	26.2	2.17
12/31/2011	0.97	1.05	23.8	2.19
01/31/2012	0.92	1.02	24.9	1.94
02/29/2012	1	1.15	24.9	2.67
03/31/2012	1.02	1.08	25.4	2.7
04/30/2012	0.97	1.05	24.8	2.5
05/31/2012	0.94	1.06	27.4	2.96
06/30/2012	1	1.11	26	2.7
07/31/2012	1.05	1.48	13.3	2.3
08/31/2012	1.02	1.11	22.1	2.89
09/30/2012	0.96	1.04	28.7	3.68
10/31/2012	0.91	0.97	36.6	3.28
11/30/2012	0.86	0.93	26.7	2.5
12/31/2012	0.88	0.96	29.6	2.8
01/31/2013	0.92	0.95	34.9	3
02/28/2013	0.93	0.98	29.9	2.1
03/31/2013	0.94	1	35.3	3.14
04/30/2013	0.97	1.08	32	2.8
05/31/2013	1.13	1.9	29.6	3.08
06/30/2013	1.18	1.38	23.7	2.15
07/31/2013	1.14	1.32	21.9	2.45
08/31/2013	1.17	1.28	15.4	2.5
09/30/2013	1.09	1.28	27.7	2.93
10/31/2013	0.99	1.07	29.5	3.38
11/30/2013	0.98	1.04	25.3	2.78
12/31/2013	0.98	1.06	9.1	2.62
01/31/2014	1.03	1.25	23.2	2.08
02/28/2014	1.08	1.23	11.1	2.44
03/31/2014	1.25	1.42	24.1	2.74
04/30/2014	1.21	1.37	22.8	2.32
05/31/2014	1.17	1.53	22.2	2.36
06/30/2014	1.23	1.64	19.1	2.18
07/31/2014	1.22	1.29	20.2	2.71
08/31/2014	1.13	1.42	22.2	2.82
Average	**1.133**	**1.676**	**23.712**	**2.499**
Median	**1.085**	**1.270**	**24.100**	**2.445**
90th Percentile	**1.300**	**1.815**	**29.900**	**3.080**
Summer Ave.	**1.222**	**2.719**	**20.400**	**2.520**
Population	8,410	Influent->	29.4	7.00
	135	216	18%	65%
	gpcd ave	gpcd max	removal	removal

Lolo WWTP				MT0020168
	Flow Monthly Ave	Flow Daily Max	Effluent TN (mg/l)	Effluent TP (mg/l)
01/31/2010	0.23	0.32	26.1	6.19
02/28/2010	0.22	0.26	27.3	4.28
03/31/2010	0.22	0.3	21.4	4.41
04/30/2010	0.22	0.28	22	4.01
05/31/2010	0.22	0.25	25.6	4.55
06/30/2010	0.19	0.27	26.9	5.95
07/31/2010	0.2	0.28	26.9	5.64
08/31/2010	0.2	0.22	22	5.32
09/30/2010	0.21	0.23	20.5	4.73
10/31/2010	0.22	0.23	17.8	3.95
11/30/2010	0.24	0.26	20.3	3.89
12/31/2010	0.25	0.27	20.1	4.5
01/31/2011	0.23	0.27	20.7	3.5
02/28/2011	0.23	0.25	19.8	3.3
03/31/2011	0.21	0.28	21.9	3.93
04/30/2011	0.2	0.24	21.8	1.36
05/31/2011	0.25	0.31	20.7	2.29
06/30/2011	0.26	0.35		2.5
07/31/2011	0.23	0.27		3.94
08/31/2011	0.21	0.36		6.9
09/30/2011	0.21	0.31		6.26
10/31/2011	0.22	0.27	28.4	8.21
11/30/2011	0.22	0.31	19.3	2.76
12/31/2011	0.23	0.26	20.4	2.19
01/31/2012	0.24	0.35	27.3	5.38
02/29/2012	0.25	0.33	23.4	4.75
03/31/2012	0.23	0.26	26.7	3.35
04/30/2012	0.22	0.26	28	3.83
05/31/2012	0.22	0.26	29.9	4.35
06/30/2012	0.23	0.25		5.06
07/31/2012	0.22	0.27		4.38
08/31/2012	0.2	0.23		4.28
09/30/2012	0.21	0.23		4.35
10/31/2012	0.02	0.25	27.1	5.18
11/30/2012	0.2	0.22	26.7	3.71
12/31/2012	0.21	0.24	26.05	4.4
01/31/2013	0.21	0.23	26.88	3.47
02/28/2013	0.2	0.24	25.3	4.35
03/31/2013	0.2	0.32	28.93	6.01
04/30/2013	0.2	0.22	31.18	3.98
05/31/2013	0.21	0.25	28.9	4.38
06/30/2013	0.21	0.28		4.94
07/31/2013	0.2	0.32		5.72
08/31/2013	0.19	0.23		4.31
09/30/2013	0.25	0.35		4.97
10/31/2013	0.22	0.26	28.3	4.28
11/30/2013	0.2	0.23	29.23	4.08
12/31/2013	0.2	0.29	27.4	5.94
01/31/2014	0.19	0.22	27.8	5
02/28/2014	0.22	0.25	27.9	4.22
03/31/2014	0.25	0.32	23.13	4.33
04/30/2014	0.2	0.25	22.46	4.18
05/31/2014	0.21	0.22	24.25	3.63
06/30/2014	0.2	0.27		6.23
07/31/2014	0.17	0.21		2.94
08/31/2014	0.22	0.28		1.03
Average	**0.213**	**0.269**	**24.798**	**4.385**
Median	**0.215**	**0.260**	**26.050**	**4.340**
90th Percentile	**0.245**	**0.320**	**28.900**	**5.980**
Summer Ave.	**0.209**	**0.271**	**23.133**	**4.626**
Population	3,892	Influent->	35.0	7.00
	55	82	26%	38%
	gpcd ave	gpcd max	removal	removal

Havre WWTP				MT0022535
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
	Ave	Max	(mg/l)	(mg/l)
01/31/2010	1.02	1.22		2.33
02/28/2010	1	1.12		2.46
03/31/2010	1.04	1.15		2.29
04/30/2010	1.03	1.35		2.86
05/31/2010	1.13	1.59		3.35
06/30/2010	1.3	2.2		2.48
07/31/2010	1.29	1.43		2.16
08/31/2010	1.33	1.54		1.7
09/30/2010	1.41	1.68		2.1
10/31/2010	1.34	1.44		2.71
11/30/2010	1.58	1.62		2.86
12/31/2010	1.47	1.63		1.59
01/31/2011	1.46	2.25		1.56
02/28/2011	1.62	2.73		1.13
03/31/2011	1.65	2.07		1.05
04/30/2011	1.78	1.86		0.82
05/31/2011	1.91	2.63	16.8	1.31
06/30/2011	2.52	3.59	14.2	1.34
07/31/2011	1.98	2.1	14.6	1.57
08/31/2011	1.77	1.92	13.1	1.59
09/30/2011	1.63	1.75	15	2.3
10/31/2011	1.58	1.64	21.4	2.57
11/30/2011	1.55	1.63	18.3	2.3
12/31/2011	1.45	1.54	17.2	1.84
01/31/2012	1.4	1.46	16.5	1.66
02/29/2012	1.38	1.45	17.2	1.4
03/31/2012	1.4	1.62	14.63	1.72
04/30/2012	1.47	1.93	13.45	1.54
05/31/2012	1.6	2.29	16.2	1.83
06/30/2012	1.73	2.03	14.3	1.49
07/31/2012	1.62	1.79	17.2	2
08/31/2012	1.46	1.67	17.8	2.3
09/30/2012	1.37	1.43	18.8	2.51
10/31/2012	1.36	1.5	17.7	2.3
11/30/2012	1.32	1.37	14.6	2.2
12/31/2012	1.27	1.39	16.5	1.97
01/31/2013			19.2	1.69
02/28/2013	1.46	2.04	19.9	2.13
03/31/2013	1.19	1.31	21.4	2.1
04/30/2013	1.31	1.42	20.6	2.12
05/31/2013	1.5	3.07	17.45	1.86
06/30/2013	2.33	4.53	12	1.27
07/31/2013	2.08	2.52	12.4	1.26
08/31/2013	2.15	2.68	14.6	1.6
09/30/2013	1.94	2.13	15.1	1.81
10/31/2013	1.86	1.99	12.9	1.71
11/30/2013	1.65	1.81	16.6	1.92
12/31/2013	1.61	1.89	15.2	1.59
01/31/2014	1.6	1.93	17.2	1.68
02/28/2014	1.55	1.73	18.3	1.82
03/31/2014	1.57	1.8	19	1.88
04/30/2014	1.64	1.75	16.42	1.59
05/31/2014	1.65	1.79	14.5	1.61
06/30/2014	1.63	2.03	13.31	1.84
07/31/2014	1.51	1.67	12.75	1.84
08/31/2014	1.56	2.46	14	1.87
Average	**1.546**	**1.894**	**16.208**	**1.900**
Median	**1.550**	**1.750**	**16.460**	**1.840**
90th Percentile	**1.928**	**2.586**	**19.270**	**2.495**
Summer Ave.	**1.650**	**1.912**	**15.032**	**1.901**
Population	9,310	Influent->	23.8	6.50
	166	278	31%	72%
	gpcd ave	gpcd max	removal	removal

Bigfork WWTP				MT0020397
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.16	0.24		0.13
02/28/2010	0.15	0.18		0.11
03/31/2010	0.15	0.18	18.02	0.13
04/30/2010	0.16	0.22		0.17
05/31/2010	0.19	0.27		0.11
06/30/2010	0.3	0.41	17.76	0.12
07/31/2010	0.34	0.41		0.14
08/31/2010	0.32	0.39	16.6	0.08
09/30/2010	0.26	0.31	14.8	0.12
10/31/2010	0.2	0.23	13.5	0.17
11/30/2010	0.19	0.23	15.4	0.19
12/31/2010	0.18	0.25	16.3	0.1
01/31/2011	0.19	0.37	15.6	0.06
02/28/2011	0.18	0.3	15.68	0.1
03/31/2011	0.17	0.22	16.2	0.1
04/30/2011	0.17	0.19	20.14	0.06
05/31/2011	0.2	0.25	13.8	0.06
06/30/2011	0.29	0.37	15.77	0.12
07/31/2011	0.34	0.38	15.07	0.18
08/31/2011	0.31	0.04	16.31	0.14
09/30/2011	0.26	0.31	15.94	0.08
10/31/2011	0.22	0.34	14.21	0.06
11/30/2011	0.18	0.21	14.74	0.08
12/31/2011	0.16	0.18	16.41	0.1
01/31/2012	0.16	0.19	17.5	0.15
02/29/2012	0.16	0.22	16.3	0.09
03/31/2012	0.16	0.21	17.4	0.24
04/30/2012	0.18	0.2	8	0.21
05/31/2012	0.21	0.25	7.37	0.84
06/30/2012	0.33	0.4	6.44	0.48
07/31/2012	0.33	0.38	8.22	0.24
08/31/2012	0.31	0.35	9.48	0.3
09/30/2012	0.25	0.29	8.54	0.42
10/31/2012	0.22	0.24	12.67	0.6
11/30/2012	0.19	0.29	12.61	0.43
12/31/2012	0.18	0.2	11.6	0.2
01/31/2013	0.17	0.19	12.83	0.18
02/28/2013	0.16	0.19	15.97	0.21
03/31/2013	0.15	0.18	15.66	0.27
04/30/2013	0.16	0.19	16.31	0.27
05/31/2013	0.2	0.3	18.01	0.5
06/30/2013	0.27	0.33	14.59	0.68
07/31/2013	0.32	0.38	8.72	0.8
08/31/2013	0.32	0.36	7.65	0.67
09/30/2013	0.26	0.35	9.05	0.67
10/31/2013	0.22	0.27	11.38	0.58
11/30/2013	0.18	0.2	14.32	0.61
12/31/2013	0.18	0.2	18.05	0.7
01/31/2014	0.12	0.21	17.97	0.29
02/28/2014	0.17	0.23	8.33	0.27
03/31/2014	0.2	0.37	17.23	0.38
04/30/2014	0.17	0.18	12.33	0.68
05/31/2014	0.21	0.26	11.31	0.85
06/30/2014	0.33	0.48	7.03	0.42
07/31/2014	0.35	0.45	7.34	0.74
08/31/2014	0.31	0.34	8.87	0.77
Average	**0.221**	**0.274**	**13.555**	**0.312**
Median	**0.195**	**0.250**	**14.740**	**0.205**
90th Percentile	**0.325**	**0.385**	**17.760**	**0.690**
Summer Ave.	**0.306**	**0.339**	**11.276**	**0.382**
Population	4,270	Influent->	35.0	7.00
	52	90	58%	97%
	gpcd ave	gpcd max	removal	removal

Great Falls WWTP				MT0021920
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010				
02/28/2010				
03/31/2010	9.54	15.4	21.9	1.96
04/30/2010	9.89	22	23.2	0.91
05/31/2010	10.67	40.8	19.7	1.8
06/30/2010				
07/31/2010	11.43	25.8	12.5	1.4
08/31/2010	11.09	39.9	18.3	2.5
09/30/2010	10.78	21.4	14	2.94
10/31/2010	10.59	18.7	14.6	2.77
11/30/2010	9.97	16.6	24	2.71
12/31/2010	10.08	19.9	23.8	2.5
01/31/2011	10.17	19.8	22.7	1.4
02/28/2011	10.19	21.9	24.5	1.1
03/31/2011	10.33	20.1	28.3	1.3
04/30/2011	11.42	22.4	27.1	1.3
05/31/2011	13.35	34.1	18.4	9.4
06/30/2011	16.68	33.4	14.5	1.3
07/31/2011	13.16	23.6	18	1.7
08/31/2011	12.15	20	11.1	2.1
09/30/2011	9.8	16.6	18.6	2.3
10/31/2011	10.25	28	16.5	2.2
11/30/2011	9.6	16.7	13.6	4.5
12/31/2011	9.8	16.3	24.2	2.9
01/31/2012	9.2	19.4	29	1.5
02/29/2012	8.54	16	29.5	2.2
03/31/2012	8.79	9.53	8	2.4
04/30/2012	8.97	11.2	26.6	2.1
05/31/2012	9.29	12.78	26.2	1.3
06/30/2012	9.8	11.64	3.5	1.9
07/31/2012	10.41	16.58	14.3	2.2
08/31/2012	10.33	11.11	15.7	2.9
09/30/2012	9.52	10.73	21.7	2.9
10/31/2012	9.26	12.42	24.9	2
11/30/2012	9.42	10.16	24.3	1.3
12/31/2012	8.93	10.07	22	2.2
01/31/2013	8.69	9.33	16.4	1.9
02/28/2013	8.58	9.25	32.9	2.5
03/31/2013	8.16	9.06	26.8	2.5
04/30/2013	8.59	8.59	28.9	3.2
05/31/2013	9.42	15.34	20.7	1.8
06/30/2013	11.05	17.25	11.1	2.6
07/31/2013	10.51	12.23	16.5	3.2
08/31/2013	10.51	13.29	12.3	2.4
09/30/2013	10.08	11.48	8	3
10/31/2013	9.14	9.61	9.1	2.5
11/30/2013	8.24	9.66	14.4	2.9
12/31/2013	8.59	9.43	22.4	0.23
01/31/2014	8.22	8.89	23	2.6
02/28/2014	7.99	9.92	21.3	2.5
03/31/2014	8.75	10.86	23	2.2
04/30/2014	8.8	10.59	18.3	1.9
05/31/2014	8.84	10.08	19.7	2.3
06/30/2014	10.96	14.92	18.1	2.7
07/31/2014	10.49	12.6	10.4	2.1
08/31/2014	12.05	24.12	11	1.1
Average	**10.020**	**16.632**	**19.236**	**2.302**
Median	**9.800**	**15.340**	**19.700**	**2.200**
90th Percentile	**11.428**	**25.464**	**27.040**	**2.932**
Summer Ave.	**10.879**	**18.531**	**14.457**	**2.339**
Population	58,505	Influent->	23.1	6.30
	171	435	15%	65%
	gpcd ave	gpcd max	removal	removal

Billings WWTP				MT0022586
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	13.7	14.8	12.7	2.7
02/28/2010	13.3	14.2	13.2	2.8
03/31/2010	13.2	15	16.2	2.6
04/30/2010	13.4	14.5	15.3	2.8
05/31/2010	15.7	19.1	13.9	2.4
06/30/2010	19	26.5	13.2	1.8
07/31/2010	18.5	20.4	11.6	1.7
08/31/2010	19	23.5	12.2	1.4
09/30/2010	19	21.2	11.4	1.2
10/31/2010	16.7	18.2	13.8	1.7
11/30/2010	15	15.6	13.7	2
12/31/2010	15	16.3	15	2.6
01/31/2011	14.6	15	13.9	1.9
02/28/2011	14.3	15.9	16.1	2.4
03/31/2011	13.7	14.3	13.7	2.3
04/30/2011	14.3	16.3	15.1	2.4
05/31/2011	21.3	39.6	9.4	1.8
06/30/2011	20.5	22.9	13.4	1.4
07/31/2011	18	20	14.7	1.5
08/31/2011	17.4	19.8	12	1.5
09/30/2011	15.9	17	11.7	1.6
10/31/2011	15.2	18.8	10.3	1.3
11/30/2011	14.3	15.8	12.8	1.4
12/31/2011	13.4	14.8	15.5	2
01/31/2012	12.5	13.4	15.1	1.9
02/29/2012	12.2	13	16.1	2.1
03/31/2012	12.2	13.9	13.8	2.3
04/30/2012	12.1	13.6	17.6	2.9
05/31/2012	13.6	16.6	18.1	2.6
06/30/2012	15.7	17	16.2	1.9
07/31/2012	16	17.5	11.4	1.8
08/31/2012	15.8	16.7	13.1	2.6
09/30/2012	14.9	16.4	11.2	2.7
10/31/2012	14.7	16.4	10.8	2.4
11/30/2012	13	14	10.7	2.8
12/31/2012	12	13	12.5	2.1
01/31/2013	11.8	13.2	18.2	2.8
02/28/2013	11.8	12.8	20.6	2.9
03/31/2013	11.6	13.6	18.9	2.5
04/30/2013	11.6	12.4	15	2.34
05/31/2013	13.8	20	15.8	2.78
06/30/2013	16	17.3	11.9	1.97
07/31/2013	16.3	18.5	13.9	2.09
08/31/2013	16.1	17	17.3	2.33
09/30/2013	17.2	23.2	11.7	1.77
10/31/2013	17.1	22.4	12	1.85
11/30/2013	13.6	15.4	15.3	2.18
12/31/2013	13.4	14.8	18.4	2.18
01/31/2014	13.3	15.6	18.8	1.94
02/28/2014	13.5	16.9	23.7	2.16
03/31/2014	15.9	17.8	21.4	3.1
04/30/2014	15.3	18	21.2	1.78
05/31/2014	15.4	17.2	20.7	1.24
06/30/2014	17.9	20.4	17.6	1.55
07/31/2014	17	18.5	12.8	1.78
08/31/2014	18.4	21.3	14.4	1.97
Average	**15.109**	**17.452**	**14.768**	**2.116**
Median	**14.950**	**16.650**	**13.900**	**2.095**
90th Percentile	**18.450**	**21.850**	**18.850**	**2.800**
Summer Ave.	**17.107**	**19.357**	**12.814**	**1.853**
Population	104.170	Influent->	27.3	7.00
	145	210	49%	70%
	gpcd ave	gpcd max	removal	removal

Hamilton WWTP				MT0020028
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.55			
02/28/2010	0.56			
03/31/2010	0.54			
04/30/2010	0.53			
05/31/2010	0.57			
06/30/2010	0.76			
07/31/2010	0.82			
08/31/2010	0.69			
09/30/2010	0.58			
10/31/2010	0.52			
11/30/2010	0.5			
12/31/2010	0.51			
01/31/2011	0.53			
02/28/2011	0.52			
03/31/2011	0.54			
04/30/2011	0.54			
05/31/2011	0.57			
06/30/2011	0.65			
07/31/2011	0.74			
08/31/2011	0.72			
09/30/2011	0.75	0.78	11	4.8
10/31/2011	0.73	0.82	4.1	4.3
11/30/2011	0.66	0.7	5.7	4.9
12/31/2011	0.58	0.64	4.2	3.2
01/31/2012	0.58	0.67	5	5.7
02/29/2012	0.58	0.63	5.8	4.55
03/31/2012	0.57	0.66	6.44	5.5
04/30/2012	0.57	0.7	5.23	5.98
05/31/2012	0.58	0.68	6.56	8.6
06/30/2012	0.67	0.73	4.9	6.08
07/31/2012	0.75	0.85	3.65	4.56
08/31/2012	0.79	0.88	3.36	5.23
09/30/2012	0.8	0.94	7.83	5.55
10/31/2012	0.67	0.76	5.9	6
11/30/2012	0.62	0.72	5.83	6.3
12/31/2012	0.58	0.65	5.1	4.08
01/31/2013	0.58	0.64	10.3	4.06
02/28/2013	0.58	0.64	6.25	6.18
03/31/2013	0.6	0.66	10.1	6.93
04/30/2013	0.59	0.61	10.93	6.36
05/31/2013	0.63	0.66	3.84	4.9
06/30/2013	0.71	0.8	2.75	3.37
07/31/2013	0.8	0.82	2.52	3.98
08/31/2013	0.82	0.86	2.26	3.39
09/30/2013	0.82	0.91	3.4	3.26
10/31/2013	0.73	0.79	2.94	4.69
11/30/2013	0.62	0.66	3.28	2.24
12/31/2013	0.62	0.65	3.45	3.44
01/31/2014	0.59	0.63	4.68	4.2
02/28/2014	0.61	0.77	5.25	4.41
03/31/2014	0.6	0.75	4.4	4.68
04/30/2014	0.61	0.65	2.92	2.27
05/31/2014	0.65	0.67	3	1.86
06/30/2014	0.71	0.84	2.53	3.44
07/31/2014	0.85	0.93	2.2	4.51
08/31/2014	0.82	0.88	1.85	3.06
Average	**0.642**	**0.740**	**4.985**	**4.627**
Median	**0.610**	**0.710**	**4.540**	**4.555**
90th Percentile	**0.800**	**0.880**	**8.965**	**6.240**
Summer Ave.	**0.768**	**0.872**	**4.230**	**4.260**
Population	4,348	Influent->	26.8	7.00
	148	202	83%	35%
	gpcd ave	gpcd max	removal	removal

