<u>Water Quality Trading Suitability Analysis</u>

Spokane River Watershed

<u>FINAL REPORT</u>

Prepared for the U.S. Environmental Protection Agency

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Executive Summary

The Spokane River watershed has water quality concerns in the form of excessive phosphorous. Ross & Associates, under contract to Industrial Economics, conducted a trading suitability analysis and recommended a course of action based on those results.

The Spokane River TMDL includes significant phosphorus reduction targets for point sources. The point source dischargers, mostly wastewater treatment plants, have financial incentive to consider water quality trading options. In a trading program, supply is dictated by a source's ability to "overcontrol" or reduce its discharges below the target load specified by the market driver. This report analysis suggests there are nonpoint sources in the watershed, particularly on the two main tributaries, which may be able to be "overcontrolled" to create tradeable supply. There are several remaining technical questions, however, that preclude a definitive conclusion about the potential for trading. Most notably, the viability of trading is dependent on real controls being implemented and resulting reductions being verifiable. If the actual supply and demand eventually align, conditions exist that suggest trading may be a viable policy tool to help meet the TMDL goals in a cost-effective manner.

The existing collection of stakeholders that have come together in the TMDL collaboration process are well suited to address the remaining questions. This same group would also be well positioned to initiate a trading market should the further analysis suggest nonpoint sources could overcontrol sufficiently.

Introduction

The U.S. Environmental Protection Agency contracted Ross & Associates Environmental Consulting, Ltd., operating as a subcontractor to Industrial Economics, to conduct an analysis of water pollutant trading potential under the draft Spokane River Total Maximum Daily Load (TMDL). The analysis focused primarily on a high level market characterization examining the factors that can contribute to a viable phosphorus trading market in accordance with the first two steps of EPA's Water Quality Trading Assessment Handbook.[1] Based on the results of the analysis conducted in these two steps the next task called for describing a process to develop a demonstration project for water quality trading, or identifying alternative approaches to achieving the phosphorous reductions required by the draft TMDL.

Ross & Associates entered the process in an existing draft TMDL collaboration forum. This forum had several workgroups set-up with watershed stakeholders. To conduct the analysis, Ross & Associates used information from the draft TMDL, participated in several meetings with the Nonpoint Source (NPS) workgroup, and considered information from all collaboration workgroups.

The analysis is divided into three sections:

- Section 1 identifies necessary elements of a potentially viable water pollutant trading market;
- Section 2 provides the key findings of the trading analysis in the context of these factors; and
- Section 3 describes the recommendations based on the trading analysis.

Section 1: Necessary Elements of a Water Pollutant Trading Market

Four factors are commonly identified as minimum conditions to establish a water pollutant trading system: a market driver; a reasonable level of interest; a tradable commodity; and financial attractiveness.

Market Driver

The typical form of a market driver is an external requirement that quantifies reduction obligations for the watershed as a whole, and/or each discharger individually. This market driver usually takes the form of new federal, state, or local regulation(s). The market driver requires stakeholders to analyze pollution mitigation options and select a course of action to meet pollution reduction obligations. Presently, TMDLs are the leading market drivers creating reduction obligations within watersheds. Additionally, the perception of a forthcoming market driver can propel a market for certain pollutants (e.g., this is beginning to occur for CO_2). Failure to meet these obligations may or may not result in punitive measures.

Level of Interest

The resource commitment needed to investigate pollutant trading as a mitigation option requires a reasonable level of interest by the potential market participants. They must believe that their time discussing opportunities with other stakeholders will lead to the opening of additional options currently unavailable. In particular, interest should be indicated by the parties with the largest potential to produce and/or consume pollutant reductions.

Tradable Commodity

[1] See http://www.epa.gov/owow/watershed/trading/handbook/

The next, and perhaps most dynamic, factor needed for a viable pollutant trading market is the identification of a common pollutant commodity that can be sufficiently controlled, measured, and traded by point and nonpoint sources in the watershed or targeted market area. A tradable commodity is established when market participants can match four pollutant parameter characteristics: Type; Impact; Time; and Quantity.