Lewistown WWTP				MT0020044
	Effluent Flow 30DA AVG	Effluent Flow DAILY MX	Effluent TN (mg/l)	Effluent TP (mg/l)
01/31/2010	1.25	1.44		0.8
02/28/2010	1.26	1.68		0.51
03/31/2010	1.48	1.85		0.76
04/30/2010	1.35	1.62		0.81
05/31/2010	2.38	3		0.88
06/30/2010	3.41	5.95		1.19
07/31/2010	2.58	3.32		0.47
08/31/2010	1.99	2.56		0.97
09/30/2010	1.83	2.16		0.94
10/31/2010	1.54	2		0.79
11/30/2010	1.48	2		0.49
12/31/2010	1.4	1.55		0.22
01/31/2011	1.34	1.55		0.26
02/28/2011	1.52	2.07		0.59
03/31/2011	1.87	2.44		1.62
04/30/2011	3.06	4.11		1.45
05/31/2011	5.41	10.5		0.34
06/30/2011	4.58	6.25		0.52
07/31/2011	2.55	3.03		0.37
08/31/2011	1.88	2.6		0.23
09/30/2011	1.45	1.66		0.54
10/31/2011	1.49	1.94		0.52
11/30/2011	1.32	1.47		0.36
12/31/2011	1.27	1.38		0.27
01/31/2012	1.26	1.46		0.19
02/29/2012	1.28	1.45		0.23
03/31/2012	1.49	1.73		0.82
04/30/2012	1.67	3.49		0.25
05/31/2012	1.48	1.73		0.68
06/30/2012	2.48	3.14		0.35
07/31/2012	2.19	2.7		0.37
08/31/2012	1.44	1.78		0.58
09/30/2012	1.31	1.8	3.15	0.55
10/31/2012	1.3	1.51	3.03	0.49
11/30/2012	1.48	1.77	1.55	0.5
12/31/2012	1.4	1.54	2.05	0.48
01/31/2013	1.36	1.55	1.65	0.55
02/28/2013	1.38	1.54	1.75	0.4
03/31/2013	1.49	1.91	1.6	0.84
04/30/2013	1.3	1.39	2.2	0.49
05/31/2013	1.69	3.16	3.87	0.45
06/30/2013	3.4	6.7	4.25	0.39
07/31/2013	2.26	2.7	3	0.37
08/31/2013	1.72	3.38	1.6	0.21
09/30/2013	1.51	1.94	6.45	0.52
10/31/2013	1.32	1.49	2.3	0.48
11/30/2013	1.21	1.41	1.85	0.29
12/31/2013	1.19	1.41	2.05	0.33
01/31/2014	1.24	1.4	2.5	0.2
02/28/2014	1.26	1.45	2.6	0.16
03/31/2014	2.22	2.94	2.75	0.39
04/30/2014	2.23	2.49	3.67	0.55
05/31/2014	2.07	2.6	3.15	0.8
06/30/2014	2.71	3.59	1.5	0.31
07/31/2014	2.35	2.91	2.95	0.52
08/31/2014	2.29	5.12	1.9	0.34
Average	**1.880**	**2.579**	**2.640**	**0.531**
Median	**1.490**	**1.940**	**2.400**	**0.490**
90th Percentile	**2.658**	**3.902**	**3.810**	**0.864**
Summer Ave.	**1.954**	**2.690**	**3.175**	**0.499**
Population	5,901	Influent->	12.4	3.39
	319	661	81%	86%
	gpcd ave	gpcd max	removal	removal

Conrad WWTP				MT0020079
	Effluent Flow 30DA AVG	Effluent Flow DAILY MX	Effluent TN (mg/l)	Effluent TP (mg/l)
01/31/2010	0.81	1.08		
02/28/2010	0.53	1.08		
03/31/2010	0.83	1.08	~~74~~	~~9.54~~
04/30/2010	0.98	1.08		
05/31/2010	0.98	1.08		
06/30/2010	0.45	0.73	~~45.2~~	~~4.2~~
07/31/2010	0.31	0.55		
08/31/2010	0.28	0.3		
09/30/2010	0.2	0.4		
10/31/2010	0.22	0.45		
11/30/2010	0.18	0.29		
12/31/2010	0.16	0.24		
01/31/2011	0.18	0.28		
02/28/2011	0.2	0.29		
03/31/2011	0.16	0.26	~~49.2~~	~~5.8~~
04/30/2011	0.19	0.37		
05/31/2011	0.24	0.73		
06/30/2011	0.52	1.37	~~52.4~~	~~2.54~~
07/31/2011	0.19	0.26		
08/31/2011	0.17	0.19		
09/30/2011	0.15	0.19	~~62~~	~~5.98~~
10/31/2011	0.16	0.31		
11/30/2011	0.13	0.16		
12/31/2011	0.12	0.16	~~78.4~~	~~5.54~~
01/31/2012	0.12	0.15		
02/29/2012	0.12	0.12		
03/31/2012	0.12	1.62		
04/30/2012	0.15	0.21		
05/31/2012	0.18	0.34		
06/30/2012	0.23	0.3	~~17.2~~	~~5.8~~
07/31/2012	0.18	0.22		
08/31/2012	0.19	0.25		
09/30/2012	0.16	0.23	10	7.4
10/31/2012	0.16	0.25		
11/30/2012	0.16	0.22		
12/31/2012	0.14	0.17	8.8	4.4
01/31/2013	0.13	0.16		
02/28/2013	0.13	0.14		
03/31/2013	0.13	0.15	11.2	0.64
04/30/2013	0.14	0.16		
05/31/2013	0.17	0.34		
06/30/2013	0.22	0.25	10	2.92
07/31/2013	0.17	0.22		
08/31/2013	0.17	0.32		
09/30/2013	0.15	0.19	14	5.94
10/31/2013	0.13	0.15		
11/30/2013	0.13	0.22		
12/31/2013	0.13	0.14	22.6	1.56
01/31/2014	0.13	0.16		
02/28/2014	0.13	0.14		
03/31/2014	0.14	0.2	27.8	1.98
04/30/2014	0.16	0.44		
05/31/2014	0.16	0.21		
06/30/2014	0.23	0.25	9.2	0.52
07/31/2014	0.18	0.24		
08/31/2014	0.19	0.22		
Average	**0.228**	**0.368**	**14.200**	**3.170**
Median	**0.170**	**0.250**	**10.600**	**2.450**
90th Percentile	**0.394**	**0.940**	**24.160**	**6.378**
Summer Ave.	**0.192**	**0.270**	**12.000**	**6.670**
Population	2,570	Influent->	35.0	7.00
	89	366	70%	65%
	gpcd ave	gpcd max	removal	removal

Dillon WWTP				MT0021458
	Effluent	Effluent	Effluent	Effluent
	Flow	Flow	TN	TP
	30DA AVG	DAILY MX	(mg/l)	(mg/l)
01/31/2010	0.43	0	39	4.9
02/28/2010	0.4	0	37	4.4
03/31/2010	0.38	0.51	37	4.5
04/30/2010	0.43	1.35	36	5.4
05/31/2010	0.5	0.99	34	5.9
06/30/2010	0.37	0.91	30	5.1
07/31/2010	0.52	1.18	33.4	5.4
08/31/2010			29	4.1
09/30/2010			18	3.4
10/31/2010	0.5	0.56	19	3.5
11/30/2010	0.44	0.56	25	6
12/31/2010	0.34	0.38	31	4.7
01/31/2011	0.34	0.41	41	4.4
02/28/2011	0.36	0.38	37	4.3
03/31/2011	0.35	0.37	36	4.5
04/30/2011	0.33	0.36	31	4.6
05/31/2011	0.32	0.48	33	5
06/30/2011	0.37	0.56	35	5
07/31/2011	0.41	0.48	32	5.5
08/31/2011	0.51	0.62	27	4.5
09/30/2011	0.52	0.57	23.1	3.3
10/31/2011	0.47	0.53	21.8	3.1
11/30/2011	0.36	0.41	16	4.01
12/31/2011	0.31	0.36	28	3.7
01/31/2012	0.3	0.33	43	4.65
02/29/2012	0.31	0.33	41	4.6
03/31/2012	0.32	0.42	35	4.4
04/30/2012	0.31	0.36	36	4.8
05/31/2012	0.3	0.39	38	5.6
06/30/2012	0.33	0.38	40	6
07/31/2012	0.37	0.44	35	4.9
08/31/2012	0.39	0.45	26	4.5
09/30/2012	0.38	0.47	22	9.1
10/31/2012	0.38	0.44	24	3.9
11/30/2012	0.32	0.42	25	3.9
12/31/2012	0.27	0.31	31	4.6
01/31/2013	0.32	0.38	41	4.9
02/28/2013	0.32	0.35	34	4.8
03/31/2013	0.33	0.35	43	4.48
04/30/2013	0.33	0.36	38	5.5
05/31/2013	0.36	0.47	43	6.2
06/30/2013	0.38	0.64	42	6.4
07/31/2013	0.29	0.37	30	6.67
08/31/2013	0.28	0.31	14	4.88
09/30/2013	0.35	0.55	19	5.14
10/31/2013	0.31	0.37	29.8	4.8
11/30/2013	0.31	0.5	34	4.15
12/31/2013	0.24	0.33	31	4.32
01/31/2014	0.29	0.35	31.8	4.51
02/28/2014	0.35	0.53	37.9	4.71
03/31/2014	0.34	0.34	40.6	4.67
04/30/2014	0.34	0.5	40	5.03
05/31/2014	0.28	0.38	44	6.4
06/30/2014	0.38	0.82	47.9	7.63
07/31/2014	0.36	0.58	36.5	4.44
08/31/2014	0.38	0.54	10.3	2.93
Average	**0.361**	**0.476**	**32.377**	**4.870**
Median	**0.350**	**0.420**	**34.000**	**4.685**
90th Percentile	**0.461**	**0.634**	**41.500**	**6.100**
Summer Ave.	**0.397**	**0.547**	**25.379**	**4.911**
Population	4,134	Influent->	35.0	7.00
	87	153	3%	33%
	gpcd ave	gpcd max	removal	removal

Manhatton WWTP				MT0021857
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
	Ave	Max	(mg/l)	(mg/l)
01/31/2010				
02/28/2010				
03/31/2010			11	
04/30/2010				
05/31/2010				
06/30/2010			9.7	
07/31/2010				
08/31/2010				
09/30/2010	0.23	0.32		
10/31/2010	0.18	0.29		
11/30/2010	0.14	0.3		
12/31/2010	0.09	0.96	10.6	1.2
01/31/2011	0.09	0.39		
02/28/2011	0.09	0.62		
03/31/2011	0.09	0.3	11.6	1
04/30/2011	0.09	0.19		
05/31/2011	0.08	0.41		
06/30/2011	0.09	0.39	18.7	0.04
07/31/2011	0.09	0.19		
08/31/2011	0.11	0.26		
09/30/2011	0.16	0.28	11.9	0.72
10/31/2011	0.19	0.67		
11/30/2011	0.15	0.37		
12/31/2011	0.13	0.53	9.2	0.7
01/31/2012	0.09	0.95		
02/29/2012	0.09	0.2		
03/31/2012	0.09	0.59	11.1	3
04/30/2012	0.09	0.46		
05/31/2012	0.09	0.97		
06/30/2012	0.08	0.27	10.6	0.46
07/31/2012	0.12	0.37		
08/31/2012	0.18	0.32		
09/30/2012	0.27	0.47	6.7	0.06
10/31/2012	0.29	0.48		
11/30/2012	0.24	0.47		
12/31/2012	0.15	0.35	8	0.2
01/31/2013	0.1	0.28		
02/28/2013	0.09	0.97		
03/31/2013	0.12	0.33	16.6	0.11
04/30/2013	0.14	0.28		
05/31/2013	0.07	0.39		
06/30/2013	0.09	0.38	11.5	2.1
07/31/2013	0.14	0.5		
08/31/2013	0.15	0.55		
09/30/2013	0.22	0.54	7.2	0.55
10/31/2013	0.28	0.53		
11/30/2013	0.2	0.49		
12/31/2013	0.16	0.45	7.9	1.07
01/31/2014	0.09	0.36		
02/28/2014	0.08	0.78		
03/31/2014	0.1	0.55	9.5	1.7
04/30/2014	0.08	0.38		
05/31/2014	0.07	0.3		
06/30/2014	0.09	0.38	7.2	3.8
07/31/2014	0.09	0.38		
08/31/2014	0.18	0.29		
Average	**0.132**	**0.448**	**10.529**	**1.114**
Median	**0.100**	**0.385**	**10.600**	**0.720**
90th Percentile	**0.223**	**0.703**	**13.780**	**2.640**
Summer Ave.	**0.162**	**0.373**	**8.600**	**0.443**
Population	1,520	Influent->	35.0	7.00
	87	463	70%	90%
	gpcd ave	gpcd max	removal	removal

Kalispell WWTP				MT0021938
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	2.32	2.56	12.3	0.15
02/28/2010	2.46	2.87	9.83	0.15
03/31/2010	2.47	2.8	7.68	0.16
04/30/2010	2.55	3.03	10.46	0.11
05/31/2010	2.71	3.23	10.44	0.13
06/30/2010	3.51	6.03	10.35	0.09
07/31/2010	2.91	3.6	9.56	0.08
08/31/2010	2.6	2.89	7.32	0.14
09/30/2010	2.51	2.89	7.41	0.12
10/31/2010	2.32	2.66	7.45	0.11
11/30/2010	2.37	2.72	10.14	0.1
12/31/2010	2.56	3.66	10.34	0.17
01/31/2011	2.93	4.72	7.93	0.12
02/28/2011	2.79	3.62	9.3	0.16
03/31/2011	3.81	4.94	6.57	0.23
04/30/2011	3.63	4.45	7.26	0.12
05/31/2011	3.28	4.56	7.28	0.09
06/30/2011	4.19	5.13	6.86	0.1
07/31/2011	3.07	3.72	6.89	0.14
08/31/2011	2.62	2.87	8.88	0.12
09/30/2011	2.43	2.78	10.27	0.11
10/31/2011	2.36	3.15	9.6	0.11
11/30/2011	2.23	2.44	8.65	0.16
12/31/2011	2.23	2.46	9.12	0.11
01/31/2012	2.31	3.09	8.5	0.12
02/29/2012	2.4	3.07	7.24	0.13
03/31/2012	2.61	3.31	7.75	0.23
04/30/2012	2.65	2.87	8.37	0.22
05/31/2012	2.61	3.1	8.95	0.21
06/30/2012	3.52	4.87	8.19	0.2
07/31/2012	3.01	3.69	7.31	0.32
08/31/2012	2.22	2.53	8.18	0.21
09/30/2012	2.14	3.12	9.12	0.14
10/31/2012	2.23	3.11	9.52	0.08
11/30/2012	2.36	2.72	7.45	0.06
12/31/2012	2.39	2.57	8.08	0.08
01/31/2013	2.32	2.72	7.89	0.09
02/28/2013	2.39	2.53	5.83	0.07
03/31/2013	2.44	2.56	6.17	0.07
04/30/2013	2.63	3.03	6.4	0.1
05/31/2013	2.84	4.45	5.74	0.09
06/30/2013	2.86	3.46	6.17	0.09
07/31/2013	2.58	2.84	6.49	0.09
08/31/2013	2.53	3.05	7.63	0.23
09/30/2013	2.57	3.78		0.11
10/31/2013	2.3	2.52	7.25	0.08
11/30/2013	2.33	3.11	5.35	0.07
12/31/2013	2.34	2.62	7.79	0.09
01/31/2014	2.4	2.95	6.59	0.09
02/28/2014	2.59	3.62	8.19	0.09
03/31/2014	3.72	5.85	15.33	0.09
04/30/2014	2.87	3.11	5.85	0.06
05/31/2014	2.95	3.23	5.31	0.07
06/30/2014	3.84	8.36	5.89	0.08
07/31/2014	3	3.58	6.24	0.09
08/31/2014	2.63	2.87	7.08	0.09
Average	**2.704**	**3.430**	**8.068**	**0.124**
Median	**2.575**	**3.095**	**7.750**	**0.110**
90th Percentile	**3.515**	**4.795**	**10.312**	**0.210**
Summer Ave.	**2.630**	**3.158**	**7.875**	**0.142**
Population	19.927	Influent->	29.2	7.00
	136	241	73%	98%
	gpcd ave	gpcd max	removal	removal

Butte WWTP				MT0022012
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	2.53	2.71	20	1.74
02/28/2010	2.53	2.64	24	1.66
03/31/2010	2.51	2.73	18	1.63
04/30/2010	3.34	3.98	18	1.51
05/31/2010	3.76	4.83	20	2.24
06/30/2010	4.28	6.23	15.3	1.53
07/31/2010	4.05	4.63	17.3	2.2
08/31/2010	3.94	4.42	17.5	1.39
09/30/2010	4.03	4.76	15.8	1.45
10/31/2010	4.15	4.41	14.2	1.37
11/30/2010	4.01	4.47	19	1.35
12/31/2010	3.82	4.14	19	1.1
01/31/2011	3.76	4.24	20	1.13
02/28/2011	3.73	4.34	20	1.44
03/31/2011	3.91	4.18	18	1.3
04/30/2011	3.95	4.11	20.1	2.08
05/31/2011	4.18	4.92	18.5	2.11
06/30/2011	5	6.59	15.3	1.31
07/31/2011	3.89	4.65	21.1	1.93
08/31/2011	3.75	4.79	17.3	1.32
09/30/2011	3.87	4.18	17.2	2
10/31/2011	3.83	4.09	14	1.54
11/30/2011	3.73	3.92	21.4	1.52
12/31/2011	3.68	3.91	16.2	1.32
01/31/2012	3.71	3.85	17	1.29
02/29/2012	3.69	3.84	18	1.25
03/31/2012	3.87	4.33	20	1.7
04/30/2012	4	4.24		
05/31/2012	3.84	4.04		
06/30/2012	3.59	3.97		1.92
07/31/2012	3.9	4.77		1.81
08/31/2012	3.58	3.96		1.44
09/30/2012	3.75	3.94		1.96
10/31/2012	3.84	4.06		
11/30/2012	3.8	4.16		
12/31/2012	3.76	3.95		
01/31/2013	3.7	3.87		
02/28/2013	3.75	3.87		
03/31/2013	3.82	3.95		
04/30/2013	3.73	3.9		
05/31/2013	3.74	4.21		
06/30/2013	3.62	4.81		2.2
07/31/2013	3.65	4.12		2.29
08/31/2013	3.68	4.31		1.79
09/30/2013	4.11	4.79		1.89
10/31/2013	4.04	4.26		
11/30/2013	3.82	4.08		
12/31/2013	3.75	4.11		
01/31/2014	3.58	3.81		
02/28/2014	3.68	3.9		
03/31/2014	4.07	5.22		
04/30/2014	4.05	4.67		
05/31/2014	4.11	4.44		
06/30/2014	3.94	4.83		2.19
07/31/2014	3.63	4.5		1.72
08/31/2014	3.87	5.09		1.35
Average	**3.784**	**4.281**	**18.230**	**1.657**
Median	**3.810**	**4.180**	**18.000**	**1.585**
90th Percentile	**4.090**	**4.830**	**20.500**	**2.193**
Summer Ave.	**3.836**	**4.494**	**17.700**	**1.753**
Population	33,525	Influent->	35.0	7.00
	113	144	49%	77%
	gpcd ave	gpcd max	removal	removal

East Helena WWTP				MT0022560
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.27	0.27	0	
02/28/2010	0.16	0.16	16.17	
03/31/2010	0.14	0.14	24.45	
04/30/2010	0.18	0.24	21.46	
05/31/2010	0.25	0.34	11.52	
06/30/2010	0.76	1.06	4.03	
07/31/2010	0.6	1.76	7.6	
08/31/2010	0.45	0.76	9.21	1.24
09/30/2010	0.38	0.57	11.9	1.59
10/31/2010	0.29	0.36	12.6	2.4
11/30/2010	0.24	0.41	19.86	2.76
12/31/2010	0.3	0.54	19.1	3.06
01/31/2011	0.34	0.54	14.4	1.48
02/28/2011	0.26	0.37	21.5	3.62
03/31/2011	0.23	0.32	20.12	3.66
04/30/2011	0.21	0.57	26.45	3.99
05/31/2011	0.49	0.95	20.78	4.34
06/30/2011	1.42	2.9	5.6	1.71
07/31/2011	0.92	1.37	6.22	0.72
08/31/2011	0.6	0.83	7.66	0.86
09/30/2011	0.48	0.71	9.8	1.23
10/31/2011	0.48	0.64	7.9	1.59
11/30/2011	0.38	0.48	12.38	0.3
12/31/2011	0.35	0.68	12.13	2.29
01/31/2012	0.35	0.61	18.3	2.44
02/29/2012	0.26	0.32	16.72	4.14
03/31/2012	0.24	0.3	14.13	2.82
04/30/2012	0.26	0.4	16.4	2.05
05/31/2012	0.46	0.6	11.08	1.75
06/30/2012	0.38	0.49	11.22	1.66
07/31/2012	0.38	0.51	12.2	2.38
08/31/2012	0.33	0.67	11.86	2.41
09/30/2012	0.24	0.42	12.05	2.36
10/31/2012	0.27	0.52	18.48	3.03
11/30/2012	0.28	0.48	15.58	2.95
12/31/2012	0.33	0.54	18.47	2.95
01/31/2013	0.48	0.65	13.02	1.77
02/28/2013	0.21	0.27	23.9	3.54
03/31/2013	0.23	0.44	26.35	0.37
04/30/2013	0.22	0.28	25.3	3.87
05/31/2013	0.35	0.53	16.57	3.49
06/30/2013	0.47	0.64	11.65	1.66
07/31/2013	0.35	0.57	12.92	2.07
08/31/2013	0.22	0.4	17.57	2.82
09/30/2013	0.26	0.3	20.72	3.29
10/31/2013	0.18	0.22	31.8	3.29
11/30/2013	0.18	0.41	22.1	6.13
12/31/2013	0.29	0.6	12.86	5.28
01/31/2014	0.15	0.23	15.68	4.87
02/28/2014	0.19	0.33	9.67	5.29
03/31/2014	0.27	0.73	15.35	6.35
04/30/2014	0.3	0.4	16.96	0.26
05/31/2014	0.53	0.78	9.1	0.28
06/30/2014	0.66	0.73	8.92	0.09
07/31/2014	0.64	0.78	10.28	0.32
08/31/2014	0.57	0.71	7.97	0.59
Average	**0.370**	**0.586**	**14.786**	**2.519**
Median	**0.300**	**0.525**	**13.575**	**2.400**
90th Percentile	**0.600**	**0.805**	**23.000**	**4.446**
Summer Ave.	**0.459**	**0.740**	**11.283**	**1.683**
Population	1,984	Influent->	21.2	5.79
	186	406	36%	59%
	gpcd ave	gpcd max	removal	removal

Missoula WWTP				MT0022594
	Flow Monthly Ave	Flow Daily Max	Effluent TN (mg/l)	Effluent TP (mg/l)
01/31/2010	9.31	10.08	11.91	0.37
02/28/2010	9.86	10.39	10.82	1.6
03/31/2010	9.94	10.67	12.48	0.5
04/30/2010	10.16	10.4	9.57	0.27
05/31/2010	9.67	10.39	9.25	0.25
06/30/2010	9.77	9.97	8.21	0.24
07/31/2010	8.1	8.59	7.43	0.16
08/31/2010	8.18	8.33	8.97	0.18
09/30/2010	8.9	8.97	9.58	0.41
10/31/2010	9.55	10.5	10	0.19
11/30/2010	6.6	9.9	9.88	0.23
12/31/2010	6.18	7.34	10.55	0.27
01/31/2011	6.5	9.37	9.99	0.28
02/28/2011	6.6	8.49	10.31	0.27
03/31/2011	6.98	7.43	10.46	0.27
04/30/2011	6.89	7.57	9.94	0.25
05/31/2011	7.62	8.91	9.33	0.24
06/30/2011	10.33	11.54	6.66	0.18
07/31/2011	8.03	8.78	7.18	0.17
08/31/2011	6.71	6.99	8.94	0.19
09/30/2011	6.82	6.91	10.16	0.17
10/31/2011	6.91	7.1	11.22	0.31
11/30/2011	6.42	6.94	10.28	0.32
12/31/2011	6.2	7.18	9.34	0.46
01/31/2012	6.38	7.44	13.08	0.64
02/29/2012	6.6	7.91	9.94	0.47
03/31/2012	7.03	7.72	9.23	0.35
04/30/2012	6.86	8.39	9.04	0.24
05/31/2012	7.03	7.96	8.54	0.22
06/30/2012	6.91	7.15	7.9	0.21
07/31/2012	6.26	6.81	7.75	0.23
08/31/2012	6.24	6.86	8.15	0.7
09/30/2012	6.5	7.54	9.73	0.43
10/31/2012	6.54	7.04	10.8	0.49
11/30/2012	6.48	7.41	10.7	0.46
12/31/2012	6.07	7.23	9.87	0.25
01/31/2013	6.02	6.98	9.79	0.54
02/28/2013	0	0	8.93	0.45
03/31/2013	6.82	7.19	8.93	0.45
04/30/2013	6.77	7.35	8.8	0.26
05/31/2013	6.88	7.72	8.51	0.26
06/30/2013	6.46	7.3	8.06	0.9
07/31/2013	6.28	6.93	7.62	0.36
08/31/2013	6.36	7.18	9.01	0.6
09/30/2013	6.69	7.6	11.52	1.07
10/31/2013	6.51	7.17	9.74	1.13
11/30/2013	6.43	7.04	9.39	0.43
12/31/2013	6.08	7.04	10.9	1.28
01/31/2014	6.13	7.01	9.73	0.85
02/28/2014	6.58	8.29	9.84	0.72
03/31/2014	7.67	11.28	9.49	2.41
04/30/2014	6.69	7.15	7.96	0.38
05/31/2014	7.51	9.69	6.98	0.3
06/30/2014	8.02	9.34	7.23	0.39
07/31/2014	6.57	7.66	7.89	0.4
08/31/2014	6.11	7.06	7.41	0.61
Average	**7.062**	**7.984**	**9.327**	**0.471**
Median	**6.700**	**7.555**	**9.440**	**0.355**
90th Percentile	**9.622**	**10.390**	**10.812**	**0.880**
Summer Ave.	**6.982**	**7.586**	**8.667**	**0.406**
Population	66,788	Influent->	35.0	7.00
	106	156	73%	95%
	gpcd ave	gpcd max	removal	removal

Bozeman WWTP				MT0022608
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	4.62	5.07	~~9.9~~	~~2.66~~
02/28/2010	4.66	4.88	~~10.1~~	~~2.89~~
03/31/2010	5.25	6.04	~~9.9~~	~~2.37~~
04/30/2010	5.88	6.45	~~9.2~~	~~2.27~~
05/31/2010	5.61	6.65	~~8.59~~	~~2.11~~
06/30/2010	7.22	8.83	~~10.3~~	~~1.61~~
07/31/2010	5.57	6.76	~~8.9~~	~~1.96~~
08/31/2010	5.26	6.05	~~10.2~~	~~2.17~~
09/30/2010	5.63	6.72	~~14.3~~	~~2.59~~
10/31/2010	5.2	5.56	~~10.43~~	~~2.62~~
11/30/2010	4.93	5.53	~~10.26~~	~~2.49~~
12/31/2010	4.55	5.01	~~9.53~~	~~2.63~~
01/31/2011	4.56	5.73	~~9.77~~	~~2.39~~
02/28/2011	4.53	4.96	~~11.54~~	~~2.57~~
03/31/2011	5	6.08	~~13.87~~	~~2.33~~
04/30/2011	6.47	7.48	~~12.61~~	~~1.74~~
05/31/2011	7.26	8.95	~~10.94~~	~~1.44~~
06/30/2011	7.9	9.71	~~9~~	~~1.46~~
07/31/2011	5.9	7.15	~~9~~	~~2.12~~
08/31/2011	5.09	5.63	~~9.5~~	~~2.85~~
09/30/2011	5.16	6.3	~~6~~	~~1.02~~
10/31/2011	5.05	6.06	~~7.22~~	~~0.17~~
11/30/2011	4.87	5.18	~~3.3~~	~~0.17~~
12/31/2011	4.58	5.02	~~5.83~~	~~0.32~~
01/31/2012	4.62	4.97	5.66	0.77
02/29/2012	4.8	4.3	4.51	0.4
03/31/2012	4.97	6.35	6.65	2.55
04/30/2012	5.48	6.7	5.92	1.32
05/31/2012	5.44	6.15	4	1.17
06/30/2012	5.6	6.18	2.85	0.54
07/31/2012	5.36	5.75	3.27	0.58
08/31/2012	5.31	5.74	3.52	0.13
09/30/2012	5.24	6.19	4.34	0.17
10/31/2012	5.16	6.7	5.42	0.18
11/30/2012	5.15	5.63	5.19	0.77
12/31/2012	5	5.8	4.09	0.32
01/31/2013	5.27	5.73	5.11	0.3
02/28/2013	5.53	6.01	5.12	0.98
03/31/2013	5.63	6.12	4.5	0.14
04/30/2013	5.91	6.37	5.14	0.19
05/31/2013	6.37	7	4.1	0.15
06/30/2013	6.27	7.3	2.79	0.12
07/31/2013	5.55	9.91	2.82	0.09
08/31/2013	5.18	5.67	3.1	0.1
09/30/2013	5.55	7.06	3.47	0.12
10/31/2013	5.66	6.49	4	0.1
11/30/2013	5.4	6.29	4.33	0.16
12/31/2013	5.08	5.88	3.71	0.17
01/31/2014	5.24	5.94	5.64	0.17
02/28/2014	5.25	5.89	4.5	0.14
03/31/2014	6.33	8.3	4	0.32
04/30/2014	7.45	8.49	4	0.36
05/31/2014	7.22	8.7	4.6	0.32
06/30/2014	6.72	7.35	4	0.21
07/31/2014	6.17	7.11	3.1	0.13
08/31/2014	5.93	7.5	3.2	0.1
Average	**5.546**	**6.453**	**6.640**	**1.075**
Median	**5.335**	**6.165**	**5.305**	**0.560**
90th Percentile	**6.595**	**8.395**	**10.365**	**2.580**
Summer Ave.	**5.493**	**6.681**	**6.051**	**1.009**
Population	37,280	Influent->	26.6	7.00
	149	225	80%	92%
	gpcd ave	gpcd max	removal	removal

Deer Lodge WWTP				MT0022616
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.57	0.69	10.2	1.41
02/28/2010	0.6	0.64	10.8	1.52
03/31/2010	0.68	0.78	11.3	1.6
04/30/2010	0.88	0.99	8.52	1.24
05/31/2010	1.09	1.2	0.37	0.71
06/30/2010	2.4	2.9	6.43	0.93
07/31/2010	2	2.72	5.84	0.76
08/31/2010	0.36	0.57	5.37	0.9
09/30/2010	1.25	1.38	6.75	1.12
10/31/2010	0.98	1.15	7.68	1.24
11/30/2010	0.85	0.99	7.52	0.42
12/31/2010	0.73	0.87	6.18	6.92
01/31/2011	0.8	0.8	6.02	1.17
02/28/2011	0.66	0.74	8.59	1.45
03/31/2011	0.7	0.83	8.35	1.58
04/30/2011	0.82	0.87	8.06	1
05/31/2011	1.21	1.86	5.3	0.71
06/30/2011	3.34	4.5	4.43	0.66
07/31/2011	2.36	2.95	4.57	0.86
08/31/2011	2	2.49	4.78	0.69
09/30/2011	1.51	1.69	6.55	1.14
10/31/2011	1.57	1.97	7.07	0.43
11/30/2011	1.1	1.29	4	0.53
12/31/2011	0.99	1.07	6.34	0.96
01/31/2012	1.03	1.09	6.91	0.8
02/29/2012	0.88	0.99	6.26	0.83
03/31/2012	1.04	1.29	6	0.87
04/30/2012	1.45	1.71	3.72	0.7
05/31/2012	2.09	2.81	4.91	0.78
06/30/2012	2.6	2.95	4.93	0.85
07/31/2012	2.28	2.86	3.44	0.45
08/31/2012	1.58	1.78	5.45	1.22
09/30/2012	1.37	1.62	6.44	0.94
10/31/2012	1.25	1.62	6	0.86
11/30/2012	1.02	1.09	4.05	0.58
12/31/2012	1	1.07	4.71	0.79
01/31/2013	0.85	0.87	7.46	0.83
02/28/2013	0.86	0.87	4.31	0.85
03/31/2013	0.9	0.97	5.26	0.94
04/30/2013	0.91	0.99	4.86	0.82
05/31/2013	1.9	2.77	7.28	0.81
06/30/2013	2.47	2.81	5.44	0.63
07/31/2013	1.79	2.49	4.24	0.59
08/31/2013	1.2	1.41	5.43	1.47
09/30/2013	1.11	1.23	6.35	0.97
10/31/2013	1.1	1.23	5.52	0.72
11/30/2013	0.85	0.92	4.21	0.74
12/31/2013	0.81	0.85	7.68	0.97
01/31/2014	0.81	0.85	17.3	0.95
02/28/2014	0.79	0.83	7.56	1
03/31/2014	1.29	1.74	6.52	0.76
04/30/2014	1.09	1.29	2.71	0.52
05/31/2014	1.28	2.05	1.81	0.6
06/30/2014	1.71	2.05	2.93	0.52
07/31/2014	1.28	1.68	4.14	0.97
08/31/2014	0.96	1.26	7.03	0.78
Average	**1.268**	**1.535**	**6.105**	**1.001**
Median	**1.090**	**1.245**	**6.000**	**0.850**
90th Percentile	**2.185**	**2.810**	**8.435**	**1.430**
Summer Ave.	**1.504**	**1.866**	**5.456**	**0.919**
Population	3,111	Influent->	9.7	2.65
	408	903	38%	68%
	gpcd ave	gpcd max	removal	removal

Helena WWTP				MT0022641
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	2.9	4.67	12.1	0.84
02/28/2010	2.75	3.84	6.9	0.88
03/31/2010	2.7	5.26	8.64	0.86
04/30/2010	2.6	3.01	7.97	3.98
05/31/2010	2.63	3.48	5.16	1.41
06/30/2010	2.97	4.18	5.27	0.99
07/31/2010	2.67	3.04	5.9	1.06
08/31/2010	2.77	3.34	6.23	1.75
09/30/2010	2.73	3.2	10.03	3.61
10/31/2010	2.65	2.88	10.59	2.48
11/30/2010	2.89	4.12	6.22	3.07
12/31/2010	2.72	3.79	9.4	3.74
01/31/2011	2.79	3.42	7.11	1.16
02/28/2011	2.99	3.8	7.55	2.2
03/31/2011	2.86	4.26	8.13	2.37
04/30/2011	2.78	2.94	5.46	2.28
05/31/2011	2.89	3.48	6.54	2.1
06/30/2011	3.66	5.33	7.02	2.31
07/31/2011	3.12	3.74	4.67	2.07
08/31/2011	2.95	3.43	5.47	2.14
09/30/2011	2.91	3.24	5.95	3.16
10/31/2011	2.95	3.11	6.15	2.15
11/30/2011	2.91	3.18	6.11	2.39
12/31/2011	2.91	3.52	6.21	2.78
01/31/2012	3.07	4.79	5.57	0.98
02/29/2012	3.08	3.82	8.79	2.09
03/31/2012	3.26	3.55	6.13	2.63
04/30/2012	3.12	3.35	6.8	2.64
05/31/2012	3	3.48	5.35	1.68
06/30/2012	2.86	3.21	7.21	1.24
07/31/2012	2.74	3	6.73	3.68
08/31/2012	2.68	2.99	10.88	3.15
09/30/2012	2.77	3.76	7.13	4.14
10/31/2012	3.41	3.54	6.35	2.55
11/30/2012	3.55	3.84	6.54	2.94
12/31/2012	3.68	3.74	7.07	2.85
01/31/2013	3.5	3.75	7.65	2.96
02/28/2013	3.51	4.08	7.48	3.08
03/31/2013	3.17	3.65	7.04	2.42
04/30/2013	3.05	3.44	6.7	2.38
05/31/2013	3.16	3.58	6.64	2.82
06/30/2013	3.13	3.57	0	2.89
07/31/2013	2.93	3.47	0	2.62
08/31/2013	3.35	3.99	9.3	2.82
09/30/2013	3.05	3.58	6.46	3.58
10/31/2013	2.96	3.38	5.91	2.86
11/30/2013	2.72	3.25	4.92	2.34
12/31/2013	3.16	3.42	4.88	2.37
01/31/2014	3.33	3.25	5.43	2.23
02/28/2014	3.73	3.52	7.81	1.78
03/31/2014	4.23	4.76	3.69	2.32
04/30/2014	3.38	3.91	5.89	2.8
05/31/2014	3.04	3.63	5.51	2.62
06/30/2014	3.31	3.92	6.17	3.01
07/31/2014	2.98	3.68	5.1	2.13
08/31/2014	3.76	4.57	5.24	1.75
Average	**3.060**	**3.674**	**6.538**	**2.395**
Median	**2.975**	**3.560**	**6.290**	**2.385**
90th Percentile	**3.530**	**4.415**	**9.045**	**3.370**
Summer Ave.	**2.958**	**3.502**	**6.364**	**2.690**
Population	28,190	Influent->	35.0	7.00
	109	157	82%	66%
	gpcd ave	gpcd max	removal	removal

Rocker WWTP				MT0027430
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.02	0.03	25.9	
02/28/2010	0.02	0.03	23.9	
03/31/2010	0.03	0.03	14.8	
04/30/2010	0.02	0.03	21	
05/31/2010	0.03	0.04	20.7	
06/30/2010	0.03	0.05	19.2	
07/31/2010	0.03	0.04	17.6	
08/31/2010	0.03	0.04	16.2	
09/30/2010	0.02	0.03	14.7	
10/31/2010	0.02	0.03	19.9	
11/30/2010	0.02	0.03	24.8	
12/31/2010	0.02	0.02	29.7	
01/31/2011	0.02	0.02	25	
02/28/2011	0.02	0.02	22.6	
03/31/2011	0.02	0.03	21.5	
04/30/2011	0.02	0.04	30.7	
05/31/2011	0.02	0.04	21.1	
06/30/2011	0.02	0.04	18.9	
07/31/2011	0.03	0.03	22.3	
08/31/2011	0.03	0.04	16.9	
09/30/2011	0.02	0.03	18.5	
10/31/2011	0.02	0.03	10.4	
11/30/2011	0.02	0.02	20.4	
12/31/2011	0.02	0.02	30.8	
01/31/2012	0.02	0.03	24	
02/29/2012	0.02	0.02	17.5	
03/31/2012	0.02	0.03	22.2	
04/30/2012	0.02	0.03	17.6	
05/31/2012	0.02	0.02	17.4	
06/30/2012	0.02	0.02	10.9	
07/31/2012	0.02	0.04	10.9	
08/31/2012	0.02	0.03	6.32	
09/30/2012	0.02	0.02	7.96	
10/31/2012	0.02	0.03	11.6	
11/30/2012	0.02	0.03	15.9	
12/31/2012	0.02	0.02	21.3	
01/31/2013	0.02	0.02	22.7	
02/28/2013	0.02	0.02	20.5	
03/31/2013	0.02	0.02	22.1	
04/30/2013	0.02	0.07	15.5	
05/31/2013	0.02	0.05	16.8	
06/30/2013	0.02	0.05	11	7.33
07/31/2013	0.03	0.06	13.8	11.8
08/31/2013	0.03	0.04	8.53	9.82
09/30/2013	0.03	0.06	12.1	7.94
10/31/2013	0.03	0.03		
11/30/2013	0.02	0.03		
12/31/2013	0.02	0.03		
01/31/2014	0.02	0.03		
02/28/2014	0.02	0.03		
03/31/2014	0.02	0.04		
04/30/2014	0.02	0.04		
05/31/2014	0.02	0.03		
06/30/2014	0.02	0.04	11	11
07/31/2014	0.02	0.04	10.9	13.8
08/31/2014	0.03	0.07	11.8	13.8
Average	**0.022**	**0.034**	**18.079**	**10.784**
Median	**0.020**	**0.030**	**18.050**	**11.000**
90th Percentile	**0.030**	**0.050**	**24.860**	**13.800**
Summer Ave.	**0.026**	**0.041**	**13.465**	**11.432**
Population	100	Influent->	17.9	4.87
	221	500	-1%	-126%
	gpcd ave	gpcd max	removal	removal

Absarokee WWTP				MT0020052
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.107			
02/28/2010	0.086			
03/31/2010	0.099		27.03	4.11
04/30/2010	0.101			
05/31/2010	0.173			
06/30/2010	0.655		20.48	3.4
07/31/2010	0.632			
08/31/2010	0.393			
09/30/2010	0.340		2.22	0.53
10/31/2010	0.190			
11/30/2010	0.075			
12/31/2010	0.043		15.61	2.08
01/31/2011	0.048			
02/28/2011	0.049			
03/31/2011	0.046		25.98	3.59
04/30/2011	0.066			
05/31/2011	0.461			
06/30/2011	0.580		5.22	0.44
07/31/2011	0.746			
08/31/2011	0.585			
09/30/2011	0.377		3.2	0.4
10/31/2011	0.190			
11/30/2011	0.084			
12/31/2011	0.050		19.15	2.17
01/31/2012	0.040			
02/29/2012	0.040			
03/31/2012	0.040		32.04	3.7
04/30/2012	0.040			
05/31/2012	0.435			
06/30/2012	0.730		2.98	0.42
07/31/2012	0.674			
08/31/2012	0.418			
09/30/2012	0.298		5.94	0.89
10/31/2012	0.233			
11/30/2012	0.091			
12/31/2012	0.042		19.4	2.3
01/31/2013	0.037			
02/28/2013	0.036			
03/31/2013	0.037		37.94	3.82
04/30/2013	0.037			
05/31/2013	0.245			
06/30/2013	0.582		6.05	0.56
07/31/2013	0.455			
08/31/2013	0.446			
09/30/2013	0.288		5.2	0.7
10/31/2013	0.248			
11/30/2013	0.081			
12/31/2013	0.076		22.25	2.52
01/31/2014	0.040			
02/28/2014	0.043			
03/31/2014	0.192		10.72	1.04
04/30/2014	0.374			
05/31/2014	0.320			
06/30/2014	0.468		5.5	0.62
07/31/2014	0.562			
08/31/2014	0.491			
Average	**0.256**		**14.828**	**1.849**
Median	**0.190**		**13.165**	**1.560**
90th Percentile	**0.583**		**28.533**	**3.736**
Summer Ave.	**0.479**		**4.140**	**0.630**
Population	1,684	Influent->	26.1	7.00
	152		49%	78%
	gpcd ave	gpcd max	removal	removal

Red Lodge WWTP				MT0020478
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.59	0.76	13	1.95
02/28/2010	0.55	0.75	14.1	2.1
03/31/2010	0.58	0.68	15.8	2.28
04/30/2010	0.55	0.71	13	2.39
05/31/2010	0.81	1.2	7.1	2.3
06/30/2010	0.86	1	9.6	2
07/31/2010	0.76	1	15.5	2.56
08/31/2010	0.76	1.1	15.8	2.33
09/30/2010	0.61	0.8	10.8	1.74
10/31/2010	0.52	0.91	12.87	2.34
11/30/2010	0.53	0.76	15.6	2.18
12/31/2010	0.54	0.68	14.48	2.12
01/31/2011	0.49	0.65	15	2.36
02/28/2011	0.44	0.58	15	2.36
03/31/2011	0.49	0.74	16	2.23
04/30/2011	0.54	0.75	12.75	1.96
05/31/2011	1.39	3.4	11.25	1.82
06/30/2011	1.15	3.1	4.78	0.71
07/31/2011	1.1	1.9	8.75	1.4
08/31/2011	0.63	0.77	11.18	1.63
09/30/2011	0.52	0.65	10.32	1.52
10/31/2011	0.45	0.67	13.32	2.04
11/30/2011	0.48	0.62	14.88	2.22
12/31/2011	0.45	0.59	16.22	2.32
01/31/2012	0.42	0.59	16.52	2.22
02/29/2012	0.36	0.42	18.6	2.4
03/31/2012	0.44	0.69	17.4	2.28
04/30/2012	0.4	0.58	16.25	2.16
05/31/2012	0.4	0.79	11.96	2.49
06/30/2012	0.49	0.61	16	2.48
07/31/2012	0.55	0.68	19.25	3.07
08/31/2012	0.55	0.68	19	2.88
09/30/2012	0.55	0.63	19	2.53
10/31/2012	0.49	0.65	18.2	2.55
11/30/2012	0.47	0.54	19	2.45
12/31/2012	0.44	0.55	19.25	2.52
01/31/2013	0.36	0.55	18.8	2.6
02/28/2013	0.26	0.42	19	2.56
03/31/2013	0.26	0.39	19.4	2.38
04/30/2013	0.3	0.43	17.6	2.24
05/31/2013	0.52	1.45	15.4	2.25
06/30/2013	0.73	1.18	15.78	2.21
07/31/2013	0.77	1.98	14.76	2.02
08/31/2013	0.58	0.73	17.37	2.52
09/30/2013	0.66	1.18	17.42	2.72
10/31/2013	0.88	1.06	14.58	2.02
11/30/2013	0.61	0.79	11.75	1.69
12/31/2013	0.56	0.78	11.72	1.7
01/31/2014	0.46	0.69	12.96	1.82
02/28/2014	0.45	0.62	14.9	2.1
03/31/2014	0.54	0.91	15.2	2.14
04/30/2014	0.95	1.4	12.18	1.65
05/31/2014	0.8	1.19	7.62	1.22
06/30/2014	0.79	1.2	10.02	1.75
07/31/2014	0.75	0.93	13.18	2.22
08/31/2014	0.61	0.78	13.6	2.07
Average	**0.593**	**0.908**	**14.478**	**2.158**
Median	**0.545**	**0.745**	**14.950**	**2.220**
90th Percentile	**0.835**	**1.300**	**19.000**	**2.560**
Summer Ave.	**0.671**	**0.986**	**14.709**	**2.233**
Population	2,125	Influent->	14.2	3.87
	279	612	-5%	43%
	gpcd ave	gpcd max	removal	removal

Laurel WWTP				MT0020311
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.64	0.71	28.3	4.4
02/28/2010	0.66	0.76	26.6	4.56
03/31/2010	0.69	0.81	22.9	4.2
04/30/2010	0.83	1.04	25.6	3.57
05/31/2010	0.94	1.4	21.1	4.5
06/30/2010	1.11	1.31	10.2	2.4
07/31/2010	1.19	1.35	11.3	2.43
08/31/2010	1.22	1.93	9.2	1.6
09/30/2010	1.25	1.52	11.8	2.8
10/31/2010	0.95	1.07	14.2	3.5
11/30/2010	0.8	0.9	13.4	3.2
12/31/2010	0.74	0.84	16.6	3.4
01/31/2011	0.74	0.89	21.3	3.6
02/28/2011	0.71	0.79	22.5	3.4
03/31/2011	0.73	0.84	26.4	3.97
04/30/2011	0.92	1.17	21.5	3.2
05/31/2011	1.7	3.44	13.4	1.44
06/30/2011	1.42	1.8	11.4	1.9
07/31/2011	1.42	1.76	9.45	2
08/31/2011	1.39	1.58	8.5	1.84
09/30/2011	1.15	1.6	10.7	2.3
10/31/2011	1.02	1.37	12.6	2.6
11/30/2011	0.85	0.94	14.4	2.6
12/31/2011	0.79	0.82	16.2	2.9
01/31/2012	0.74	0.8	23.6	3.1
02/29/2012	0.68	0.73	24.2	3.6
03/31/2012	0.67	0.75	26.3	4
04/30/2012	0.76	0.97	21.9	3.7
05/31/2012	0.91	1.43	16	3.5
06/30/2012	1.09	1.32	10.7	2.6
07/31/2012	1.16	1.34	9.1	2.1
08/31/2012	1.11	1.39	12	2.56
09/30/2012	0.95	1.18	11.2	2.8
10/31/2012	0.94		14	2.4
11/30/2012	0.78	0.89	18	3.2
12/31/2012	0.69	0.79	20	3.2
01/31/2013	0.65	0.75	22	3.4
02/28/2013	0.64	0.71	24	3.8
03/31/2013	0.63	0.72	21.5	3.95
04/30/2013	0.72	0.81	23.6	3.67
05/31/2013	0.97	2.25	17.95	3.4
06/30/2013	1.19	1.42	11.3	
07/31/2013	1.13	1.23	10.85	2.65
08/31/2013	1.01	1.21	10.15	2.6
09/30/2013	1.07	1.46	11.05	2.5
10/31/2013			10.25	1.93
11/30/2013	0.87	0.99	13.25	2.42
12/31/2013	0.79	0.93	17.85	2.72
01/31/2014	0.82	0.89	26	2.78
02/28/2014	0.8	0.95	23.95	3.17
03/31/2014	0.97	1.23	18.4	2.42
04/30/2014	0.86	1.11	21.95	2.82
05/31/2014	0.88	1.18	17.15	2.58
06/30/2014	0.88	1.13	15.65	2.84
07/31/2014	1.1	1.44	13	2.68
08/31/2014	1.08	1.57	10.65	2.09
Average	**0.935**	**1.189**	**16.912**	**2.973**
Median	**0.880**	**1.120**	**16.100**	**2.820**
90th Percentile	**1.208**	**1.594**	**24.900**	**3.962**
Summer Ave.	**1.159**	**1.469**	**10.639**	**2.354**
Population	6,718	Influent->	28.4	7.00
	139	237	43%	60%
	gpcd ave	gpcd max	removal	removal