Type/Form—Current practice dictates that pollutant trading systems have an identified controllable pollutant common to all potential market participants. This establishes a “common currency” with which market participants can evaluate offers of behavior change from others. In some instances more than one pollutant parameter may be allowed in the market with a defined translation ratio establishing the rate at which the two parameters may be exchanged with an “equal” overall effect on water quality.

Time—Aligned discharge timing matches buyers and sellers needs. First, the buyer’s and seller’s need for and ability to produce reductions must coincide with each other. The timing of the need for reductions is typically driven by both the TMDL compliance period (e.g., annual, seasonal, etc.) and NPDES permit limit compliance metrics (e.g., daily, weekly, monthly, etc.). For example, if the TMDL requires a source to reduce discharges during the summer, a seller typically cannot produce reductions in the winter for exchange.

Additionally, to be part of the same market, dischargers must have reasonable alignment between the timing of concrete knowledge of reduction obligations and initial compliance deadlines. For example, if a potential purchaser needs to meet obligations in 24 months and its mitigation options require 12 months to implement, it cannot wait 18 months while a potential reduction provider verifies its own obligations, selects its mitigation option, and calculates any surplus reductions available for purchase. If participants are unable to match both dimensions of time, the parties have “missed the market” and no trades will materialize.

Impact—Impact matching relates to the ability to establish water quality equivalence between the points of purchase and sale so as to ensure, at minimum, the neutral water quality impact of a trade at the buyer’s and seller’s discharge points and any other relevant compliance points within the watershed. The fate and transport characteristics of a pollutant parameter (how it is assimilated by a river system) and the unique ecosystem it moves through can result in diminishing its presence and effect on water quality as it moves from up to down stream. For example, through uptake by plants, settling out, and/or water diversion for agricultural uses, a pound of phosphorus discharge can “disappear” or be removed from the water column as it travels down river. This can erode the value of the purchased pollutant parameter reduction to water quality as it travels downstream. A purchaser therefore may be required to buy more reductions from other sources than they need at their discharge point to ensure the desired effect on water quality and compliance at specified locations. A variety of ratios or similar mechanisms—which depend on pollutant parameter stability as well as the distance the pollutant travels, river hydrology, and environmental conditions between purchase, sale, and compliance points—are typically used to establish the necessary water quality equivalence relationships.

Quantity—The number (or block) of reductions demanded must reasonably match the number (or block) of reductions supplied for a trade to materialize. Demand for reductions is driven by a baseline load (usually defined by historical data pertaining to a particular monitoring year), current load (what dischargers are currently discharging or plan to discharge in the future), and target load (what the market driver states is the maximum a discharger is allowed to release). Supply is dictated by a source’s ability to “overcontrol” or reduce its discharges below the target load specified by the market driver. The volume of reduced discharge below obligations or targets (also known as the water quality contribution) represents the stock of potential surplus reductions available for exchange with other parties. In some cases, and often with agricultural control strategies, trading markets will require an uncertainty discount be applied to the reductions created.

The increments, or range, of reductions demanded and supplied will dictate if a match is possible. The quantity of reductions supplied is driven by the control techniques and methods available to pollution sources. These techniques and methods include altering product production levels or management practices, substituting inputs, or investing in new technology. For a quantity match to occur and a trade to take place, reductions must result in overcontrol and the amount of surplus reductions produced must meet with the need of another party to reduce their discharge.

The nature of pollution control will often create an uneven market place; control technology often creates reductions in large blocks, rather than in small increments. Depending on the discharger's need for reductions relative to what technology can deliver, this can limit or encourage trading. If a discharger needs one lb./day of reductions to move into compliance, but the only available control option is a major, expensive technology step (that will produce reductions well in excess of that one lb./day) then their willingness to pay another party for that one pound could be substantial. On the other hand, if the same discharger needs 200 lbs./day, they may only be willing to purchase reductions if the entire 200 lbs. are available. Furthermore, if the 200 lbs. are only available from diffuse sources holding small surplus reduction amounts, the associated transaction costs can reach the point where trading will not take place.