Western Sugar				MT0000281
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	1.495		31.63	0.86
02/28/2010	0		0	0
03/31/2010	0		0	0
04/30/2010	0		0	0
05/31/2010	0		0	0
06/30/2010	0		0	0
07/31/2010	0		0	0
08/31/2010	0		0	0
09/30/2010	2.895		34.56	0.55
10/31/2010	3.505		33.64	0.552
11/30/2010	2.615		44.89	1.1
12/31/2010	3.165		43.21	0.46
01/31/2011	2.83		42.73	0.45
02/28/2011	1.4		35.11	0.315
03/31/2011	0		0	0
04/30/2011	0		0	0
05/31/2011	0		0	0
06/30/2011	0		0	0
07/31/2011	0		0	0
08/31/2011	0		0	0
09/30/2011	0		0	0
10/31/2011	1.945		17.69	0.56
11/30/2011	2.365		27.1	0.59
12/31/2011	0.84		34.06	0.37
01/31/2012	1.12		35.18	0.484
02/29/2012	1.45		32.29	0.216
03/31/2012	0		0	0
04/30/2012	0		0	0
05/31/2012	0		0	0
06/30/2012	0		0	0
07/31/2012	0		0	0
08/31/2012	0		0	0
09/30/2012	0		0	0
10/31/2012	0.45		35.86	0.94
11/30/2012	0.996		38.35	0.439
12/31/2012	1.2855		33.13	0.485
01/31/2013	1.4055		33.03	0.288
02/28/2013	0.782		22.85	0.26
03/31/2013	0		0	0
04/30/2013	0		0	0
05/31/2013	0		0	0
06/30/2013	0		0	0
07/31/2013	0		0	0
08/31/2013	0		0	0
09/30/2013	0		0	0
10/31/2013	1.525		28.11	0.583
11/30/2013	1.7165		28.04	0.33
12/31/2013	1.7465		33.37	0.134
01/31/2014	2.373		30.61	0.269
02/28/2014	1.474		26.27	0.424
03/31/2014	0		0	0
04/30/2014	0		0	0
05/31/2014	0		0	0
06/30/2014	0		0	0
07/31/2014				
08/31/2014				
Average	**0.729**		**13.365**	**0.197**
Median	**0.000**		**0.000**	**0.000**
90th Percentile	**2.371**		**35.159**	**0.558**
Summer Ave.	**0.241**		**2.880**	**0.046**
	gpcd ave	gpcd max	removal	removal

Cenex Harvest WWTP				MT0000264
	Flow Monthly	Flow Daily	Effluent Ammonia Ave	Effluent Ammonia Max
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010 Averag	1.17	1.21	7.25	10.08
02/28/2010 Averag	1.06	1.19	4.33	10.3
03/31/2010 Averag	1.15	1.32		
04/30/2010 Averag	0.99	1.35		
05/31/2010 Averag	0.81	1.01	0.08	0.11
06/30/2010 Averag	0.79	1.31		
07/31/2010 Averag	1.23	1.56	0.3	0.58
08/31/2010 Averag	1.35	1.63	0.07	0.09
09/30/2010 Averag	1.29	1.63	0.1	0.22
10/31/2010 Averag	1.29	1.76	0.19	0.55
11/30/2010 Averag	1.46	2.17		
12/31/2010 Averag	1.25	1.89	1.55	3.98
01/31/2011 Averag	1.1	1.33	5.5	8.2
02/28/2011 Averag	1.28	2.15	0.29	0.9
03/31/2011 Averag	1.19	1.56		
04/30/2011 Averag	1.21	1.94		
05/31/2011 Averag	1.17	2.02	0.33	0.62
06/30/2011 Averag	1.25	1.55		
07/31/2011 Averag	1.22	1.66		
08/31/2011 Averag	1.39	1.64		
09/30/2011 Averag	1.31	2.09		
10/31/2011 Averag	1.31	2.09	0.11	0.24
11/30/2011 Averag	1.25	1.71	0.49	1
12/31/2011 Averag	1.22	2.16		
01/31/2012 Averag	1.17	2.02	0.09	0.14
02/29/2012 Averag	1.24	1.8	0.08	0.11
03/31/2012 Averag	1.14	1.56		
04/30/2012 Averag	1.3	1.8		
05/31/2012 Averag	1.44	1.71		
06/30/2012 Averag	1.36	2.03	0.09	0.13
07/31/2012 Averag	1.42	2.13		
08/31/2012 Averag	1.39	1.58	0.22	0.83
09/30/2012 Averag	1.34	1.67		
10/31/2012 Averag	1.42	1.91		
11/30/2012 Averag	1.34	1.53	0.57	2.07
12/31/2012 Averag	1.42	2.09	0.14	0.34
01/31/2013 Averag	1.48	1.93	0.08	0.11
02/28/2013 Averag	1.12	1.53	3.94	12.8
03/31/2013 Averag	1.39	1.97		
04/30/2013 Averag	1.35	1.99	0.25	0.62
05/31/2013 Averag	1.03	1.9	3.27	7.4
06/30/2013 Averag	1.3	1.77	10.63	23.4
07/31/2013 Averag	1.52	1.79	0.52	0.95
08/31/2013 Averag	1.44	1.53	0.16	0.34
09/30/2013 Averag	1.51	2.1	0.31	0.92
10/31/2013 Averag	1.49	2.07	0.2	0.38
11/30/2013 Averag	1.37	1.55	2.26	7.72
12/31/2013 Averag	1.48	1.66	0.84	2.1
01/31/2014 Averag	1.41	1.8	0.45	1.31
02/28/2014 Averag	1.36	1.5		
03/31/2014 Averag	1.29	1.58		
04/30/2014 Averag	1.37	2.07		
05/31/2014 Averag	1.32	1.66		
06/30/2014 Averag	1.31	1.58	0.14	0.34
07/31/2014 Averag	1.28	1.66		
08/31/2014 Averag	1.39	1.8	2.23	8.57
Average	**1.284**	**1.736**	**1.426**	**3.256**
Median	**1.305**	**1.710**	**0.300**	**0.830**
90th Percentile	**1.450**	**2.090**	**4.252**	**9.778**
Summer Ave.	**1.363**	**1.748**	**0.489**	**1.563**
	gpcd ave	gpcd max	removal	removal

Barretts Minerals Treasure Mine				MT0029891
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.50	0.50	5.6	0.01
02/28/2010	0.58	0.58	7.1	0.04
03/31/2010	0.72	0.72	4.3	0.03
04/30/2010	0.50	0.50	3.5	0.03
05/31/2010	0.51	0.51	3	0.02
06/30/2010	1.31	1.31	2.6	0.02
07/31/2010	1.04	1.04	4.2	0.02
08/31/2010	0.82	0.82	5.2	0.01
09/30/2010	0.76	0.76	6	0.03
10/31/2010	0.50	0.50	8.1	0.01
11/30/2010	0.50	0.50	6.6	0.01
12/31/2010	0.54	0.54	4.4	0.03
01/31/2011	0.54	0.54	6	0.03
02/28/2011	0.52	0.52	4.8	0.02
03/31/2011	0.50	0.50	6.2	0.01
04/30/2011	0.72	0.72	4.1	0.02
05/31/2011	0.58	0.58	2.5	0.03
06/30/2011	0.76	0.76	2.5	0.02
07/31/2011	0.77	0.77	5.7	0.02
08/31/2011	0.42	0.42	4.9	0.04
09/30/2011	0.31	0.31	5.3	0.03
10/31/2011	0.35	0.35	6.3	0.03
11/30/2011	0.36	0.36	7.1	0.01
12/31/2011	0.36	0.36	7.51	0.06
01/31/2012	0.35	0.35	7.3	0.01
02/29/2012	0.16	0.16	7.9	0.01
03/31/2012	0.33	0.33	8.4	0.02
04/30/2012	0.36	0.36	7.7	
05/31/2012	0.55	0.55	6.3	0.01
06/30/2012	0.36	0.36	8.1	0.01
07/31/2012	0.18	0.18	7.6	0.02
08/31/2012	0.12	0.12	9.5	0.02
09/30/2012	0.11	0.14	9.4	0.01
10/31/2012	0.17	0.17	7.8	0.01
11/30/2012	0.14	0.14	7.5	0.01
12/31/2012	0.17	0.17	8.95	0.01
01/31/2013	0.14	0.14	8.9	0.02
02/28/2013	0.22	0.22	8	0.02
03/31/2013	0.11	0.11	8.4	0.02
04/30/2013	0.50	0.50	6.5	0.04
05/31/2013	0.85	0.85	7.7	0.02
06/30/2013	0.71	0.71	7.3	0.02
07/31/2013	0.30	0.30	8.6	0.01
08/31/2013	0.10	0.36	9.75	0.01
09/30/2013	0.52	0.52	8.7	0.02
10/31/2013	0.12	0.43	3.4	0.03
11/30/2013	0.10	0.35	8.9	
12/31/2013	0.36	0.50	10.1	0.02
01/31/2014	0.36	0.50	9	0.02
02/28/2014	0.36	0.50	5.9	0.03
03/31/2014	0.36	0.50	2.3	0.02
04/30/2014	0.55	0.55	7.2	0.03
05/31/2014	0.59	0.59	3.9	0.02
06/30/2014	0.67	0.67		
07/31/2014	0.52	0.52	3.9	0.05
08/31/2014	0.51	0.51	6.4	0.01
Average	**0.453**	**0.479**	**6.451**	**0.021**
Median	**0.504**	**0.504**	**6.600**	**0.020**
90th Percentile	**0.756**	**0.756**	**8.930**	**0.030**
Summer Ave.	**0.462**	**0.483**	**6.796**	**0.021**
	gpcd ave	gpcd max	removal	removal

Yellowstone Energy Limited Partnership				MT0030180
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.11	0.15		
02/28/2010	0.12	0.15		
03/31/2010	0.13	0.15		19.2
04/30/2010	0.13	0.15		
05/31/2010	0.11	0.13		
06/30/2010	0.12	0.22		2.54
07/31/2010	0.11	0.16		
08/31/2010	0.08	0.13		
09/30/2010	0.01	0.09		4.5
10/31/2010	0.10	0.16		
11/30/2010	0.12	0.17		
12/31/2010	0.11	0.16		2.47
01/31/2011	0.12	0.20		
02/28/2011	0.08	0.16		
03/31/2011	0.15	0.25		12.2
04/30/2011	0.03	0.15		
05/31/2011	0.14	0.24		
06/30/2011	0.16	0.20		1.1
07/31/2011	0.16	0.18		
08/31/2011	0.15	0.18		
09/30/2011	0.15	0.18		
10/31/2011	0.07	0.15		
11/30/2011	0.07	0.16		
12/31/2011	0.14	0.20		
01/31/2012	0.14	0.22		
02/29/2012	0.14	0.19		
03/31/2012	0.13	0.21		
04/30/2012	0.13	0.19		
05/31/2012	0.13	0.26		
06/30/2012	0.08	0.20		
07/31/2012	0.12	0.19		
08/31/2012	0.10	0.19		
09/30/2012	0.11	0.17		
10/31/2012	0.10	0.17		
11/30/2012	0.11	0.15		
12/31/2012	0.12	0.16		
01/31/2013	0.13	0.17		
02/28/2013	0.12	0.15		
03/31/2013	0.13	0.17		
04/30/2013	0.13	0.18		
05/31/2013	0.15	0.22		
06/30/2013	0.10	0.20		
07/31/2013	0.14	0.18		
08/31/2013	0.14	0.20		
09/30/2013	0.17	0.21		
10/31/2013	0.16	0.23		
11/30/2013	0.16	0.19		
12/31/2013	0.15	0.24		
01/31/2014	0.15	0.20		
02/28/2014	0.14	0.19		
03/31/2014	0.16	0.36		
04/30/2014	0.16	0.21		
05/31/2014	0.14	0.21		
06/30/2014	0.01	0.04		
07/31/2014	0.11	0.21		
08/31/2014	0.11	0.18		
Average	**0.120**	**0.184**		**7.002**
Median	**0.125**	**0.183**		**3.520**
90th Percentile	**0.158**	**0.225**		**15.700**
Summer Ave.	**0.118**	**0.176**		**4.500**
	gpcd ave	gpcd max	removal	removal

Montana Sulphur and Chemical

MT0000230

Date	Flow Monthly Ave	Flow Daily Max	Effluent TN (mg/l)	Effluent TP (mg/l)
1/31/2010	2.95	3.04		
2/28/2010	3.10	3.29		
3/31/2010	2.93	3.08	2.2	0.04
4/30/2010	3.02	3.16		
5/31/2010	2.97	3.08		
6/30/2010	2.74	2.95	1.7	0.72
7/31/2010	2.62	2.94		
8/31/2010	2.84	3.05		
9/30/2010	2.75	3.09	2.2	0.04
10/31/2010	2.58	2.80		
11/30/2010	2.58	2.80		
12/31/2010	2.66	2.94	2.4	0.05
1/31/2011	2.94	3.11		
2/28/2011	2.65	3.14		
3/31/2011	2.76	3.17	2.4	0.04
4/30/2011	2.95	3.19		
5/31/2011	2.88	3.15		
6/30/2011	2.85	3.10	2.8	0.13
7/31/2011	2.83	2.92		
8/31/2011	2.62	2.93		
9/30/2011	2.75	3.03	4.2	0.49
10/31/2011	2.79	3.03		
11/30/2011	2.77	3.10		
12/31/2011	3.06	3.19	2.2	0.04
1/31/2012	3.09	3.16		
2/29/2012	3.00	3.10		
3/31/2012	2.79	3.00	2.5	0.04
4/30/2012	2.95	3.07		
5/31/2012	2.64	3.07		
6/30/2012	2.52	2.87	2.4	0.84
7/31/2012	2.32	2.49		
8/31/2012	2.41	2.55		
9/30/2012	2.43	2.63	3.1	0.03
10/31/2012	2.42	2.51		
11/30/2012	2.48	2.77		
12/31/2012	2.64	2.76	2.8	0.03
1/31/2013	2.82	3.11		
2/28/2013	3.03	3.08		
3/31/2013	3.01	3.03	2	0.1
4/30/2013	2.98	3.09		
5/31/2013	2.82	3.15		
6/30/2013	2.67	3.00	2.6	0.27
7/31/2013	2.67	2.90		
8/31/2013	2.92	2.98		
9/30/2013	2.70	2.78	3	0.06
10/31/2013	2.60	2.70		
11/30/2013	2.54	2.73		
12/31/2013	2.48	2.53	2.4	0.01
1/31/2014	2.34	2.47		
2/28/2014	2.14	2.24		
3/31/2014	2.23	2.30	3.2	0.04
4/30/2014	2.24	2.31		
5/31/2014	2.21	2.45		
6/30/2014	2.31	2.50		
7/31/2014	2.39	2.61		
8/31/2014	2.64	2.92		
Average	**2.697**	**2.895**	**2.594**	**0.175**
Median	**2.720**	**2.987**	**2.400**	**0.040**
90th Percentile	**3.006**	**3.155**	**3.140**	**0.582**
Summer Ave.	**2.635**	**2.844**	**3.125**	**0.155**
	gpcd ave	gpcd max	removal	removal

Bull Mountain Mine #1				MT0028983
Date	Flow Monthly Ave	Flow Daily Max	Effluent TN (mg/l)	Effluent TP (mg/l)
01/31/2010	0	0		
02/28/2010	0	0		
03/31/2010	0	0		
04/30/2010	0	0		
05/31/2010	0	0		
06/30/2010	0	0		
07/31/2010	0	0		
08/31/2010	0	0		
09/30/2010	0	0		
10/31/2010	0	0		
11/30/2010	0	0		
12/31/2010	0	0		
01/31/2011	0	0		
02/28/2011	0	0		
03/31/2011	0	0		
04/30/2011	0	0		
05/31/2011	0.74	1.75		
06/30/2011	0.52	1.55		
07/31/2011	0	0		
08/31/2011	0	0		
09/30/2011	0	0		
10/31/2011	0	0		
11/30/2011	0	0		
12/31/2011	0	0		
01/31/2012	0	0		
02/29/2012	0	0		
03/31/2012	0	0		
04/30/2012	0	0		
05/31/2012	0	0		
06/30/2012	0	0		
07/31/2012	0	0		
08/31/2012	0	0		
09/30/2012	0	0		
10/31/2012	0	0		
11/30/2012	0	0		
12/31/2012	0	0		
01/31/2013	0	0		
02/28/2013	0	0		
03/31/2013	0	0		
04/30/2013	0	0		
05/31/2013	31.29	64.78	2.294	0.252
06/30/2013	0.91	1.12	2.215	0.095
07/31/2013	0	0		
08/31/2013	0.31	0.32	0.51	0.01
09/30/2013	0	0		
10/31/2013	0.320	0.032	1.17	0.01
11/30/2013	0.57	0.57	1.1	0.01
12/31/2013	0.72	0.72	1.8	0.18
01/31/2014	0	0		
02/28/2014	0	0		
03/31/2014	0	0		
04/30/2014	0	0		
05/31/2014	0	0		
06/30/2014	0	0		
07/31/2014	0	0		
08/31/2014	13.797	13.797	18.59	0.33
Average	**0.878**	**1.511**	**3.954**	**0.127**
Median	**0.000**	**0.000**	**1.800**	**0.095**
90th Percentile	**0.543**	**0.645**	**8.812**	**0.283**
Summer Ave.	**1.008**	**1.009**	**9.550**	**0.170**
	gpcd ave	gpcd max	removal	removal

Montana Behavioral Health				MT0021431
Date	Flow Monthly Ave	Flow Daily Max	Effluent TN (mg/l)	Effluent TP (mg/l)
01/31/2010	0	0.01	32.2	10.1
02/28/2010	0	0.01	39.3	10.4
03/31/2010	0	0	38.5	7.72
04/30/2010	0	0.01	33.4	6.25
05/31/2010	0.01	0.01	23.7	5.87
06/30/2010	0.01	0.01	18.7	3.96
07/31/2010	0.01	0.01	32.5	3.72
08/31/2010	0.01	0.01	32.7	2.46
09/30/2010	0.01	0.01	33.6	0.73
10/31/2010	0	0.01	32	5.9
11/30/2010	0.01	0.01	31.9	4.3
12/31/2010	0	0.01	28	5.06
01/31/2011	0	0	30.6	6.03
02/28/2011	0	0.01	25.6	5.15
03/31/2011	0	0.01	39.5	5.79
04/30/2011	0	0	36.9	7.4
05/31/2011	0	0.01	33.6	6.85
06/30/2011	0	0.01	28.9	7.62
07/31/2011	0	0.01	37.2	7.97
08/31/2011	0.01	0.01	22.7	4.75
09/30/2011	0.01	0.01	16	3.7
10/31/2011	0.01	0.01	6.43	3.46
11/30/2011	0.01	0.01	23.5	2.36
12/31/2011	0.01	0.01	24.7	3.43
01/31/2012	0.01	0.01	28	4.51
02/29/2012	0.01	0.01	29.6	4.3
03/31/2012	0.01	0.01	29.1	5.3
04/30/2012	0.01	0.01	32.3	5.68
05/31/2012	0.01	0.01	31.2	6.31
06/30/2012	0.01	0.01	29	6.98
07/31/2012	0.01	0.02	22.9	5.25
08/31/2012	0.01	0.01	16.1	2.74
09/30/2012	0.01	0.01	17.7	2.34
10/31/2012	0.01	0.01		
11/30/2012	0.01	0.01		
12/31/2012	0	0.01		
01/31/2013	0	0.01		
02/28/2013	0	0		
03/31/2013	0	0.01		
04/30/2013	0	0.01		
05/31/2013	0	0.02		
06/30/2013	0	0.01	39.3	6.17
07/31/2013	0	0.01	34.9	8.56
08/31/2013	0	0	30	7.17
09/30/2013	0	0.01	27.2	6.08
10/31/2013	0	0.01		
11/30/2013	0	0		
12/31/2013	0	0.03		
01/31/2014	0	0		
02/28/2014	0	0		
03/31/2014	0	0.01		
04/30/2014	0	0		
05/31/2014	0	0.02		
06/30/2014	0	0.01	41.3	8.02
07/31/2014	0	0.02	38.4	9.18
08/31/2014	0	0.01	28.3	8.02
Average	**0.004**	**0.009**	**29.436**	**5.690**
Median	**0.000**	**0.010**	**30.300**	**5.830**
90th Percentile	**0.010**	**0.010**	**38.580**	**8.074**
Summer Ave.	**0.006**	**0.011**	**27.871**	**5.191**
	gpcd ave	gpcd max	removal	removal

Decker East Mine				MT0024210
Date	Flow Monthly Ave	Flow Daily Max	Effluent TN (mg/l)	Effluent TP (mg/l)
01/31/2010	1.14	1.36	1.8	
02/28/2010	1.09	1.65	2.3	0.01
03/31/2010	1.42	2.08	1.3	
04/30/2010	1.36	2.40	5.6	0.01
05/31/2010	1.89	2.47	2.7	0.02
06/30/2010	1.83	2.47	2.2	0.02
07/31/2010	1.59	2.27	1.9	0.01
08/31/2010	1.65	2.40	2.2	0.01
09/30/2010	1.25	2.27	1.3	
10/31/2010	1.25	2.40	1.7	
11/30/2010	1.36	1.95	2.4	0.01
12/31/2010	1.31	1.59	1.6	
01/31/2011	1.36	1.95	1.5	0.01
02/28/2011	1.25	1.83	1.5	
03/31/2011	1.42	1.95	2.1	
04/30/2011	1.25	2.40	3.3	
05/31/2011	1.89	2.54	2.5	0.02
06/30/2011	1.89	2.47	5.2	0.01
07/31/2011	1.89	2.54	3	
08/31/2011	1.36	2.47	2.6	
09/30/2011	1.53	2.47	5.3	
10/31/2011	1.53	2.60	2.5	0.01
11/30/2011	1.31	2.47	2.1	0.02
12/31/2011	1.14	1.77	1.8	0.01
01/31/2012	1.42	2.54	2.1	
02/29/2012	1.14	1.59	1.4	
03/31/2012	1.59	2.47	1.8	
04/30/2012	1.47	2.40	2.1	
05/31/2012	1.59	2.08	2.52	0.01
06/30/2012	1.71	2.28	2.83	0.01
07/31/2012	1.65	2.22	1.9	
08/31/2012	1.47	1.88	2.5	0.02
09/30/2012	1.25	1.67	2.37	0.01
10/31/2012	1.36	2.04	2.3	0.01
11/30/2012	1.25	1.55	2.5	0.01
12/31/2012	1.31	1.46	2.5	0.01
01/31/2013	1.14	1.51	2.4	
02/28/2013	1.14	1.52	2.2	0.01
03/31/2013	1.36	1.56	2.7	
04/30/2013	1.71	2.25	2.5	
05/31/2013	1.71	2.28	2.5	
06/30/2013	1.71	2.81	1.8	0.01
07/31/2013	1.59	2.08	1.4	
08/31/2013	1.59	2.02	1.8	0.01
09/30/2013	1.53	2.08	1.8	
10/31/2013	1.71	2.27	1.9	0.01
11/30/2013	1.59	2.34	1.6	
12/31/2013	1.83	2.88	1.7	0.01
01/31/2014	1.59	2.68	2.7	0.01
02/28/2014	1.31	2.95	1.5	0.01
03/31/2014	2.14	3.02	2	0.02
04/30/2014	1.53	2.74	1.9	0.01
05/31/2014	1.36	2.54	1.6	
06/30/2014	1.83	4.21	2	0.01
07/31/2014	1.89	2.68	1.9	
08/31/2014	1.71	3.17	1.3	0.02
Average	**1.503**	**2.260**	**2.258**	**0.012**
Median	**1.502**	**2.280**	**2.100**	**0.010**
90th Percentile	**1.860**	**2.775**	**2.765**	**0.020**
Summer Ave.	**1.569**	**2.301**	**2.234**	**0.013**
	gpcd ave	gpcd max	removal	removal

Decker West Mine				MT0000892
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.00	8.52	1.2	0.02
02/28/2010	0.00	12.53	1.1	0.02
03/31/2010	0.00	7.30	0.6	0.03
04/30/2010	0.00	6.86	1.6	0.01
05/31/2010	0.00	5.95	0.6	0.02
06/30/2010	0.00	12.84	0.5	0.02
07/31/2010	0.00	10.79	0.5	0.03
08/31/2010	0.12	9.46	2.6	0.035
09/30/2010	0.05	9.02	1.6	0.025
10/31/2010	0.00	6.08	0.8	0.02
11/30/2010	0.05	8.73	1.8	0.02
12/31/2010	0.01	5.46	2.1	0.035
01/31/2011	0.00	3.24	1	0.02
02/28/2011	0.00	3.59	1.1	0.02
03/31/2011	0.00	5.58	0.3	0.02
04/30/2011	0.00	8.80	2.2	0.02
05/31/2011	0.05	10.28	1.3	0.025
06/30/2011	0.36	11.67	2.6	0.025
07/31/2011	0.02	7.55	3.15	0.025
08/31/2011	0.36	7.23	0.7	0.02
09/30/2011	0.00	5.65		0.02
10/31/2011	0.00	5.79	4.6	0.02
11/30/2011	0.00	5.13	1.4	0.02
12/31/2011	0.00	6.27	1	0.03
01/31/2012	0.00	4.75	0.3	0.01
02/29/2012	0.00	4.94	0.7	0.01
03/31/2012	0.01	8.96	1.2	0.01
04/30/2012	0.10	11.76	1.35	0.025
05/31/2012	0.00	0.00	0.51	0.02
06/30/2012	0.00	0.00	0.76	0.02
07/31/2012	0.00	0.00	0.62	0.01
08/31/2012	0.00	0.00	0.7	0.03
09/30/2012	0.00	0.00	0.91	0.03
10/31/2012	0.00	0.00	0.7	
11/30/2012	0.00	0.00	0.9	0.03
12/31/2012	0.00	0.00	1	0.02
01/31/2013	0.00	0.00	0.9	0.02
02/28/2013	0.00	0.00	0.4	0.01
03/31/2013	0.00	0.00	1	0.02
04/30/2013	0.00	0.00	1	0.02
05/31/2013	0.00	0.00	0.8	0.02
06/30/2013	0.00	0.00	1	0.03
07/31/2013	0.00	0.00	0.5	0.04
08/31/2013	0.00	0.00	4.3	0.02
09/30/2013	0.00	0.00	0.9	0.03
10/31/2013	0.00	0.00	0.8	0.03
11/30/2013	0.00	0.00	0.4	0.03
12/31/2013	0.00	0.00	0.3	0.03
01/31/2014	0.00	0.00	0.4	0.02
02/28/2014	0.00	0.00		0.03
03/31/2014	0.00	0.00	0.4	0.03
04/30/2014	0.00	0.00	1.15	0.04
05/31/2014	0.00	0.00	0.8	0.03
06/30/2014	0.00	0.00	0.9	0.03
07/31/2014	0.00	0.00	0.9	0.02
08/31/2014	0.00	0.00	0.7	0.025
Average	**0.021**	**3.835**	**1.140**	**0.023**
Median	**0.000**	**1.622**	**0.900**	**0.020**
90th Percentile	**0.052**	**9.873**	**2.170**	**0.030**
Summer Ave.	**0.040**	**3.551**	**1.391**	**0.026**
	gpcd ave	gpcd max	removal	removal

Fidelity - Tongue River Project				MT0030724
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.66	0.66	0.8	0.1
02/28/2010	0.65	0.65	0.6	0.1
03/31/2010	0.909221902	0.995677233	0.2	0.09
04/30/2010	0.737752161	0.962536023	1.1	0.08
05/31/2010	0.694524496	0.737752161		0.09
06/30/2010	0.720461095	0.825648415	0.2	0.09
07/31/2010	0.94092219	1.321325648	0.3	0.09
08/31/2010	0.922190202	0.956772334	0.4	0.09
09/30/2010	0.991354467	1.645533141	0.3	0.1
10/31/2010	0.995677233	1.390489914	1	0.11
11/30/2010				
12/31/2010	1.17	1.195	0.4	
01/31/2011	1.145	1.18	0.4	
02/28/2011	1.115	1.165	0.8	
03/31/2011	1.495	2.205	1.35	
04/30/2011	1.045	1.09	0.8	
05/31/2011	2.125	2.28	1.6	
06/30/2011	1.135	1.16	0.9	
07/31/2011	1.71	2.245	1.25	
08/31/2011	1.035	1.125	0.8	
09/30/2011	0.915	1	0.3	
10/31/2011	0.925	0.98	1	
11/30/2011	0.945	1.04	1.1	
12/31/2011	0.925	0.975	1.1	
01/31/2012	0.89	1	1	
02/29/2012	0.905	1.005	0.8	
03/31/2012	0.835	1.1	0.7	
04/30/2012	0.465	0.505	0.9	
05/31/2012	0.45	0.465	0.6	
06/30/2012	0.45	0.455	1.1	
07/31/2012	0.425	0.455	0.8	
08/31/2012	0.435	0.5	0.8	
09/30/2012	0.475	0.545	0.9	
10/31/2012	0.475	0.52	1.2	
11/30/2012	0.485	0.535	0.9	
12/31/2012	0.5	0.55	0.8	
01/31/2013	0.47	0.535	1	
02/28/2013	0.475	0.56	0.9	
03/31/2013	0.435	0.47	1	
04/30/2013	0.41	0.435	1.2	
05/31/2013	0.415	0.44	1.1	
06/30/2013	0.47	0.61	0	
07/31/2013	0	0		
08/31/2013	0	0		
09/30/2013	0	0		
10/31/2013	0	0		
11/30/2013	0	0		
12/31/2013	0	0		
01/31/2014	0	0		
02/28/2014	0	0		
03/31/2014	0	0		
04/30/2014	0	0		
05/31/2014	0	0		
06/30/2014	0	0		
07/31/2014	0	0		
08/31/2014	0	0		
Average	**0.607**	**0.699**	**0.810**	**0.094**
Median	**0.485**	**0.560**	**0.850**	**0.090**
90th Percentile	**1.127**	**1.271**	**1.200**	**0.101**
Summer Ave.	**0.561**	**0.700**	**0.650**	**0.093**
	gpcd ave	gpcd max	removal	removal

REC Advanced Silicon Materials				MT0030350
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.74	0.82		
02/28/2010	0.75	0.82		
03/31/2010	0.72	0.89		
04/30/2010	0.73	0.82		
05/31/2010	0.74	0.85		
06/30/2010	0.75	0.92		
07/31/2010	0.72	0.82		
08/31/2010	0.73	0.85		
09/30/2010	0.74	0.89		
10/31/2010	0.75	0.89		
11/30/2010	0.75	0.89		0.28
12/31/2010	0.73	0.85		0.2
01/31/2011	0.83	0.89		0.28
02/28/2011	0.82	0.89	1.2	0.27
03/31/2011	0.89	1.15		0.35
04/30/2011	0.94	1.07		0.37
05/31/2011	0.87	1.01		0.05
06/30/2011	0.91	1.01		0.03
07/31/2011	0.92	1.04		0.17
08/31/2011	0.9	1.12		0.21
09/30/2011	0.83	1.01		0.2
10/31/2011	0.84	0.92	0.5	0.2
11/30/2011	0.89	1.03		0.21
12/31/2011	0.84	0.96		0.17
01/31/2012	0.82	0.97		0.19
02/29/2012	0.82	1.45		0.09
03/31/2012	0.85	1.06		0.16
04/30/2012	0.87	1.07		0.13
05/31/2012	0.84	1.45	0.3	0.15
06/30/2012	0.82	1.45	0.06	0.14
07/31/2012	0.87	1.16	0.3	0.22
08/31/2012	0.88	1.45		0.24
09/30/2012	0.84	1.44		0.18
10/31/2012	0.89	1.1		0.2
11/30/2012	0.89	1.11		0.17
12/31/2012	0.86	1.06		0.2
01/31/2013	0.87	1.03		0.24
02/28/2013	0.87	1.06		0.18
03/31/2013	0.85	1.1		0.22
04/30/2013	0.88	1.06	0.2	0.22
05/31/2013	0.84	1.05		0.18
06/30/2013	0.8	1.08	0.2	0.18
07/31/2013	0.9	1.09		0.23
08/31/2013	0.87	1.05	0.2	0.29
09/30/2013	0.86	1.03	0.3	0.3
10/31/2013	0.84	0.97		0.33
11/30/2013	0.81	1.02	0.3	0.34
12/31/2013	0.72	1.44	0.4	0.35
01/31/2014	0.74	1.01	0.3	0.34
02/28/2014	0.91	1.03	0.2	0.26
03/31/2014	0.82	0.94		0.25
04/30/2014	0.85	1		0.27
05/31/2014	0.87	0.99	0.4	0.3
06/30/2014	0.89	0.99	0.2	0.3
07/31/2014	0.91	0.99	0.3	0.36
08/31/2014	0.87	0.97	0.3	0.23
Average	**0.831**	**1.037**	**0.333**	**0.227**
Median	**0.840**	**1.015**	**0.300**	**0.220**
90th Percentile	**0.900**	**1.300**	**0.440**	**0.340**
Summer Ave.	**0.846**	**1.065**	**0.280**	**0.239**
	gpcd ave	gpcd max	removal	removal

ASARCO EAST HELENA

MT0030147

Date	Flow Monthly Ave	Flow Daily Max	Effluent TN (mg/l)	Effluent TP (mg/l)
01/31/2010	0	0		
02/28/2010	0	0		
03/31/2010	0.088178	0.118311		
04/30/2010	0	0		
05/31/2010	0.090833	0.120385		
06/30/2010	0.090833	0.120385		
07/31/2010	0.080828	0.111896		
08/31/2010	0.104173	0.109421		
09/30/2010	0.088211	0.111354		
10/31/2010	0.113413	0.136994		
11/30/2010	0	0		
12/31/2010	0.117127	0.126134		
01/31/2011	0.114678	0.130768		
02/28/2011	0	0		
03/31/2011	0.090794	0.10744		
04/30/2011	0.107548	0.127014		
05/31/2011	0.122161	0.127112		
06/30/2011	0.10069	0.123696		
07/31/2011	0.10205	0.139257		
08/31/2011	0	0		
09/30/2011	0	0		
10/31/2011	0.110096	0.139073		
11/30/2011	0.077443	0.13149		
12/31/2011	0	0		
01/31/2012	0	0		
02/29/2012	0.106893	0.137845		
03/31/2012	0.108224	0.138596		
04/30/2012	0	0		
05/31/2012	0	0		
06/30/2012	0.127201	0.14079		
07/31/2012	0	0		
08/31/2012	0	0		
09/30/2012	0	0		
10/31/2012	0.077034	0.118241		
11/30/2012	0	0		
12/31/2012	0.089293	0.122064		
01/31/2013	0	0		
02/28/2013	0.033509	0.046273		
03/31/2013	0	0		
04/30/2013	0	0		
05/31/2013	0	0		
06/30/2013	0.091945	0.138721		
07/31/2013	0.120048	0.12752		
08/31/2013	0.108579	0.129087		
09/30/2013	0.107133	0.107133		
10/31/2013	0.108682	0.128403		
11/30/2013	0	0		
12/31/2013	0	0		
01/31/2014	0	0		
02/28/2014	0.077435	0.118951		
03/31/2014	0.09863	0.124889		
04/30/2014	0.077717	0.098554		
05/31/2014	0.073404	0.112675		
06/30/2014	0	0		
07/31/2014	0.064901	0.099014		
08/31/2014	0.094361	0.112388		
Average	**0.057**	**0.071**		
Median	**0.077**	**0.108**		
90th Percentile	**0.112**	**0.137**		
Summer Ave.	**0.062**	**0.075**		
	gpcd ave	gpcd max	removal	removal

Elkhorn Rehabilitation Center				MT0030350
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.02	0.02	21.3	0.71
02/28/2010	0.01	0.02	59.9	3.65
03/31/2010	0.01	0.02	16.2	1.2
04/30/2010	0.01	0.02	16.3	0.8
05/31/2010	0.01	0.02	16.75	1
06/30/2010	0.01	0.02	16.8	1.1
07/31/2010	0.01	0.02	21.5	1.44
08/31/2010	0.01	0.01	21.8	2.53
09/30/2010	0.01	0.02	23.8	3.59
10/31/2010	0	0	21.4	2.8
11/30/2010	0	0.01	59.9	3.65
12/31/2010	0.01	0.02	25	4
01/31/2011	0.01	0.02	34	2.89
02/28/2011	0	0	36	3.23
03/31/2011	0	0	50.18	3.64
04/30/2011	0	0	21.3	2.23
05/31/2011	0	0	14.9	1.2
06/30/2011	0	0	14.07	1.81
07/31/2011	0	0	22.06	2.83
08/31/2011	0	0	21.12	2.43
09/30/2011	0	0	18.19	2.59
10/31/2011	0	0	13.55	2.69
11/30/2011	0	0.02	14.82	2.67
12/31/2011			16.15	2.36
01/31/2012	0	0	17.37	2.6
02/29/2012	0	0	21.7	2.53
03/31/2012	0	0	15.8	2.6
04/30/2012	0	0	14.1	2.5
05/31/2012	0	0	13.6	2.8
06/30/2012	0	0	14.5	1.76
07/31/2012	0	0	14.5	3.23
08/31/2012	0	0	8.5	4.84
09/30/2012	0	0	10.1	2.5
10/31/2012	0	0	9.1	2.2
11/30/2012	0	0	28.4	3
12/31/2012	0	0	21.5	2.9
01/31/2013	0	0	9.5	1.4
02/28/2013	0	0	13.6	4.1
03/31/2013	0	0	50.5	3.1
04/30/2013	0	0	20.7	2.54
05/31/2013	0	0	13.53	1.07
06/30/2013	0	0		2.1
07/31/2013	0	0		2.41
08/31/2013	0	0	11.06	2.8
09/30/2013	0	0	9.3	1.92
10/31/2013	0	0	15.05	3.15
11/30/2013	0	0	23.71	3.7
12/31/2013	0	0	25.92	5.13
01/31/2014	0	0	39.4	3.9
02/28/2014	0	0	26.3	2.15
03/31/2014	0	0	25.94	3.7
04/30/2014	0	0	19.84	4.14
05/31/2014	0	0	19.2	5.02
06/30/2014	0	0	18.8	3.87
07/31/2014	0	0	18.3	2.2
08/31/2014	0.08	0	4.08	1.17
Average	**0.004**	**0.004**	**21.313**	**2.680**
Median	**0.000**	**0.000**	**18.550**	**2.600**
90th Percentile	**0.010**	**0.020**	**35.400**	**3.950**
Summer Ave.	**0.008**	**0.004**	**15.716**	**2.606**
	gpcd ave	gpcd max	removal	removal

BN Whitefish Facility				MT0000019
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0	0		
02/28/2010	0	0		
03/31/2010	0	0		
04/30/2010	0	0		
05/31/2010	0.02	0.04		0.01
06/30/2010	0.12	0.32		0.01
07/31/2010	0	0		
08/31/2010	0.08	0.12	2.01	0.03
09/30/2010	0	0		
10/31/2010	0	0		
11/30/2010	0	0		
12/31/2010	0	0		
01/31/2011	0	0		
02/28/2011	0	0		
03/31/2011	0.03	0.26		0.01
04/30/2011	0.1	0.25		0.01
05/31/2011	0.03	0.06		0.01
06/30/2011	0.05	0.17		0.01
07/31/2011	0.05	0.24		0.01
08/31/2011	0	0		
09/30/2011				
10/31/2011	0	0		
11/30/2011	0	0		
12/31/2011	0	0		
01/31/2012	0	0		
02/29/2012	0	0		
03/31/2012	0	0		
04/30/2012	0.13	0.36		0.02
05/31/2012	0.09	0.23		0.02
06/30/2012	0	0		
07/31/2012	0.1	0.24		0.02
08/31/2012	0.1	0.15		0.02
09/30/2012	0	0		
10/31/2012	0	0		
11/30/2012	0	0		
12/31/2012	0	0		
01/31/2013	0	0		
02/28/2013	0.04	0.27		0.01
03/31/2013	0.03	0.05		0.01
04/30/2013	0.02	0.04		0.01
05/31/2013	0.05	0.1		0.01
06/30/2013	0	0		
07/31/2013	0.15	0.23	0.5	0.02
08/31/2013	0	0		
09/30/2013	0	0		
10/31/2013	0	0		
11/30/2013	0	0		
12/31/2013	0	0		
01/31/2014	0	0		
02/28/2014	0.03	0.04	0.02	
03/31/2014	0.13	0.33		0.04
04/30/2014	0.11	0.31		0.03
05/31/2014	0	0		
06/30/2014	0	0		
07/31/2014	0.23	0.39	0.6	0.01
08/31/2014	0.02	0.02	0.6	0.01
Average	**0.031**	**0.077**	**0.746**	**0.016**
Median	**0.000**	**0.000**	**0.600**	**0.010**
90th Percentile	**0.106**	**0.266**	**1.446**	**0.030**
Summer Ave.	**0.056**	**0.107**	**0.928**	**0.017**
	gpcd ave	gpcd max	removal	removal

Stillwater Mining Company - Stillwater Mine				MT0024716
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.17	0.29	3.50	0.03
02/28/2010	0.16	0.28	0.52	0.04
03/31/2010	0.06	0.09	1.33	0.05
04/30/2010	0.17	0.66	2.04	0.04
05/31/2010	0.29	0.53	4.74	0.02
06/30/2010	0.14	0.19	0.52	
07/31/2010	0.15	0.19	0.51	
08/31/2010	0.17	0.22	0.73	0.10
09/30/2010	0.18	0.20	1.09	0.02
10/31/2010	0.16	0.20	0.50	0.01
11/30/2010	0.17	0.20	0.35	
12/31/2010	0.16	0.20	0.41	0.08
01/31/2011	0.14	0.19	0.41	0.03
02/28/2011	0.14	0.17	0.40	
03/31/2011	0.13	0.16	0.42	0.09
04/30/2011	0.14	0.26	0.39	
05/31/2011	0.14	0.21	0.48	0.01
06/30/2011	0.26	0.55	7.10	0.03
07/31/2011	0.21	0.40	0.43	0.01
08/31/2011	0.27	0.36	0.34	0.04
09/30/2011	0.25	0.50	0.37	0.01
10/31/2011	0.23	0.28	0.37	0.01
11/30/2011	0.22	0.28	0.38	0.01
12/31/2011	0.18	0.23	0.39	0.01
01/31/2012	0.15	0.21	0.41	0.01
02/29/2012	0.14	0.17	0.38	0.01
03/31/2012	0.14	0.17	0.37	
04/30/2012	0.14	0.16	0.35	0.01
05/31/2012	0.10	0.14	0.32	0.01
06/30/2012	0.12	0.22	0.24	0.01
07/31/2012	0.16	0.45	0.34	0.01
08/31/2012	0.14	0.18	0.37	0.01
09/30/2012	0.15	0.18	0.38	0.01
10/31/2012	0.15	0.20	0.38	0.01
11/30/2012	0.14	0.20	0.43	0.01
12/31/2012	0.16	0.20	0.43	0.01
01/31/2013	0.16	0.19	0.44	0.01
02/28/2013	0.17	0.27	0.43	0.01
03/31/2013	0.22	0.26	0.44	0.01
04/30/2013	0.36	0.68	6.80	0.02
05/31/2013	0.17	0.63	2.26	0.01
06/30/2013	0.14	0.16	0.56	0.01
07/31/2013	0.14	0.21	0.51	0.01
08/31/2013	0.13	0.16	0.46	0.01
09/30/2013	0.10	0.17	0.42	0.01
10/31/2013	0.06	0.11	0.41	0.01
11/30/2013	0.06	0.12	0.51	0.01
12/31/2013	0.06	0.08	0.45	0.01
01/31/2014	0.06	0.13	0.46	0.01
02/28/2014	0.06	0.09	0.40	0.01
03/31/2014	0.33	0.65	7.40	0.02
04/30/2014	0.33	0.49	5.67	0.02
05/31/2014	1.20	0.50	1.90	0.03
06/30/2014	0.22	0.46	6.45	0.03
07/31/2014	0.17	0.55	1.47	0.02
08/31/2014	0.15	0.54	5.47	0.01
Average	**0.184**	**0.282**	**1.340**	**0.021**
Median	**0.155**	**0.207**	**0.436**	**0.010**
90th Percentile	**0.266**	**0.545**	**5.108**	**0.040**
Summer Ave.	**0.169**	**0.307**	**0.921**	**0.021**
	gpcd ave	gpcd max	removal	removal

Stillwater Mining Company - East Boulder Mine				MT0026808
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.01	0.11	3.34	2.73
02/28/2010	0.04	0.22	2.55	1.7
03/31/2010	0.05	0.22	3.86	3.58
04/30/2010	0.05	0.21	2.09	1.55
05/31/2010	0.07	0.22	4.15	2.58
06/30/2010	0.16	0.21	4.37	3.03
07/31/2010	0.15	0.22	2.6	2.43
08/31/2010	0.12	0.21	2.6	2.42
09/30/2010	0.11	0.22	2.67	2.38
10/31/2010	0.10	0.22	2.15	1.51
11/30/2010	0.11	0.25	5.09	3.12
12/31/2010	0.07	0.22	1.83	1
01/31/2011	0.06	0.18	6.96	3.85
02/28/2011	0.03	0.17	2.39	1.06
03/31/2011	0.07	0.21	8.9	3.37
04/30/2011	0.08	0.21	5.72	2.83
05/31/2011	0.10	0.27	2.99	1.72
06/30/2011	0.29	0.35	4.05	2.34
07/31/2011	0.28	0.29	3.08	1.83
08/31/2011	0.26	0.30	2.91	2.9
09/30/2011	0.24	0.26	2.04	0.97
10/31/2011	0.22	0.26	5.01	1.49
11/30/2011	0.19	0.27	5.6	4.36
12/31/2011	0.19	0.27	8.39	3.67
01/31/2012	0.18	0.24	4.89	1.91
02/29/2012	0.18	0.26	4.47	1.97
03/31/2012	0.15	0.26	2.88	1.74
04/30/2012	0.16	0.26	4.4	2.4
05/31/2012	0.23	0.28	1.73	2.67
06/30/2012	0.26	0.29	4.06	2.54
07/31/2012	0.24	0.30	4.76	3.76
08/31/2012	0.27	0.40	2.97	2.14
09/30/2012	0.26	0.38	2.27	1.6
10/31/2012	0.24	0.36	2.8	2.04
11/30/2012	0.24	0.36	1.46	1.53
12/31/2012	0.34	0.38	1.94	1.56
01/31/2013	0.37	0.42	1.82	1.7
02/28/2013	0.34	0.39	0.46	0.82
03/31/2013	0.31	0.38	1.12	1.36
04/30/2013	0.32	0.36	5.67	3.22
05/31/2013	0.41	0.41	2.96	2.01
06/30/2013	0.38	0.41	2.9	1.85
07/31/2013	0.34	0.45	1.14	1.96
08/31/2013	0.32	0.45	1.54	2.07
09/30/2013	0.33	0.41	1.94	2
10/31/2013	0.35	0.38	1.97	165
11/30/2013	0.37	0.39	2.6	2
12/31/2013	0.38	0.38	2.65	1.76
01/31/2014	0.34	0.38	2.94	2.13
02/28/2014	0.20	0.39	2.21	1.99
03/31/2014	0.23	0.37	3.81	2.84
04/30/2014	0.20	0.39	1.69	2.12
05/31/2014	0.33	0.38	2.15	1.61
06/30/2014	0.42	0.45	3.49	2.78
07/31/2014	0.43	0.48	3.22	2.42
08/31/2014	0.43	0.46	2.74	2.37
Average	**0.226**	**0.312**	**3.268**	**5.148**
Median	**0.232**	**0.297**	**2.890**	**2.095**
90th Percentile	**0.378**	**0.418**	**5.345**	**3.475**
Summer Ave.	**0.271**	**0.345**	**2.606**	**2.232**
	gpcd ave	gpcd max	removal	removal