Financial Attractiveness

The financial attractiveness of potential pollution trading is created by differences in individual incremental costs of control throughout the market. Incremental cost is the average cost of control for the increment of reduction required to meet compliance. For example, if a discharger needs a 5 lbs./day reduction, but that drives a $10 million technology investment that creates a reduction of 20 lbs./day, then the incremental cost associated with the 5 lbs./day is substantial (essentially the amortized value of capital plus the O&M expense attributable to the new technology). Average cost would divide all of the costs by 20 lbs./day; incremental cost divides the costs by 5 lbs./day and would be four times higher than average cost.

For trading to be financially attractive, the difference in incremental costs between dischargers must, at a minimum, be sufficient to cover trade transaction costs and offset any sense of increased risk. In this context, risk primarily relates to the expected value of non-compliance costs associated with the probability that non-compliance can occur. In the absence of this minimum incremental cost differential, a trade will not be financially attractive and is unlikely to occur. A differential that offsets both the transaction costs and risks presents the opportunity to achieve an economically efficient and mutually beneficial exchange.

The ratio of fixed to variable costs associated with control options combined with the timing of reduction demand and supply can also affect the financial attractiveness of a trade. High fixed cost control options create dramatic differences in the incremental costs of control faced by a discharger before and after the investment is made. Before the investment, a potential reduction purchaser will calculate incremental cost of control as the combination of the amortized fixed and the annual variable costs of control. After making the investment, the fixed costs are "sunk" and incremental cost of control calculations will include only the variable cost of control. As a result, trades that may have been financially attractive before the investment will reflect a greatly diminished incremental cost differential after the investment and may actually represent a negative financial return.

The relationship between the fixed/variable cost profile of control options and the timing of demand and supply becomes an important factor in situations where supply will lag behind demand. In such situations, a potential reduction purchaser will need to create, at least initially, their own reductions to meet compliance obligations. If this discharger needs to use a high fixed cost control strategy to create these reductions, the economics of any potential future trade will be altered, likely negatively affecting its financial attractiveness. In effect, the potential supplier of reductions will have "missed the market" unless they have a relatively low incremental cost of control that can compete with the discharger's lowered incremental cost of pollution control created by the large fixed cost investment. Alternatively, if this discharger can use a high variable cost control strategy to create the initial reductions, the economics of the trade remain fairly constant and a financially viable option to shift from the short-term control strategy to a trade remains open to the discharger.

Section 2: Trading Opportunity Findings

Spokane River Watershed Overview

The Spokane River stretches from Lake Coeur D'Alene in Idaho to Lake Spokane in Eastern Washington, west of the City of Spokane. The Spokane River watershed has water quality concerns in the form of dissolved oxygen (DO) deficiency in Lake Spokane due to excessive phosphorus. The Washington Department of Ecology released a draft TMDL in October 2004. The draft TMDL assigns phosphorus targets to specific point sources and a target for nonpoint sources. A natural background load is identified, but the difference between the background and nonpoint source loads is not clearly defined. TMDLs are currently underway for the two main tributaries: Hangman (Latah) Creek; and the Little Spokane River.

There are several wastewater treatment plants discharging into the river. The largest single source is the City of Spokane's wastewater treatment plant. In addition there are many nonpoint sources on the mainstem and tributaries. The Spokane Valley aquifer is another source to the system, although the complicated hydrology constrains characterization of this source.

To address concerns around the draft TMDL and to determine an implementation plan, watershed users have formed a TMDL collaboration effort. The TMDL collaboration effort includes representatives from each of the point sources, environmental non-governmental organizations, state and federal environmental agencies, city and county officials, and local stakeholders.

Market Driver

The Spokane River draft TMDL calls for phosphorus reductions beginning in 2005 with dischargers reaching a limit of 0.05 mg/L limit by 2009. By 2015, the TMDL targets point source concentration limits of 0.01 mg/L. Wastewater treatment plants have suggested that there is no technology available to reach these targets without eliminating discharge to the river. The alternative option to land apply the discharge is costly and provides a significant driver to examine trading options. There is a strong market driver to consider trading in this watershed.