Beaverhead Talc Mine				MT0026808
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
03/31/2010	0			
06/30/2010	0.103680664	0.006796843		
09/30/2010	0.021600138	0.009172859		
12/31/2010	0			
03/31/2011	0			
06/30/2011	0.093600599	0.009648062		
09/30/2011	0.021600138	0.009072058		
12/31/2011	0			
03/31/2012	0			
06/30/2012	0.001080007	0.004132826		
09/30/2012	0			
12/31/2012	0			
03/31/2013	0			
06/30/2013	0			
09/30/2013	0			
12/31/2013	0			
03/31/2014	0			
06/30/2014	0.014400092	0.002764818		
09/30/2014	0.014400092	0.004334428		
Average	**0.014**	**0.007**		
Median	**0.000**	**0.007**		
90th Percentile	**0.036**	**0.009**		
	gpcd ave	gpcd max	removal	removal

MDU - Lewis and Clark Plant				MT0000302
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	32.67	32.68		
02/28/2010	32.64	32.66		
03/31/2010	32.55	32.66		
04/30/2010	28.16	32.54		
05/31/2010	28.44	32.55		
06/30/2010	32.63	32.7		
07/31/2010	32.52	32.6		
08/31/2010	30.68	32.73		
09/30/2010	32.59	32.75		
10/31/2010	28.72	32.67		
11/30/2010	32.63	32.69		
12/31/2010	32.27	32.68		
01/31/2011	32.66	32.71		
02/28/2011	32.37	32.68		
03/31/2011	31.92	32.69		
04/30/2011	24.98	32.64		
05/31/2011	27.52	32.78		
06/30/2011	32.65	32.67		
07/31/2011	32.71	32.76		
08/31/2011	32.24	32.57		
09/30/2011	32.65	32.79		
10/31/2011	26	32.27		
11/30/2011	32.57	32.61		
12/31/2011	32.33	32.55		
01/31/2012	32.23	32.54		
02/29/2012	32.33	32.54		
03/31/2012	30.53	32.54		
04/30/2012	22.81	32.52		
05/31/2012	15.57	32.72		
06/30/2012	27.47	32.7		
07/31/2012	32.18	32.55		
08/31/2012	32.47	32.47		
09/30/2012	31.44	32.64		
10/31/2012	27.82	32.67		
11/30/2012	32.38	32.64		
12/31/2012	29.19	32.61		
01/31/2013	27.97	32.58		
02/28/2013	30.66	32.57		
03/31/2013	32.54	32.56		
04/30/2013	32.11	64.31		
05/31/2013	23.4	32.74		
06/30/2013	0.99	1.05		
07/31/2013	32.4	32.61		
08/31/2013	32.52	32.57		
09/30/2013	32.07	32.5		
10/31/2013	27.01	32.61		
11/30/2013	32.52	32.56		
12/31/2013	30.7	32.54		
01/31/2014	32.43	32.57		
02/28/2014	32.34	32.55		
03/31/2014	30.53	32.55		
04/30/2014	23.92	64.19		
05/31/2014	32.14	32.57		
06/30/2014	29.57	32.67		
07/31/2014	32.32	32.61		
08/31/2014	31.17	32.52		
Average	**29.872**	**33.182**		
Median	**32.160**	**32.610**		
90th Percentile	**32.635**	**32.745**		
Summer Ave.	**32.140**	**32.619**		
	gpcd ave	gpcd max	removal	removal

Hinsdale WWTP				MT0020656
	Effluent Flow 30DA AVG	Effluent Flow DAILY MX	Effluent TN (mg/l)	Effluent TP (mg/l)
01/31/2010	0.01	0.01	1.2	0.03
02/28/2010	0.01	0.01	2	0.11
03/31/2010	0.02	0.02	1.4	0.04
04/30/2010	0.03	0.03	19	1.97
05/31/2010	0.03	0.03	12	1.5
06/30/2010	0.03	0.03	24.4	0.14
07/31/2010	0.03	0.03	10	0.71
08/31/2010	0.03	0.03	26	3.11
09/30/2010	0.01	0.03	28	2.97
10/31/2010	0.01	0.03	34	2.84
11/30/2010	0.01	0.02	26	2.55
12/31/2010	0.01	0.02	24	1.17
01/31/2011	0.01	0.03	18.4	1.06
02/28/2011	0.03	0.03	23.7	1.09
03/31/2011	0.01	0.03	28.2	1.32
04/30/2011	0.01	0.03	28.9	1.64
05/31/2011	0.01	0.03	28	2.19
06/30/2011	0.02	0.03	21	0.99
07/31/2011	0.01	0.03	22	0.83
08/31/2011	0.01	0.03	27.7	2.08
09/30/2011	0.01	0.03	14.4	0.6
10/31/2011	0.01	0.03	13.8	1.41
11/30/2011	0.01	0.03	3.8	0.59
12/31/2011	0.01	0.03	16.8	0.25
01/31/2012	0.01	0.03	19.7	0.39
02/29/2012	0.03	0.03	17	0.93
03/31/2012	0.03	0.03	17	0.93
04/30/2012	0.03	0.03	13	0.52
05/31/2012	0.02	0.02	14.4	0.49
06/30/2012	0.03	0.03	11.1	0.15
07/31/2012	0.02	0.02	5	0.52
08/31/2012	0.02	0.02	5.8	2.9
09/30/2012	0.02	0.03	24	5.9
10/31/2012	0.02	0.02	19	0.6
11/30/2012	0.02	0.03	13	3.83
12/31/2012	0.02	0.02	17	0.2
01/31/2013	0.02	0.03	18	0.17
02/28/2013	0.02	0.02	20	0.21
03/31/2013	0.02	0.03	25	0.92
04/30/2013	0.02	0.02	18	1.93
05/31/2013	0.02	0.03	22	0.65
06/30/2013	0.02	0.02	22	0.54
07/31/2013	0.02	0.03	31.2	0.76
08/31/2013	0.02	0.02	14.6	2.48
09/30/2013	0.03	0.03	3.5	0.8
10/31/2013	0.02	0.02	14.3	0.1
11/30/2013	0.02	0.02	10.2	0.14
12/31/2013	0.01	0.01	3.4	0.19
01/31/2014	0.01	0.09	11.9	0.6
02/28/2014	0.01	0.1	17.1	0.15
03/31/2014	0.01	0.09	10.8	0.35
04/30/2014	0.01	0.1	18.3	0.12
05/31/2014	0.01	0.1	12.4	1.38
06/30/2014	0.01	0.07	30.2	2.67
07/31/2014	0.01	0.07	22.7	0.17
08/31/2014	0.01	0.1	27.9	2.43
Average	**0.017**	**0.035**	**17.575**	**1.166**
Median	**0.020**	**0.030**	**18.000**	**0.780**
90th Percentile	**0.030**	**0.080**	**28.000**	**2.755**
Summer Ave.	**0.018**	**0.036**	**18.771**	**1.876**
Population	217	Influent->	35.0	7.00
	80	369	49%	89%
	gpcd ave	gpcd max	removal	removal

Columbia Falls WWTP				MT0020036
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.36	0.39		0.25
02/28/2010	0.34	0.38		0.3
03/31/2010	0.34	0.36		0.28
04/30/2010	0.34	0.42		0.23
05/31/2010	0.26	0.34	27.9	0.38
06/30/2010	0.33	0.48	19.9	0.45
07/31/2010	0.31	0.35	50.8	0.23
08/31/2010	0.24	0.3	25.4	0.23
09/30/2010	0.29	0.59	11.98	0.12
10/31/2010	0.3	0.37	5.98	0.05
11/30/2010	0.31	0.38	6.96	0.61
12/31/2010	0.33	0.57	8.57	0.1
01/31/2011	0.37	0.51	12.2	0.25
02/28/2011	0.37	0.52	11.57	0.86
03/31/2011	0.37	0.46	10.85	0.41
04/30/2011	0.44	0.7	11.28	0.17
05/31/2011	0.48	0.56	9.05	0.39
06/30/2011	0.57	0.68	8.1	0.77
07/31/2011	0.51	0.71	8.01	0.23
08/31/2011	0.43	0.48	11.2	0.12
09/30/2011	0.37	0.4	10.8	0.29
10/31/2011	0.35	0.39	11.06	1.12
11/30/2011	0.34	0.39	12.75	1.68
12/31/2011	0.36	0.39	7.66	0.91
01/31/2012	0.37	0.42	4.39	0.15
02/29/2012	0.37	0.46	7.05	0.61
03/31/2012	0.39	0.53	6.85	0.25
04/30/2012	0.38	0.49	7.12	0.15
05/31/2012	0.46	0.57	6.68	0.4
06/30/2012	0.57	0.75	5.2	0.28
07/31/2012	0.54	0.64	7.66	0.82
08/31/2012	0.46	0.62	7.17	0.32
09/30/2012	0.39	0.43	7.7	1.3
10/31/2012	0.42	0.52	7.82	0.24
11/30/2012	0.39	0.42	6.3	0.17
12/31/2012	0.4	0.45	5.79	0.15
01/31/2013	0.4	0.46	6.51	0.21
02/28/2013	0.38	0.39	6.52	0.15
03/31/2013	0.4	0.43	6.95	0.42
04/30/2013	0.43	0.47	6.58	0.33
05/31/2013	0.49	0.59	6.17	0.24
06/30/2013	0.54	0.7	2.89	0.25
07/31/2013	0.52	0.64	6.45	0.43
08/31/2013	0.45	0.59	6.64	0.17
09/30/2013	0.46	0.56	6.63	0.05
10/31/2013	0.41	0.51	8.07	0.31
11/30/2013	0.42	0.49	7.95	0.73
12/31/2013	0.42	0.5	8.14	0.14
01/31/2014	0.43	0.5	7.59	0.15
02/28/2014	0.45	0.6	7.59	0.21
03/31/2014	0.52	0.95	6.9	0.35
04/30/2014	0.42	0.62	7.14	0.12
05/31/2014	0.5	0.69	6.42	0.3
06/30/2014	0.62	0.99	5.8	0.28
07/31/2014	0.62	0.73	5.57	0.18
08/31/2014	0.5	0.66	7.81	0.35
Average	**0.415**	**0.527**	**9.540**	**0.369**
Median	**0.400**	**0.500**	**7.590**	**0.265**
90th Percentile	**0.530**	**0.700**	**12.178**	**0.795**
Summer Ave.	**0.435**	**0.550**	**12.416**	**0.346**
Population	4,688	Influent->	35.0	7.00
	88	149	78%	96%
	gpcd ave	gpcd max	removal	removal

Stevensville WWTP				MT0022713
	Flow Monthly	Flow Daily	Effluent TN	Effluent TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.63	0.665		
02/28/2010	0.58	0.62	16.7	2.7
03/31/2010	0.25			2.97
04/03/2010	0.295	0.34	16.9	2.27
05/31/2010	0.47	0.515		
06/03/2010				
07/31/2010	2.8	2.8		
08/31/2010	1.3			
09/03/2010	0.82	0.975		
01/31/2010	0.23			
11/03/2010	0.19	0.23	13.6	2.1
12/31/2010	0.425	0.87	2.1	2.74
01/31/2011	1.35	1.67		
02/28/2011	0.39	1.51		
03/31/2011	0.445	0.83	14.1	2.26
04/03/2011	0.38	0.455		
05/31/2011	0.31	0.38		
06/03/2011	0.31	0.38	5	1.42
07/31/2011	0.56		4.36	1.78
08/31/2011	0.25	0.275		
09/03/2011	0.27	0.31		
01/31/2011	0.31	0.37		
11/03/2011				
12/31/2011	0.5	0.59		
01/31/2012	0.3		19.6	4
02/29/2012	0.31	0.365		
03/31/2012	0.25		15.4	1.35
04/03/2012	0.23	0.26		
05/31/2012	0.21	0.28	18.1	3.72
06/03/2012	0.21	0.265		
07/31/2012			16.9	
08/31/2012			11.2	
09/03/2012			2.2	
01/31/2012	0.215	0.28		
11/03/2012				
12/31/2012	0.285	0.44		
01/31/2013	0.245	0.31		
02/28/2013				
03/31/2013	0.215	0.29		
04/03/2013				
05/31/2013	0.235	0.33		
06/03/2013			19	
07/31/2013	0.21	0.3	19	
08/31/2013			2.7	2.43
09/03/2013	0.245	0.32	21.31	
01/31/2013	0.215	0.28		
11/03/2013	0.24	0.29		
12/31/2013				
01/31/2014	0.21	0.26		
02/28/2014				
03/31/2014	0.37	0.94		
04/03/2014				
05/31/2014	0.25	0.29		
06/03/2014			19.4	
07/31/2014	0.23	0.31		4.55
08/31/2014				2.18
Average	**0.428**	**0.557**	**13.198**	**2.605**
Median	**0.285**	**0.340**	**16.050**	**2.350**
90th Percentile	**0.604**	**0.965**	**19.460**	**3.916**
Summer Ave.	**0.743**	**0.756**	**11.096**	**2.735**
Population	1,809	Influent->	16.7	4.56
	236	533	4%	49%
	gpcd ave	gpcd max	removal	removal

Wolf Point WWTP				MT0030571
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0	0		
02/28/2010	0	0		
03/31/2010	1.07	1.07		
04/30/2010	0	0		
05/31/2010	0	0		
06/30/2010	0	0		
07/31/2010	0	0		
08/31/2010	0	0		
09/30/2010	0	0		
10/31/2010	0	0		
11/30/2010	1.07	1.07		
12/31/2010	0	0		
01/31/2011	0	0		
02/28/2011	0	0		
03/31/2011	1.07	1.07		
04/30/2011	0	0		
05/31/2011	0	0		
06/30/2011	0	0		
07/31/2011	0	0		
08/31/2011	1.07	1.07		
09/30/2011	0	0		
10/31/2011	1.07	1.07		
11/30/2011	0	0		
12/31/2011	0	0		
01/31/2012	0	0		
02/29/2012	0	0		
03/31/2012	0	0		
04/30/2012	0	0		
05/31/2012	0	0		
06/30/2012	0	0		
07/31/2012	0	0		
08/31/2012	0	0		
09/30/2012	0	0		
10/31/2012	1.07	1.07		
11/30/2012	0	0		
12/31/2012	0	0	8	1.98
01/31/2013	0	0		
02/28/2013	0	0		
03/31/2013	0	0		
04/30/2013	1.07	1.07		
05/31/2013	0	0		
06/30/2013	1.07	1.07		
07/31/2013	0	0		
08/31/2013	0	0		
09/30/2013	0	0		
10/31/2013	0	0		
11/30/2013	1.07	1.07		
12/31/2013	0	0		
01/31/2014	0	0		
02/28/2014	0	0		
03/31/2014	0	0		
04/30/2014	1.07	1.07		
05/31/2014	0	0		
06/30/2014	0	0		
07/31/2014	0	0		
08/31/2014	0	0		
Average	**0.191**	**0.191**	**8.000**	**1.980**
Median	**0.000**	**0.000**	**8.000**	**1.980**
90th Percentile	**1.070**	**1.070**	**8.000**	**1.980**
Summer Ave.	**0.076**	**0.076**		
Population	2,621	Influent->	35.0	7.00
	73	408	77%	72%
	gpcd ave	gpcd max	removal	removal

Hysham WWTP				MT0021709
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0	0		
02/28/2010	0	0		
03/31/2010	0	0		
04/30/2010	0	0		
05/31/2010	0	0		
06/30/2010	0.01	0.09		
07/31/2010	0	0		
08/31/2010	0	0		
09/30/2010	0	0		
10/31/2010	0.01	0.1		
11/30/2010	0	0		
12/31/2010	0	0		
01/31/2011	0	0		
02/28/2011	0	0		
03/31/2011	0	0		
04/30/2011	0	0		
05/31/2011	0	0		
06/30/2011	0	0		
07/31/2011	0	0		
08/31/2011	0	0		
09/30/2011	0	0		
10/31/2011	0.01	0.14		
11/30/2011	0	0		
12/31/2011	0	0		
01/31/2012	0	0		
02/29/2012	0	0		
03/31/2012	0	0		
04/30/2012	0	0		
05/31/2012	0.04	0.14		
06/30/2012	0	0		
07/31/2012	0	0		
08/31/2012	0	0		
09/30/2012	0	0		
10/31/2012	0	0		
11/30/2012	0	0		
12/31/2012	0	0		
01/31/2013	0	0		
02/28/2013	0	0		
03/31/2013	0	0		
04/30/2013	0	0		
05/31/2013	0	0		
06/30/2013	0	0		
07/31/2013	0	0		
08/31/2013	0	0		
09/30/2013	0	0		
10/31/2013	0	0		
11/30/2013	0	0		
12/31/2013	0	0		
01/31/2014	0	0		
02/28/2014	0	0		
03/31/2014	0	0		
04/30/2014	0	0		
05/31/2014	0	0		
06/30/2014	0.03	0.17		
07/31/2014	0	0		
08/31/2014	0	0		
Average	**0.002**	**0.011**		
Median	**0.000**	**0.000**		
90th Percentile	**0.000**	**0.000**		
Summer Ave.	**0.000**	**0.000**		
Population		312		
		37		
	gpcd ave	gpcd max	removal	removal

Superior WWTP				MT0020664
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.06	0.07	38.1	7.39
02/28/2010	0.05	0.07	40.1	6.78
03/31/2010	0.05	0.10	40.2	6.24
04/30/2010	0.05	0.07	39	6.23
05/31/2010	0.05	0.06	33.5	6.02
06/30/2010	0.06	0.12	35.3	6.98
07/31/2010	0.05	0.07	20.9	5.32
08/31/2010	0.05	0.07	10.2	6.86
09/30/2010	0.06	0.09	6.11	7.22
10/31/2010	0.05	0.07	14	6.75
11/30/2010	0.06	0.07	21	6.05
12/31/2010	0.06	0.06	29.7	5.49
01/31/2011	0.06	0.09	32	5.41
02/28/2011	0.05	0.09	37.6	5.44
03/31/2011	0.06	0.07	39.1	5.75
04/30/2011	0.05	0.06	37.2	5.89
05/31/2011	0.05	0.06	37.6	5.35
06/30/2011	0.05	0.06	27.6	4.39
07/31/2011	0.03	0.03	18.3	5.26
08/31/2011	0.03	0.04	17.7	7.03
09/30/2011	0.03	0.04	4.87	7.57
10/31/2011	0.04	0.05	8.37	6.66
11/30/2011	0.03	0.05	15.8	5.49
12/31/2011	0.03	0.05	24.1	5.46
01/31/2012	0.03	0.05	30.5	5.86
02/29/2012	0.03	0.04	37	6.41
03/31/2012	0.04	0.05	38.2	6.32
04/30/2012	0.03	0.04	37.8	6.26
05/31/2012	0.03	0.05	33.3	6.31
06/30/2012	0.03	0.30	26.6	5.37
07/31/2012	0.03	0.03	14	6.08
08/31/2012	0.02	0.03	14.4	7.15
09/30/2012	0.03	0.03	13.7	7.34
10/31/2012	0.03	0.05	17.1	7.56
11/30/2012	0.03	0.05	24.2	6.09
12/31/2012	0.03	0.06	28.2	5.83
01/31/2013	0.03	0.04	35.7	6.03
02/28/2013	0.03	0.03	39.1	6.2
03/31/2013	0.03	0.03	33.2	6.36
04/30/2013	0.03	0.04	39	6.51
05/31/2013	0.03	0.05	35.5	6.09
06/30/2013	0.03	0.04	31.6	6.87
07/31/2013	0.03	0.04	14.1	6.64
08/31/2013	0.03	0.04	9.86	7.83
09/30/2013	0.03	0.35	9.95	7.37
10/31/2013	0.03	0.04	5.98	6.82
11/30/2013	0.03	0.04	10.9	6.23
12/31/2013	0.03	0.04	18.4	6.23
01/31/2014	0.03	0.05	30.5	6.79
02/28/2014	0.04	0.05	36.8	6.92
03/31/2014	0.24	0.07	37.2	6.47
04/30/2014	0.03	0.05	36.5	5.67
05/31/2014	0.02	0.03	36.2	6.6
06/30/2014	0.03	0.05	34.1	7.03
07/31/2014	0.02	0.03	17.9	5.64
08/31/2014	0.02	0.03	4.22	7.64
Average	**0.041**	**0.064**	**26.073**	**6.349**
Median	**0.031**	**0.051**	**30.100**	**6.285**
90th Percentile	**0.056**	**0.089**	**38.600**	**7.355**
Summer Ave.	**0.032**	**0.067**	**12.586**	**6.782**
Population	812	Influent->	35.0	7.00
	50	110	14%	10%
	gpcd ave	gpcd max	removal	removal

Glendive WWTP				MT0021628
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0	0		
02/28/2010	0	0		
03/31/2010	0	0		
04/30/2010	0	0		
05/31/2010	0.7	1.2	18	4.7
06/30/2010	0.25	1.1	16	4.5
07/31/2010	0	0		
08/31/2010	0	0		
09/30/2010	0	0		
10/31/2010	1.15	1.28	12	4.9
11/30/2010	0	0		
12/31/2010	0	0		
01/31/2011	0	0		
02/28/2011	0	0		
03/31/2011	0	0		
04/30/2011	1.1	1.2	21	4.2
05/31/2011	1.19	1.22	19	3.3
06/30/2011	1.24	1.29	10	3.8
07/31/2011	0	0		
08/31/2011	0	0		
09/30/2011	0	0		
10/31/2011	0	0		
11/30/2011	1.3	1.8	10.3	3.1
12/31/2011	0	0		
01/31/2012	0	0		
02/29/2012	0	0		
03/31/2012	0	0		
04/30/2012	0	0		
05/31/2012	1.2	1.37	22.1	5.1
06/30/2012	0	0		
07/31/2012	0	0		
08/31/2012	0	0		
09/30/2012	0	0		
10/31/2012	0.3	1.4	11	3.6
11/30/2012	0	0		
12/31/2012	0	0		
01/31/2013	0	0		
02/28/2013	0	0		
03/31/2013	0	0		
04/30/2013	0	0		
05/31/2013	0.78	1.2	18.2	4.3
06/30/2013	1.4	2	19.1	4.7
07/31/2013	0	0		
08/31/2013	0	0		
09/30/2013	0	0		
10/31/2013	1.2	2.6	15.1	4.8
11/30/2013	1	2	19.8	5.09
12/31/2013	0	0		
01/31/2014	0	0		
02/28/2014	0	0		
03/31/2014	0	0		
04/30/2014	0	0		
05/31/2014	0	0		
06/30/2014	0	0		
07/31/2014	0	0		
08/31/2014	0	0		
Average	**0.229**	**0.351**	**16.277**	**4.315**
Median	**0.000**	**0.000**	**18.000**	**4.500**
90th Percentile	**1.170**	**1.330**	**20.760**	**5.052**
Summer Ave.	**0.000**	**0.000**		
Population	4,935	Influent->	35.0	7.00
	46	270	49%	36%
	gpcd ave	gpcd max	removal	removal

Whitehall WWTP				MT0020133
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.09		23.5	4.54
02/28/2010	0.89		28.3	5.04
03/31/2010	0.1		23	3.56
04/30/2010	0			
05/31/2010	0			
06/30/2010	0.1		11.3	2.87
07/31/2010	0.09		9.31	0.54
08/31/2010	0.09		7.35	2.52
09/30/2010	0.09		15.7	1.94
10/31/2010	0.09		14.9	3.77
11/30/2010	0.09		18.9	2.97
12/31/2010	0.09		20.8	3.84
01/31/2011	0.09		27	4.34
02/28/2011	0.09		27.3	4.56
03/31/2011	0.1		26.1	4.08
04/30/2011	0			
05/31/2011	0.1		11.4	1.38
06/30/2011	0.1		10.3	0.18
07/31/2011	0.09		10.5	1.18
08/31/2011	0.09		8.01	1.66
09/30/2011	0			
10/31/2011	0.1		18.9	1.89
11/30/2011	0.1		17.4	2.01
12/31/2011	0.09		20.9	2.59
01/31/2012	0.09		21.5	3.33
02/29/2012	0			
03/31/2012	0			
04/30/2012	0			
05/31/2012	0.1		0.81	0.17
06/30/2012	0.09		16.3	4.44
07/31/2012	0.1		22	5.21
08/31/2012	0.1		17.1	4.17
09/30/2012	0			
10/31/2012				
11/30/2012	0			
12/31/2012	0			
01/31/2013	0			
02/28/2013	0			
03/31/2013	0			
04/30/2013	0			
05/31/2013	0			
06/30/2013	0			
07/31/2013	0			
08/31/2013	0			
09/30/2013	0			
10/31/2013	0			
11/30/2013	0			
12/31/2013	0			
01/31/2014	0			
02/28/2014	0			
03/31/2014	0			
04/30/2014	0			
05/31/2014	0			
06/30/2014	0			
07/31/2014	0			
08/31/2014	0			
Average	**0.057**		**17.143**	**2.911**
Median	**0.000**		**17.400**	**2.970**
90th Percentile	**0.100**		**26.640**	**4.552**
Summer Ave.	**0.046**		**12.853**	**2.460**
Population	1,038		35.0	7.00
	55		50%	58%
	gpcd ave	gpcd max	removal	removal

Baker WWTP				MTG580029
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0			
02/28/2010	0			
03/31/2010	0			
04/30/2010	0			
05/31/2010	0.088560567	9.2	3.5	
06/30/2010	0			
07/31/2010	0			
08/31/2010	0			
09/30/2010	0			
10/31/2010	0.087840562	12.2	3.21	
11/30/2010	0			
12/31/2010	0			
01/31/2011	0			
02/28/2011	0			
03/31/2011	0			
04/30/2011	0.087840562	9.7	2.84	
05/31/2011	0.087840562	8.6	2.32	
06/30/2011	0			
07/31/2011	0			
08/31/2011	0			
09/30/2011	0			
10/31/2011	0			
11/30/2011	0			
12/31/2011	0			
01/31/2012	0			
02/29/2012	0			
03/31/2012	0			
04/30/2012	0			
05/31/2012	0			
06/30/2012	0			
07/31/2012	0			
08/31/2012	0			
09/30/2012	0			
10/31/2012	0			
11/30/2012	0			
12/31/2012	0			
01/31/2013	0			
02/28/2013	0			
03/31/2013	0			
04/30/2013	0			
05/31/2013	0			
06/30/2013	0			
07/31/2013	0			
08/31/2013	0			
09/30/2013	0			
10/31/2013	0.1		9.55	4.34
11/30/2013	0			
12/31/2013	0			
01/31/2014	0			
02/28/2014	0			
03/31/2014	0			
04/30/2014	0.05			
05/31/2014	0.05		6.4	
06/30/2014	0			
07/31/2014	0			
08/31/2014	0			
Average	**0.010**		**7.975**	**4.340**
Median	**0.000**		**7.975**	**4.340**
90th Percentile	**0.050**		**9.235**	**4.340**
Summer Ave.	**0.000**			
Population	1,741		35.0	7.00
	6		77%	38%
	gpcd ave	gpcd max	removal	removal

Cut Bank WWTP				MT0020141
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.18		26.1	6.27
02/28/2010	0.12		33.6	6.59
03/31/2010	0			
04/30/2010	0.1		19.2	4.49
05/31/2010	0			
06/30/2010	0			
07/31/2010	0.28		11.1	4.66
08/31/2010	0.25		11.8	5.56
09/30/2010	0.28		12.8	5.88
10/31/2010	0.28		15	5.44
11/30/2010	0			
12/31/2010	0.18		13.2	2.99
01/31/2011	0			
02/28/2011	0			
03/31/2011	0.18		28.2	7.04
04/30/2011	0			
05/31/2011	0.18		23.6	4.46
06/30/2011	0			
07/31/2011	0.18		10.8	3.81
08/31/2011	0.18		17.4	5.42
09/30/2011	0			
10/31/2011	0			
11/30/2011	0.14		9.67	1.6
12/31/2011	0			
01/31/2012	0.18		12.2	2.99
02/29/2012	0.18		15.8	3.63
03/31/2012	0	0		
04/30/2012	0	0		
05/31/2012	0	0		
06/30/2012	0	0		
07/31/2012	0.15	2.43	13.9	4.17
08/31/2012	0	0		
09/30/2012	0	0		
10/31/2012	0	0		
11/30/2012	0	0		
12/31/2012	0	0		
01/31/2013	0.14	0.14	26.3	4.27
02/28/2013	0	0		
03/31/2013	0	0		
04/30/2013	0	0		
05/31/2013	0	0		
06/30/2013	0.36	0.36	14.5	4.32
07/31/2013	0	0		
08/31/2013	0	0		
09/30/2013	0	0		
10/31/2013	0.18	0.18	4.95	1.28
11/30/2013	0.12	0.12	7.62	1.93
12/31/2013	0	0		
01/31/2014	0	0		
02/28/2014	0	0		
03/31/2014	0	0		
04/30/2014	0.18	0.18	21.9	5.12
05/31/2014	0	0		
06/30/2014	0.18	0.18	9.82	3.77
07/31/2014	0	0		
08/31/2014	0	0		
Average	**0.075**	**0.120**	**16.339**	**4.350**
Median	**0.000**	**0.000**	**14.200**	**4.390**
90th Percentile	**0.180**	**0.180**	**26.280**	**6.231**
Summer Ave.	**0.094**	**0.304**	**12.967**	**4.917**
Population	2,869	Influent->	35.0	7.00
	26	63	59%	37%
	gpcd ave	gpcd max	removal	removal

Eureka WWTP				MTG580032
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.04		8.3	2.77
02/28/2010	0.05		9.23	3.02
03/31/2010	0.06		8.39	2.34
04/30/2010	0.04		11.1	3.08
05/31/2010	0.05		10	2.91
06/30/2010	0.10		10.1	3.05
07/31/2010	0			
08/31/2010	0			
09/30/2010	0			
10/31/2010	0.08		2.55	3.47
11/30/2010	0.09		2.61	2.78
12/31/2010	0.10		2.83	2.85
01/31/2011	0.11		3.28	2.68
02/28/2011	0.11		6.76	3.3
03/31/2011	0.13		7.99	3.31
04/30/2011	0.13		9.17	2.76
05/31/2011	0.12		9.58	3.03
06/30/2011	0.26		6.09	2.69
07/31/2011	0			
08/31/2011	0			
09/30/2011	0			
10/31/2011	0.13		1.55	2.63
11/30/2011	0.10		1.75	2.32
12/31/2011	0.10		2.44	2.19
01/31/2012	0.10		4.17	2.8
02/29/2012	0.11		5.82	2.61
03/31/2012	0.12		9.3	2.98
04/30/2012	0.12		9.96	2.7
05/31/2012	0.12		9.75	2.61
06/30/2012	0.24		10.2	2.74
07/31/2012	0			
08/31/2012	0			
09/30/2012	0			
10/31/2012	0.10		4	2.41
11/30/2012	0.08		3.51	2.12
12/31/2012	0.07		4.72	2.23
01/31/2013	0.06	0.08		
02/28/2013	0.06	0.09		
03/31/2013	0.06	0.09		
04/30/2013	0.05	0.07		
05/31/2013	0.06	0.2	10.7	2.46
06/30/2013	0.06	0.12	7.29	2.39
07/31/2013	0.04	0.09	5.92	2.58
08/31/2013	0.11	0.19	4.15	2.16
09/30/2013	0.04	0.12	2.39	2.55
10/31/2013	0	0		
11/30/2013	0.06	0.16		
12/31/2013	0	0		
01/31/2014	0.07	0.15		
02/28/2014	0.1	0.11		
03/31/2014	0.11	0.19		
04/30/2014	0.11	0.19		
05/31/2014	0.07	0.18	7.92	2.14
06/30/2014	0.09	0.15	8.42	2.94
07/31/2014	0.09	0.21	7.37	3.6
08/31/2014	0.11	0.18	3.84	3.49
Average	**0.075**	**0.129**	**6.476**	**2.741**
Median	**0.074**	**0.135**	**7.025**	**2.720**
90th Percentile	**0.121**	**0.191**	**10.050**	**3.305**
Summer Ave.	**0.028**	**0.158**	**4.734**	**2.876**
Population	1,037	Influent->	35.0	7.00
	72	184	80%	61%
	gpcd ave	gpcd max	removal	removal

Shelby WWTP				MT0031488
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0			
02/28/2010	0			
03/31/2010	0			
04/30/2010	0.05			
05/31/2010	0.3			
06/30/2010	0.29		9.7	1.1
07/31/2010	0.3			
08/31/2010	0.22			
09/30/2010	0.18		4.2	1.14
10/31/2010	0.17			
11/30/2010	0.2			
12/31/2010	0.19		6.8	1
01/31/2011	0			
02/28/2011	0			
03/31/2011	0			
04/30/2011	0			
05/31/2011	0.3			
06/30/2011	0.38		8.9	1.93
07/31/2011	0.23			
08/31/2011	0.14			
09/30/2011	0.14		1.31	1.31
10/31/2011	0.27			
11/30/2011	0.16			
12/31/2011	0.22			
01/31/2012	0			
02/29/2012	0			
03/31/2012	0			
04/30/2012	0			
05/31/2012	0.39			
06/30/2012	0.27		14.8	4.26
07/31/2012	0.27			
08/31/2012	0.22			
09/30/2012	0.12		3	0.9
10/31/2012	0.18			
11/30/2012	0.19			
12/31/2012	0.37		10.4	2.1
01/31/2013	0			
02/28/2013	0			
03/31/2013	0			
04/30/2013	0			
05/31/2013	0.07			
06/30/2013	0.46		11.2	2.5
07/31/2013	0.34			
08/31/2013	0.26			
09/30/2013	0.14		2.2	1.25
10/31/2013	0.18			
11/30/2013	0.05			
12/31/2013	0.12		7.8	
01/31/2014	0			
02/28/2014	0			
03/31/2014	0			
04/30/2014	0			
05/31/2014	0.31	0.56		
06/30/2014	0.37	0.55	18	4.41
07/31/2014	0.12	0.12		
08/31/2014	0.15	0.15	4.9	2.49
Average	**0.149**	**0.345**	**7.939**	**2.033**
Median	**0.145**	**0.350**	**7.800**	**1.620**
90th Percentile	**0.325**	**0.557**	**14.080**	**4.084**
Summer Ave.	**0.202**	**0.135**	**3.122**	**1.418**
Population	3,376	Influent->	35.0	7.00
	44	165	78%	77%
	gpcd ave	gpcd max	removal	removal

Choteau WWTP				MT0020052
	Flow Monthly	Flow Daily	Effluent TN	Effluent TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0.49	0.6		
02/28/2010	0.84	0.94		
03/31/2010	0.89	0.94	10.8	2.02
04/30/2010	0.69	1.15		
05/31/2010	0.63	0.8		
06/30/2010	0.69	0.76	2	0.21
07/31/2010	0.63	0.94		
08/31/2010	0.29	0.72		
09/30/2010	0.27	0.33	7.97	0.02
10/31/2010	0.07	0.33		
11/30/2010	0.16	0.36		
12/31/2010	0.25	0.35		
01/31/2011	0.35	0.39		
02/28/2011	0.44	0.5		
03/31/2011	0.28	0.55	8.3	1.73
04/30/2011	0.7	0.78		
05/31/2011	0.66	0.81		
06/30/2011	1.19	1.73	7.2	0.9
07/31/2011	0.8	0.94		
08/31/2011	0.53	0.86		
09/30/2011	0.36	0.65	1.7	0.51
10/31/2011	0.49	0.91		
11/30/2011	0.73	0.79		
12/31/2011	0.23	0.79	7.7	1.45
01/31/2012	0.34	0.65		
02/29/2012	0.58	0.6		
03/31/2012	0.51	0.58	9.09	0.91
04/30/2012	0.52	0.58		
05/31/2012	0.5	1.01		
06/30/2012	0.29	1.01	4.65	0.21
07/31/2012	0.49	0.97		
08/31/2012	0.37	0.97		
09/30/2012			16	2.7
10/31/2012	0.09	0.46		
11/30/2012	0.5	0.58		
12/31/2012	0.48	0.58	11.5	1.08
01/31/2013	0.53	0.67		
02/28/2013	0.56	0.59		
03/31/2013	0.35	0.99	12.13	2.4
04/30/2013	0.17	0.43		
05/31/2013	0.41	0.86		
06/30/2013	0.26	0.78	5.08	0.58
07/31/2013	0.4	0.91		
08/31/2013	0.33	0.86		
09/30/2013			2.45	1.95
10/31/2013	0.46	0.89		
11/30/2013	0.31	0.33		
12/31/2013	0.32	0.34	3.59	0.93
01/31/2014	0.34	0.36		
02/28/2014	0.3	0.38		
03/31/2014				
04/30/2014	0.52	0.65		
05/31/2014	0.62	0.86		
06/30/2014	0.22	0.58	9.67	1.82
07/31/2014	0.71	0.86		
08/31/2014	0.54	0.54		
Average	**0.466**	**0.713**	**7.489**	**1.214**
Median	**0.480**	**0.720**	**7.835**	**1.005**
90th Percentile	**0.708**	**0.970**	**11.815**	**2.210**
Summer Ave.	**0.477**	**0.796**	**7.030**	**1.295**
Population	1,684	Influent->	14.3	3.90
	277	576	45%	74%
	gpcd ave	gpcd max	removal	removal

Glasgow WWTP				MT0021211
Date	Flow Monthly Ave	Flow Daily Max	Effluent TN (mg/l)	Effluent TP (mg/l)
01/31/2010	0.34	0.34		
02/28/2010	0.34	0.34		
03/31/2010	0.35	0.35	31	3.4
04/30/2010	0.34	0.34		
05/31/2010	0.42	0.42		
06/30/2010	0.49	0.49	24	3.5
07/31/2010	0.43	0.43		
08/31/2010	0.56	0.56		
09/30/2010	0.44	0.44	25	2.4
10/31/2010	0.38	0.38		
11/30/2010	0.44	0.44		
12/31/2010	0.44	0.44	25	2.68
01/31/2011	0.46	0.46		
02/28/2011	0.47	0.47		
03/31/2011	0.46	0.46	20	2.1
04/30/2011	0.63	0.63		
05/31/2011	0.91	0.91		
06/30/2011	0.53	0.53	14.8	0.43
07/31/2011	0.63	0.63		
08/31/2011	0.44	0.44		
09/30/2011	0.38	0.38	18.4	1.28
10/31/2011	0.38	0.38		
11/30/2011	0.35	0.35		
12/31/2011	0.32	0.32	25	2.26
01/31/2012	0.37	0.37		
02/29/2012	0.28	0.28		
03/31/2012	0.38	0.38	26	2.76
04/30/2012	0.4	0.4		
05/31/2012	0.39	0.39		
06/30/2012	0.36	0.36	21	2.1
07/31/2012	0.37	0.37		
08/31/2012	0.43	0.43		
09/30/2012	0.38	0.38	13	1.5
10/31/2012	0.36	0.36		
11/30/2012	0.44	0.44		
12/31/2012	0.38	0.38	19.7	2.15
01/31/2013	0.39	0.39		
02/28/2013	0.4	0.4		
03/31/2013	0.34	0.34	25	2.36
04/30/2013	0.38	0.38		
05/31/2013	0.42	0.42		
06/30/2013	0.72	0.72	14.2	0.93
07/31/2013	0.47	0.47		
08/31/2013	0.42	0.42		
09/30/2013	0.44	0.76	20.9	1.94
10/31/2013	0.39	0.6		
11/30/2013	0.37	0.39		
12/31/2013	0.34	0.38		
01/31/2014	0.34	0.45		
02/28/2014	0.32	0.35		
03/31/2014	0.34	0.4		
04/30/2014	0.33	0.42		
05/31/2014	0.37	0.42		
06/30/2014	0.4	0.45	20	3.24
07/31/2014	0.4	0.47	10.2	2.85
08/31/2014	0.58	1.92	28.7	3
Average	**0.422**	**0.465**	**21.217**	**2.271**
Median	**0.390**	**0.420**	**20.950**	**2.310**
90th Percentile	**0.545**	**0.615**	**26.810**	**3.288**
Summer Ave.	**0.455**	**0.579**	**19.367**	**2.162**
Population	3,250	Influent->	30.5	7.00
	130	189	31%	67%
	gpcd ave	gpcd max	removal	removal

Plentywood WWTP				MTG580008
	Flow	Flow	Effluent	Effluent
	Monthly	Daily	TN	TP
Date	Ave	Max	(mg/l)	(mg/l)
01/31/2010	0			
02/28/2010	0			
03/31/2010	0			
04/30/2010	0			
05/31/2010	0.22			
06/30/2010	0			
07/31/2010	0			
08/31/2010	0			
09/30/2010	0			
10/31/2010	0			
11/30/2010	0.22			
12/31/2010	0			
01/31/2011	0			
02/28/2011	0			
03/31/2011	0			
04/30/2011	0			
05/31/2011	0.22			
06/30/2011				
07/31/2011	0			
08/31/2011	0			
09/30/2011	0			
10/31/2011	0			
11/30/2011	0.21			
12/31/2011	0			
01/31/2012	0			
02/29/2012	0			
03/31/2012	0			
04/30/2012	0			
05/31/2012	0			
06/30/2012	0.21			
07/31/2012	0			
08/31/2012	0			
09/30/2012	0			
10/31/2012	0			
11/30/2012	0.22			
12/31/2012	0			
01/31/2013	0			
02/28/2013	0			
03/31/2013	0			
04/30/2013	0			
05/31/2013	0			
06/30/2013	0			
07/31/2013	0			
08/31/2013	0			
09/30/2013	0			
10/31/2013		0.22	9.7	3.22
11/30/2013	0			
12/31/2013	0			
01/31/2014	0			
02/28/2014	0			
03/31/2014	0			
04/30/2014	0			
05/31/2014	0			
06/30/2014		0.22	5.4	1.19
07/31/2014	0			
08/31/2014	0			
Average	**0.024**	**0.220**	**7.550**	**2.205**
Median	**0.000**	**0.220**	**7.550**	**2.205**
90th Percentile	**0.165**	**0.220**	**9.270**	**3.017**
Summer Ave.				
Population	1,734	Influent->	35.0	7.00
	14	127	78%	69%
	gpcd ave	gpcd max	removal	removal

APPENDIX B

SEASONAL DEMAND AND COST CALCULATIONS
FOR TOTAL NITROGEN AND TOTAL PHOSPHOROUS
FOR EACH DISCHARGER AND EACH PERMIT CYCLE (4 CYCLES)

STILLWATER MINING COMPANY - EAST BOULDER

Demand Calculations

Total Nitrogen

NPV Costs based on 20 Years at 3.3%

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	2/1/2015	15	3.3	0.23	-22	0	0	$0	$0	$0
2	2/1/2020	12	3.3	0.23	-17	0	0	$0	$0	$0
3	2/1/2025	10	3.3	0.24	-13	0	0	$0	$0	$0
4	2/1/2030	8	3.3	0.24	-10	0	0	$0	$0	$0

*Incremental Demand / Assuming season is 90 days

Total Phosphorous

NPV Costs based on 20 Years at 3.3%

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	2/1/2015	2	5.1	0.23	6	535	535	$163,132	$1,529	$185,267
2	2/1/2020	2	5.1	0.23	6	11	546	$166,395	$1,560	$188,972
3	2/1/2025	1	5.1	0.24	8	191	736	$224,472	$2,104	$254,930
4	2/1/2030	0.8	5.1	0.24	9	51	788	$285,870	$3,288	$333,450

*Incremental Demand / Assuming season is 90 days

WESTERN SUGAR COOPERATIVE

Settling Ponds (One Pond with Aeration)

Demand Calculations

Total Nitrogen

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	1/1/2015	15	13.4	0.73	-10	0	0	$0	$0	$0
2	1/1/2020	12	13.4	0.74	9	1,174	1,174	$243,175	$2,189	$274,850
3	1/1/2025	10	13.4	0.76	22	1,734	2,907	$597,035	$5,373	$674,803
4	1/1/2030	8	13.4	0.77	35	1,803	4,710	$1,265,373	$14,379	$1,473,484

*Incremental Demand / Assuming season is 90 days

Total Phosphorous

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	1/1/2015	2	0.2	0.73	-11	0	0	$0	$0	$0
2	1/1/2020	2	0.2	0.74	-11	0	0	$0	$0	$0
3	1/1/2025	1	0.2	0.76	-5	0	0	$0	$0	$0
4	1/1/2030	0.8	0.2	0.77	-4	0	0	$0	$0	$0

*Incremental Demand / Assuming season is 90 days

ELKHORN HEALTH CARE WWTP

Demand Calculations

Extended Aeration Package Plant with Polishing Pond

Total Nitrogen

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	2/1/2015	15	21.3	0.004	0.21	28	28	$61,760	$556	$69,805
2	2/1/2020	12	21.3	0.004	0.32	14	43	$92,168	$830	$104,173
3	2/1/2025	10	21.3	0.004	0.39	10	53	$113,215	$1,019	$127,962
4	2/1/2030	8	21.3	0.004	0.47	11	64	$177,820	$2,021	$207,066

*Incremental Demand / Assuming season is 90 days

Total Phosphorous

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	2/1/2015	2	2.7	0.004	0.02	2	2	$641	$6	$728
2	2/1/2020	2	2.7	0.004	0.02	0	2	$653	$6	$742
3	2/1/2025	1	2.7	0.004	0.06	3	5	$1,619	$15	$1,838
4	2/1/2030	0.8	2.7	0.004	0.07	1	6	$2,197	$25	$2,562

*Incremental Demand / Assuming season is 90 days

MISSOULA										Demand Calculations
4 Stage Bardenpho with Bio-P										
Total Nitrogen										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	3/1/2015	10	9.3	7.06	-41	0	0	$0	$0	$0
2	3/1/2020	8	9.3	7.20	78	10,540	10,540	$1,038,300	$11,799	$1,209,066
3	3/1/2025	8	9.3	7.35	80	211	10,751	$1,049,670	$11,928	$1,222,306
4	3/1/2030	6	9.3	7.49	206	17,086	27,837	$2,856,983	$38,773	$3,418,153
*Incremental Demand / Assuming season is 90 days										
Total Phosphorous										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	3/1/2015	1	0.47	7.06	-31	0	0	$0	$0	$0
2	3/1/2020	0.8	0.47	7.20	-20	0	0	$0	$0	$0
3	3/1/2025	0.5	0.47	7.35	-2	0	0	$0	$0	$0
4	3/1/2030	0.3	0.47	7.49	11	956	956	$107,544	$2,559	$144,574
*Incremental Demand / Assuming season is 90 days										