Level of Interest

The relevant regulatory agencies, Washington Department of Ecology and EPA Region 10, have been supportive to explore trading options to meet water quality goals. Other stakeholders in the collaboration process have been open to explore the feasibility of trading. Dischargers are notably interested in trading in lieu of the last costly technology step that would require them to land apply the effluent.

Tradable Commodity

Type/Form

In the TMDL, Ecology designated total phosphorus (TP) as a pollutant of concern in the TMDL. Using TP eliminates the need to consider the likely variability in different pollutant types in the river (such as orthophosphate vs. sediment attached). This enables all sources, irrespective of the specific type of phosphorus, to trade with one another. Furthermore, TP represents a relatively stable pollutant that can support establishment of water quality equivalent trading relationships. Therefore, the type/form of pollutant supports the potential for trading.

Timing

The TMDL calls for a seasonal limit on discharge – the critical period stretches from April to October. Depending on the nature of the permit limits for NPDES dischargers (seasonal or annual) potential trading partners may or may not align well. For example, when point source dischargers would be most interested in trading in the dry summer months during the critical period, nonpoint source trading partners in the tributaries typically have low loads. Seasonal differences can allow for trading, but may not align the loads well for trading relationships.

Another timing issue is the impact of phosphorus loads in the critical period versus loads outside of the critical period. At the time of this report, there was still some uncertainty as to nutrient residence time in Lake Spokane and the subsequent water quality impact of sediment-attached phosphorus. Significant loads from rainfall in the tributaries outside the critical time period raised concerns about the timing of load impacts. If the draft TMDL were to consider loads outside the critical time period, there could be significantly higher loads counted from nonpoint sources.

Impact

Pollutant sources stretch along the river over 50 miles. However, some of the largest sources are clustered relatively close together near Spokane (Spokane treatment plant and the Hangman and Little Spokane tributaries). Past experience suggests that sources in close geographic proximity have similar water quality impacts and may have water quality equivalence ratios of 1-to-1. However, water quality equivalence ratios would likely be required for wastewater treatment plants further upstream to account for differing water quality impacts. The equivalence ratios are likely to erode the value for upstream users to participate in trading.

Quantity

Figure 1 below shows the total phosphorus load budget in line with the Spokane River Draft TMDL (from TMDL Figure 10, revised April 11, 2005).

Figure 1: Spokane River Draft TMDL budget

Source	Current Load (2003) (lbs./day)	2009 Load	2015 Load	Reductions Needed from Current (lbs./day)	Reduction Percentage
Coeur D'Alene	7.1	0.4	0.1	7.0	99
Hayden	0.0	0.0	0.0	0.0	0
Post Falls	4.3	0.4	0.1	4.2	99
Liberty Lake	9.4	0.1	0.0	9.4	100
Kaiser	0.1	3.2	1.3	-1.2	-1000
International Empire	10.1	1.1	0.2	9.9	99

Spokane City/County	156.1	14.5	2.9	153.2	99
Stormwater	16.4	0.0	0.0	16.4	100
Nonpoint Sources	38.5	38.5	8.5	30.0	78
Natural Background	118	118	118	0.0	0
Total	**360**	**176.2**	**127**	**233**	**65**

The NPS workgroup of the TMDL collaboration process approached the draft TMDL as a starting point to better understand the sources of phosphorus and the controllability of the load. In so doing, the workgroup attempted to better identify sources in a "bottom-up" methodology. The workgroup considered the draft TMDL categories of stormwater, nonpoint sources, and background load. The workgroup conducted a detailed examination of component parts for these source categories in the draft TMDL to discern:

1. If alternative measurement, modeling, or previous studies suggested a higher or lower potentially controllable load; and
2. If there was a basis for attributing loads in a greater level of detail.