EAST HELENA										Demand Calculations
Biolac Extended Aeration Activated Sludge										
Total Nitrogen										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	3/1/2015	15	14.8	0.37	-1	0	0	$0	$0	$0
2	3/1/2020	12	14.8	0.38	9	1,190	1,190	$334,682	$3,012	$378,277
3	3/1/2025	10	14.8	0.38	15	891	2,080	$580,023	$5,220	$655,575
4	3/1/2030	8	14.8	0.39	22	926	3,006	$1,096,521	$12,460	$1,276,862
*Incremental Demand / Assuming season is 90 days										
Total Phosphorous										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	3/1/2015	2	2.5	0.37	2	139	139	$42,327	$397	$48,071
2	3/1/2020	2	2.5	0.38	2	3	142	$43,174	$405	$49,032
3	3/1/2025	1	2.5	0.38	5	292	433	$132,113	$1,239	$150,038
4	3/1/2030	0.8	2.5	0.39	6	68	501	$181,812	$2,091	$212,073
*Incremental Demand / Assuming season is 90 days										

DILLON										Demand Calculations
Biolac Extended Aeration										
Total Nitrogen										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	3/1/2015	15	32	0.36	51	6,910	6,910	$1,982,945	$17,847	$2,241,239
2	3/1/2020	12	32	0.37	61	1,382	8,292	$2,358,424	$21,226	$2,665,627
3	3/1/2025	10	32	0.38	69	1,012	9,303	$2,622,676	$23,604	$2,964,300
4	3/1/2030	8	32	0.38	77	1,049	10,352	$3,818,012	$43,386	$4,445,948
*Incremental Demand / Assuming season is 90 days										
Total Phosphorous										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	3/1/2015	2	4.9	0.36	9	786	786	$239,528	$2,246	$272,028
2	3/1/2020	2	4.9	0.37	9	16	802	$244,318	$2,290	$277,469
3	3/1/2025	1	4.9	0.38	12	298	1,099	$335,138	$3,142	$380,611
4	3/1/2030	0.8	4.9	0.38	13	79	1,179	$427,822	$4,920	$499,029
*Incremental Demand / Assuming season is 90 days										

KALISPELL									Demand Calculations	
University of Capetown Process										
Total Nitrogen										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	6/1/2015	10	8.1	2.70	-43	0	0	$0	$0	$0
2	6/1/2020	8	8.1	2.75	2	310	310	$11,412	$214	$14,509
3	6/1/2025	8	8.1	2.81	2	6	316	$11,537	$216	$14,668
4	6/1/2030	6	8.1	2.87	50	6,458	6,775	$306,163	$7,654	$416,941
*Incremental Demand / Assuming season is 90 days										
Total Phosphorous										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	6/1/2015	1	0.12	2.70	-20	0	0	$0	$0	$0
2	6/1/2020	0.8	0.12	2.75	-16	0	0	$0	$0	$0
3	6/1/2025	0.5	0.12	2.81	-9	0	0	$0	$0	$0
4	6/1/2030	0.3	0.12	2.87	-4	0	0	$0	$0	$0
*Incremental Demand / Assuming season is 90 days										

LAUREL										Demand Calculations
Activated Sludge Rotating Biological Contactors (RBCs) - Currently being upgraded										
Total Nitrogen										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	8/1/2015	15	8	0.94	-55	0	0	$0	$0	$0
2	8/1/2020	12	8	0.96	-32	0	0	$0	$0	$0
3	8/1/2025	10	8	0.98	-16	0	0	$0	$0	$0
4	8/1/2030	8	8	1.00	0	0	0	$0	$0	$0
*Incremental Demand / Assuming season is 90 days										
Total Phosphorous										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	8/1/2015	2	3	0.94	8	706	706	$215,069	$2,016	$244,251
2	8/1/2020	2	3	0.96	8	14	720	$219,371	$2,057	$249,136
3	8/1/2025	1	3	0.98	16	748	1,468	$447,517	$4,195	$508,238
4	8/1/2030	0.8	3	1.00	18	179	1,647	$597,754	$6,874	$697,245
*Incremental Demand / Assuming season is 90 days										

BIGFORK										Demand Calculations
Membrane Bioreactor (MLE process with chemical P removal using alum										
Total Nitrogen										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	8/1/2015	15	13.6	0.22	-3	0	0	$0	$0	$0
2	8/1/2020	12	13.6	0.22	3	404	404	$143,686	$1,293	$162,403
3	8/1/2025	10	13.6	0.23	7	523	928	$326,835	$2,942	$369,407
4	8/1/2030	8	13.6	0.23	11	544	1,472	$678,450	$7,710	$790,032
*Incremental Demand / Assuming season is 90 days										
Total Phosphorous										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	8/1/2015	2	0.3	0.22	-3	0	0	$0	$0	$0
2	8/1/2020	2	0.3	0.22	-3	0	0	$0	$0	$0
3	8/1/2025	1	0.3	0.23	-1	0	0	$0	$0	$0
4	8/1/2030	0.8	0.3	0.23	-1	0	0	$0	$0	$0
*Incremental Demand / Assuming season is 90 days										

MANHATTAN

Biowheel Extended Aeration

Demand Calculations

Total Nitrogen

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	9/1/2015	15	10.5	0.13	-5	0	0	$0	$0	$0
2	9/1/2020	12	10.5	0.13	-2	0	0	$0	$0	$0
3	9/1/2025	10	10.5	0.14	1	77	77	$0	$0	$0
4	9/1/2030	8	10.5	0.14	3	317	394	$55,441	$1,040	$70,486

*Incremental Demand / Assuming season is 90 days

Total Phosphorous

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	9/1/2015	2	1.1	0.13	-1	0	0	$0	$0	$0
2	9/1/2020	2	1.1	0.13	-1	0	0	$0	$0	$0
3	9/1/2025	1	1.1	0.14	0	10	10	$0	$0	$0
4	9/1/2030	0.8	1.1	0.14	0	21	32	$1,831	$41	$2,432

*Incremental Demand / Assuming season is 90 days

GREAT FALLS

Demand Calculations

Primary plus Secondary MLE Process - construction almost finishec

Total Nitrogen

NPV Costs based on 20 Years at 3.3%

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)**	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	12/1/2015	10	8	10.00	-167	0	0	$0	$0	$0
2	12/1/2020	8	8	10.20	0	0	0	$0	$0	$0
3	12/1/2025	8	8	10.40	0	0	0	$0	$0	$0
4	12/1/2030	6	8	10.61	177	23,896	23,896	$599,119	$14,978	$815,896

*Incremental Demand / Assuming season is 90 days

**TN Discharge based on recent upgrade design instead of historical DMR data

Total Phosphorous

NPV Costs based on 20 Years at 3.3%

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	12/1/2015	1	2.3	10.00	108	9,758	9,758	$2,974,365	$27,885	$3,377,942
2	12/1/2020	0.8	2.3	10.20	128	1,726	11,484	$4,167,379	$47,925	$4,860,999
3	12/1/2025	0.5	2.3	10.40	156	2,572	14,057	$5,100,872	$58,660	$5,949,863
4	12/1/2030	0.3	2.3	10.61	177	1,874	15,931	$6,648,137	$88,160	$7,924,084

*Incremental Demand / Assuming season is 90 days

MILES CITY

Extended Aeration with two oxidation ditches

Demand Calculations

Total Nitrogen

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	4/1/2016	10	23.7	1.13	129	17,430	17,430	$2,993,275	$26,939	$3,383,172
2	4/1/2021	8	23.7	1.15	151	2,944	20,374	$4,577,514	$52,017	$5,330,363
3	4/1/2026	8	23.7	1.18	154	407	20,782	$4,627,642	$52,587	$5,388,736
4	4/1/2031	6	23.7	1.20	177	3,116	23,897	$5,274,284	$59,935	$6,141,728

*Incremental Demand / Assuming season is 90 days

Total Phosphorous

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	4/1/2016	1	2.5	1.13	14	1,272	1,272	$387,811	$3,636	$440,432
2	4/1/2021	0.8	2.5	1.15	16	198	1,471	$533,702	$6,138	$622,532
3	4/1/2026	0.5	2.5	1.18	20	294	1,765	$640,443	$7,365	$747,038
4	4/1/2031	0.3	2.5	1.20	22	215	1,980	$718,577	$8,264	$838,177

*Incremental Demand / Assuming season is 90 days

HAVRE

Activated Sludge Plant with upgrade design almost finished

Demand Calculations

Total Nitrogen

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	5/1/2016	10	8	1.55	-26	0	0	$0	$0	$0
2	5/1/2021	8	8	1.58	0	0	0	$0	$0	$0
3	5/1/2026	8	8	1.61	0	0	0	$0	$0	$0
4	5/1/2031	6	8	1.64	27	3,704	3,704	$709,103	$8,058	$825,727

*Incremental Demand / Assuming season is 90 days

Total Phosphorous

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	5/1/2016	1	1.9	1.55	12	1,047	1,047	$319,172	$2,992	$362,479
2	5/1/2021	0.8	1.9	1.58	15	258	1,305	$473,692	$5,447	$552,534
3	5/1/2026	0.5	1.9	1.61	19	389	1,695	$614,938	$7,072	$717,289
4	5/1/2031	0.3	1.9	1.64	22	281	1,975	$716,843	$8,244	$836,154

*Incremental Demand / Assuming season is 90 days

HAMILTON										Demand Calculations
Oxidation Ditch Extended Aeration Plant with Anoxic Selector										
Total Nitrogen										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	9/1/2016	15	5	0.64	-54	0	0	$0	$0	$0
2	9/1/2021	12	5	0.65	-38	0	0	$0	$0	$0
3	9/1/2026	10	5	0.67	-28	0	0	$0	$0	$0
4	9/1/2031	8	5	0.68	-17	0	0	$0	$0	$0
*Incremental Demand / Assuming season is 90 days										
Total Phosphorous										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	9/1/2016	2	4.6	0.64	14	1,253	1,253	$381,908	$3,580	$433,728
2	9/1/2021	2	4.6	0.65	14	25	1,278	$389,547	$3,652	$442,402
3	9/1/2026	1	4.6	0.67	20	527	1,805	$550,160	$5,158	$624,808
4	9/1/2031	0.8	4.6	0.68	22	138	1,943	$705,165	$8,109	$822,533
*Incremental Demand / Assuming season is 90 days										

CONRAD

Activated Sludge with Lined Earthen Basins

Demand Calculations

Total Nitrogen

NPV Costs based on 20 Years at 3.3%

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	2/1/2017	15	14.2	0.23	-2	0	0	$0	$0	$0
2	2/1/2022	12	14.2	0.23	4	576	576	$201,488	$1,813	$227,734
3	2/1/2027	10	14.2	0.24	8	546	1,122	$388,872	$3,500	$439,525
4	9/1/2031	8	14.2	0.24	13	567	1,689	$766,043	$8,705	$892,031

*Incremental Demand / Assuming season is 90 days

Total Phosphorous

NPV Costs based on 20 Years at 3.3%

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	2/1/2017	2	3.2	0.23	2	205	205	$62,599	$587	$71,093
2	2/1/2022	2	3.2	0.23	2	4	209	$63,851	$599	$72,515
3	2/1/2027	1	3.2	0.24	4	182	392	$119,401	$1,119	$135,602
4	2/1/2032	0.8	3.2	0.24	5	44	436	$158,168	$1,819	$184,493

*Incremental Demand / Assuming season is 90 days

BUTTE									Demand Calculations		
4 stage MBR with chemical addition for phosphorus removal (under construction)											
Total Nitrogen											4
								NPV Costs based on 20 Years at 3.3%			
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)**	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade	
1	4/1/2017	10	3	3.78	-221	0	0	$0	$0	$0	2
2	4/1/2022	8	3	3.86	-161	0	0	$0	$0	$0	3
3	4/1/2027	8	3	3.94	-164	0	0	$0	$0	$0	3
4	4/1/2032	6	3	4.02	-100	0	0	$0	$0	$0	4
*Incremental Demand / Assuming season is 90 days											
**TN Discharge based on recent upgrade design instead of historical DMR data											
Total Phosphorous											4
								NPV Costs based on 20 Years at 3.3%			
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)**	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade	
1	4/1/2017	1	0.3	3.78	-22	0	0	$0	$0	$0	2
2	4/1/2022	0.8	0.3	3.86	-16	0	0	$0	$0	$0	3
3	4/1/2027	0.5	0.3	3.94	-7	0	0	$0	$0	$0	3
4	4/1/2032	0.3	0.3	4.02	0	0	0	$0	$0	$0	4
*Incremental Demand / Assuming season is 90 days											
**TP Discharge based on recent upgrade design instead of historical DMR data											

BOZEMAN										Demand Calculations
Primary Tratment plus 5-Stage Bardenpho Secondary Treatment										
Total Nitrogen										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	6/1/2017	10	6.6	5.55	-157	0	0	$0	$0	$0
2	6/1/2022	8	6.6	5.66	-66	0	0	$0	$0	$0
3	6/1/2027	8	6.6	5.77	-67	0	0	$0	$0	$0
4	6/1/2032	6	6.6	5.89	29	3,976	3,976	$129,964	$3,249	$176,989
*Incremental Demand / Assuming season is 90 days										
Total Phosphorous										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	6/1/2017	1	1.1	5.55	5	416	416	$0	$0	$0
2	6/1/2022	0.8	1.1	5.66	14	858	1,274	$73,959	$1,676	$98,211
3	6/1/2027	0.5	1.1	5.77	29	1,325	2,599	$150,877	$3,418	$200,350
4	6/1/2032	0.3	1.1	5.89	39	935	3,534	$397,561	$9,458	$534,449
*Incremental Demand / Assuming season is 90 days										

MT BEHAVIORAL HEALTH INC WWTP

Demand Calculations

Activated Sludge Plant

Total Nitrogen

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	8/1/2017	15	29	0.0040	0.47	63	63	$137,244	$1,235	$155,121
2	8/1/2022	12	29	0.0041	0.58	15	78	$168,479	$1,516	$190,424
3	8/1/2027	10	29	0.0042	0.66	11	89	$190,362	$1,713	$215,158
4	8/1/2032	8	29	0.0042	0.74	11	100	$280,769	$3,191	$326,946

*Incremental Demand / Assuming season is 90 days

Total Phosphorous

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	8/1/2017	2	5.7	0.0040	0.12	11	11	$3,386	$32	$3,846
2	8/1/2022	2	5.7	0.0041	0.13	0	11	$3,454	$32	$3,923
3	8/1/2027	1	5.7	0.0042	0.16	3	15	$4,475	$42	$5,082
4	8/1/2032	0.8	5.7	0.0042	0.17	1	16	$5,665	$65	$6,608

*Incremental Demand / Assuming season is 90 days

LEWISTOWN

Two Oxidation Ditches with Selector Zone

Demand Calculations

Total Nitrogen

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	9/1/2017	10	2.6	1.8800	-116.03	0	0	$0	$0	$0
2	9/1/2022	8	2.6	1.9176	-86.36	0	0	$0	$0	$0
3	9/1/2027	8	2.6	1.9560	-88.09	0	0	$0	$0	$0
4	9/1/2032	6	2.6	1.9951	-56.57	0	0	$0	$0	$0

*Incremental Demand / Assuming season is 90 days

Total Phosphorous

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	9/1/2017	1	0.5	1.8800	-7.84	0	0	$0	$0	$0
2	9/1/2022	0.8	0.5	1.9176	-4.80	0	0	$0	$0	$0
3	9/1/2027	0.5	0.5	1.9560	0.00	0	0	$0	$0	$0
4	9/1/2032	0.3	0.5	1.9951	3.33	300	300	$17,389	$394	$23,091

*Incremental Demand / Assuming season is 90 days

HELENA										Demand Calculations
Primary plus Secondary Activated Sludge with MLE Process										
Total Nitrogen										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	10/1/2017	10	6.5	3.0600	-89.32	0	0	$0	$0	$0
2	10/1/2022	8	6.5	3.1212	-39.05	0	0	$0	$0	$0
3	10/1/2027	8	6.5	3.1836	-39.83	0	0	$0	$0	$0
4	10/1/2032	6	6.5	3.2473	13.54	1,828	1,828	$78,091	$1,952	$106,346
*Incremental Demand / Assuming season is 90 days										
Total Phosphorous										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	10/1/2017	1	2.4	3.0600	35.73	3,216	3,216	$980,168	$9,189	$1,113,162
2	10/1/2022	0.8	2.4	3.1212	41.65	533	3,748	$1,360,233	$15,643	$1,586,630
3	10/1/2027	0.5	2.4	3.1836	50.45	792	4,540	$1,647,582	$18,947	$1,921,806
4	10/1/2032	0.3	2.4	3.2473	56.87	578	5,119	$2,136,046	$28,326	$2,546,008
*Incremental Demand / Assuming season is 90 days										

DEER LODGE

Demand Calculations

Oxidation Ditch with MLE process (under construction)

Total Nitrogen

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)**	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	3/1/2018	10	6	1.27	-42.37	0	0	$0	$0	$0
2	3/1/2023	8	6	1.30	-21.61	0	0	$0	$0	$0
3	3/1/2028	8	6	1.32	-22.04	0	0	$0	$0	$0
4	3/1/2033	6	6	1.35	0.00	0	0	$0	$0	$0

*Incremental Demand / Assuming season is 90 days

**Discharge concentration after construction will be similar to current discharge because of significant I&I reduction projec

Total Phosphorous

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)**	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	3/1/2018	1	1	1.27	0.00	0	0	$0	$0	$0
2	3/1/2023	0.8	1	1.30	2.16	194	194	$11,291	$256	$14,993
3	3/1/2028	0.5	1	1.32	5.51	301	496	$28,792	$652	$38,233
4	3/1/2033	0.3	1	1.35	7.87	212	708	$41,114	$931	$54,596

*Incremental Demand / Assuming season is 90 days

**Discharge concentration after construction will be similar to current disharge because of significant I&I reduction projec

ROCKER										Demand Calculations
Activated Sludge Package Plant with Aerated Lagoon Polish										
Total Nitrogen										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	6/1/2018	15	18.1	0.022	0.57	77	77	$77,612	$699	$87,721
2	6/1/2023	12	18.1	0.022	1.14	77	154	$154,392	$1,390	$174,503
3	6/1/2028	10	18.1	0.023	1.55	55	209	$207,258	$1,865	$234,255
4	6/1/2033	8	18.1	0.023	1.97	57	265	$344,866	$3,919	$401,586
*Incremental Demand / Assuming season is 90 days										
Total Phosphorous										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	6/1/2018	2	10.8	0.022	1.61	145	145	$44,295	$415	$50,305
2	6/1/2023	2	10.8	0.022	1.65	3	148	$45,181	$424	$51,311
3	6/1/2028	1	10.8	0.023	1.87	20	168	$51,322	$481	$58,285
4	6/1/2033	0.8	10.8	0.023	1.95	7	175	$63,591	$731	$74,175
*Incremental Demand / Assuming season is 90 days										

YELLOWSTONE ENERGY LIMITED PARTNERSHIP FACILITY

Demand Calculations

Settling Pond with pH Adjustment

Total Nitrogen

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	5/1/2019	15	NA	0.120		0	0	$0	$0	$0
2	5/1/2024	12	NA	0.122		0	0	$0	$0	$0
3	5/1/2029	10	NA	0.125		0	0	$0	$0	$0
4	5/1/2034	8	NA	0.127		0	0	$0	$0	$0

*Incremental Demand / Assuming season is 90 days

Total Phosphorous

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	5/1/2019	2	7	0.120	5.00	450	450	$137,278	$1,287	$155,905
2	5/1/2024	2	7	0.122	5.10	9	459	$140,024	$1,313	$159,023
3	5/1/2029	1	7	0.125	6.25	103	562	$171,389	$1,607	$194,644
4	5/1/2034	0.8	7	0.127	6.58	30	593	$215,053	$2,473	$250,846

*Incremental Demand / Assuming season is 90 days

LOLO										Demand Calculations
Activated Sludge Plant										
Total Nitrogen										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	9/1/2019	15	25	0.21	18	2,398	2,398	$872,653	$7,854	$986,323
2	9/1/2024	12	25	0.22	24	782	3,180	$1,146,872	$10,322	$1,296,261
3	9/1/2029	10	25	0.22	28	563	3,743	$1,337,806	$12,040	$1,512,065
4	9/1/2034	8	25	0.23	32	584	4,326	$2,023,274	$22,992	$2,356,036
*Incremental Demand / Assuming season is 90 days										
Total Phosphorous										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	9/1/2019	2	4.4	0.21	4	384	384	$116,961	$1,097	$132,831
2	9/1/2024	2	4.4	0.22	4	8	391	$119,300	$1,118	$135,488
3	9/1/2029	1	4.4	0.22	6	174	566	$172,389	$1,616	$195,780
4	9/1/2034	0.8	4.4	0.23	7	45	611	$221,643	$2,549	$258,533
*Incremental Demand / Assuming season is 90 days										

BILLINGS										Demand Calculations
Primary Treatment plus A2O Secondary Treatment (under construction) - upgradable to 5-stage when needed										
Total Nitrogen										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)**	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	11/1/2019	10	8	15.10	-252	0	0	$0	$0	$0
2	11/1/2024	8	8	15.40	0	0	0	$0	$0	$0
3	11/1/2029	8	8	15.71	0	0	0	$0	$0	$0
4	11/1/2034	6	8	16.02	267	36,083	36,083	$751,537	$18,788	$1,023,464
*Incremental Demand / Assuming season is 90 days										
**TN Discharge based on recent upgrade design instead of historical DMR data										
Total Phosphorous										
								NPV Costs based on 20 Years at 3.3%		
Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)**	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	11/1/2019	1	0.5	15.10	-63	0	0	$0	$0	$0
2	11/1/2024	0.8	0.5	15.40	-39	0	0	$0	$0	$0
3	11/1/2029	0.5	0.5	15.71	0	0	0	$0	$0	$0
4	11/1/2034	0.3	0.5	16.02	27	2,406	2,406	$270,608	$6,438	$363,784
*Incremental Demand / Assuming season is 90 days										
**TP Discharge based on recent upgrade design instead of historical DMR data										

ABSAROKEE — **Demand Calculations**

Three Cell Aerated Lagoon

Total Nitrogen

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3%		
								Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	2/1/2020	15	14.8	0.26	0	0	0	$0	$0	$0
2	2/1/2025	12	14.8	0.26	6	823	823	$273,308	$2,460	$308,909
3	2/1/2030	10	14.8	0.27	11	616	1,439	$473,660	$4,263	$535,357
4	2/1/2035	8	14.8	0.27	15	641	2,080	$895,443	$10,175	$1,042,714

*Incremental Demand / Assuming season is 90 days

Total Phosphorous

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3%		
								Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	2/1/2020	2	1.8	0.26	0	0	0	$0	$0	$0
2	2/1/2025	2	1.8	0.26	0	0	0	$0	$0	$0
3	2/1/2030	1	1.8	0.27	2	160	160	$48,751	$457	$55,365
4	2/1/2035	0.8	1.8	0.27	2	44	204	$73,997	$851	$86,313

*Incremental Demand / Assuming season is 90 days

RED LODGE

Enhanced 3-Cell Aerated Lagoon

Demand Calculations

Total Nitrogen

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	7/1/2020	15	14.5	0.59	-2	0	0	$0	$0	$0
2	7/1/2025	12	14.5	0.60	13	1,694	1,694	$386,253	$3,476	$436,565
3	7/1/2030	10	14.5	0.61	23	1,416	3,110	$702,869	$6,326	$794,423
4	7/1/2035	8	14.5	0.63	34	1,472	4,582	$1,354,812	$15,396	$1,577,634

*Incremental Demand / Assuming season is 90 days

Total Phosphorous

Permit	Date	Variance Limit (mg/l)	Current Discharge (mg/l)	Flow (mgd)	Demand (lbs/day)	Seasonal Demand (lbs)*	Cumulative Demand (lbs)	NPV Costs based on 20 Years at 3.3% Captial Cost to Upgrade	O&M Cost to Upgrade	NPV Cost to Upgrade
1	7/1/2020	2	2.2	0.59	1	89	89	$26,998	$253	$30,661
2	7/1/2025	2	2.2	0.60	1	2	90	$27,538	$258	$31,275
3	7/1/2030	1	2.2	0.61	6	463	553	$168,533	$1,580	$191,400
4	7/1/2035	0.8	2.2	0.63	7	105	658	$238,755	$2,746	$278,493

*Incremental Demand / Assuming season is 90 days