Figure 2 presents the NPS workgroup findings. As of the time of this report, the information presented in the table is subject to continuing discussions among workgroup members with differing opinions as to the appropriateness of controllable loads. This table does not imply consensus support among NPS Workgroup members, nor has Ross & Associates attempted to verify or corroborate the information presented. Further study may be necessary to ensure this range of reductions is actually feasible for the Spokane River watershed.

In particular, this table reflects the workgroup's efforts to more precisely characterize and attribute "background load" to more discernable and potentially controllable "nonpoint" sources. The workgroup drew on a number of sources to derive a better understanding of phosphorus loading to the watershed. Monitoring data was the preferred source of information. Calculated or literature values were used as an alterative in the absence of better information. Supporting data and research to define the current load and range of control effectiveness can be found in the appendix.

Figure 2: NPS Workgroup Matrix for the Full Group
9/14/2005

Source	Current Load (lbs./day)	Controls	Range of Effectiveness	Controlled (Low) in lbs./day	Controlled (High) in lbs./day
Valley Aquifer	37	Septic tank elimination Dish detergent ban Garbage disposal/composting education Street sweeping Ditch, catch basin and drywell cleaning Vegetation maintenance Adding swales or catch basins to drywells	10%-20%	4	7
Little Spokane River	82	Conservation tillage Riparian/shoreline rehabilitation Livestock fencing/watering systems Catchment basins/grassed waterways Buffer/filter strips Shoreline stabilization Shoreline education	50%-80%	41	66
Hangman Creek †	39	Conservation tillage Riparian/shoreline rehabilitation Livestock fencing/watering systems Catchment basins/grassed waterways Buffer/filter strips Shoreline stabilization Satellite treatment	50%-80%	20	31
Lake Spokane	6	Septic tank elimination Fertilizer phosphorus ban or reduction Satellite treatment	0%-30%	0	2
Lake Coeur D'Alene	22	Lake aeration	0%-20%	0	4
Stormwater ††	16	Fertlizer phosphorus ban or reduction Education/outreach Adding swales to drainage areas Street sweeping Construction site BMPs Weed control Doggie dootie stations	0%-40%	0	6
Total	202			64	117

Notes:

†) The Hangman (Latah) Creek suggested current load is based on an average flow from 1948-2001 rather than the TMDL year of 2001because the low flow year of 2001 represents a "best case scenario" with respect to the phosphorus load coming out of the tributary.

††) Stormwater includes only the City of Spokane separate stormwater system

There are two notable differences between the draft TMDL load information and the NPS workgroup information. First, there is a greater level of detail in the source characterization compared to the draft TMDL. The workgroup identified contributors of nutrients and associated control options. Second, the total potentially controllable load increased from 173 lbs./day[2] to 202 lbs./day.

Supply and Demand

To define potential trading relationships, the analysis needs to identify individual sources' potential demand and supply. Demand is defined as a source's needed reduction (the difference between the future load and target load). On the flip side, supply is created by overcontrol beyond the target (that is a reduction below the target load).

On the demand side, any of the point source dischargers appear to be good candidates. The City and County of Spokane have the greatest demand for reduction. The dischargers may also find it advantageous to pool their load and meet their target collectively. The key to understanding the actual demand in terms of lbs./day requires understanding the potential preferences of the dischargers for

[2] TMDL loadings for stormwater + Nonpoint Sources + Natural Background = 16.4 +38.5 + 118 = 172.9 lbs./day

meeting load reduction requirements through direct treatment investments or through trading. Dischargers have indicated that, in particular, there is an interest in using trading in lieu of taking a final technology step that involves eliminating discharge to the river. Using the best available information at the time of this report, the dischargers may be interested in trading to offset the potential difference between technology that would achieve concentration of 50-100 µg/L and the TMDL limit of 10 µg/L.[3] Using flow figures from the draft TMDL, this translates to a dischargers' demand of between 15-45 lbs./day[4]. It is important to note that the figures to estimate a concentration achievable through technology and/or a resulting "demand" should be viewed as illustrative and do not represent Ross & Associates belief of what the technology will do, nor have these figures been embraced by the TMDL collaboration process. Once further information is known on the maximum extent possible for the point source installed technologies, a more accurate demand can be determined. Particularly since the TMDL collaboration process is not "picking a number" but rather is working to select, install, and operate control technologies, the true demand number (if any) will be determined once these steps have been taken.

On the supply side, it appears that there is potential for sources identified by the Nonpoint Source Workgroup to create some level of supply. The ability for these sources to create tradeable reductions requires overcontrol beyond the draft TMDL targets. In the draft TMDL, the stormwater, nonpoint, and background sources need to meet a collective 46.4 lbs./day reduction (30.0 lbs./day for nonpoint sources plus 16.4 lbs./day for stormwater) before creating supply by overcontrol. Figure 2 identifies a range of potential control between 64-117 lbs./day. Given the need to meet a 46.4 lbs./day reduction, sources identified by the Nonpoint Source Workgroup could potentially overcontrol to supply up to 18-71 lbs./day[5]. Revisions to controllability assumptions, however, (such as with water quality equivalence differences or uncontrollable background loads) could erode the potential to create supply. Supply will only be created when real controls are implemented and their effectiveness verified.

It is also important to note that through the TMDL Collaboration process, stakeholders are reviewing a range of opportunities to reduce the phosphorus load to the river. In addition to nonpoint sources, Collaboration workgroups are specifically evaluating the potential benefit of conservation measures, reuse, and aquifer recharge. All of these have the potential to also 'offset' or supply the point source dischargers need for reduction.

These initial supply/demand figures suggest a possibility for trading – in the absence of potentially eroding factors, nonpoint sources could create sufficient supply (18-71 lbs./day) to meet dischargers demand (15-45 lbs./day). This initial suggestion that supply and demand conditions appear to support the possibility of trading is dependent on further analysis and work currently underway within the TMDL collaboration process. This report uses the best available information to analyze a potential range of scenarios, but the figures used in this report neither represent consensus support from the TMDL Collaboration process stakeholders, nor Ross & Associates beliefs. Rather, the numbers used in this analysis are illustrative and if the actual supply and demand numbers eventually align, trading may be a viable option.

Financial Attractiveness

[3] It is important to note that the technical ability and cost of treatment technology is still under consideration. The true test of the point source discharger technology options will be when the equipment is installed and operated to the maximum extent possible. Other tools, in addition to trading, such as conservation, reuse, and aquifer recharge are being pursued as part of the TMDL collaboration process.

[4] The dischargers' demand assumes a cumulative flow in line with the TMDL of approximately 63 MGD.

[5] Control – Target = Overcontrol (supply). 64 lbs./day – 46 lbs./day = 18 lbs./day. 117 lbs./day – 46 lbs./day = 71 lbs./day.

To determine the financial attractiveness of trading requires understanding the economic drivers for those sources who would be likely buyers (that is have demand for reductions) and the likely suppliers. The analysis below compares the cost of two scenarios that would meet the draft TMDL targets: 1) eliminating wastewater treatment plant discharge to the river; and 2) implementing Best Management Practices (BMPs) for nonpoint source controls in the tributaries. A difference in cost between the two scenarios such that the potential buyers' (point source dischargers) cost is higher than the suppliers' would support trading.

At the time of writing, the dischargers were evaluating a number of technology options to reach a draft TMDL target of 0.01 mg/L. Initial estimates of the cost between technological upgrades to plants and eliminating discharge to the river ("getting out of the river") are in the range of hundreds of millions. This information can be used to determine a source's average cost of control. While exact figures are not known, the scope of need suggests that the relative cost of control would be extremely high.

On the supplier side, the cost of control is anticipated to be much lower. For example, initial estimates from the Spokane Soil Conservation District for cumulative control costs on both Hangman (Latah) Creek and the Little Spokane are on the order of $30 - $40 million.

Figure 4: Nonpoint source consideration

Source and Control Action	2009 Target Load (lbs./day)	2015 Target Load (lbs./day)	Reduction Achieved (lbs./day)	Annualized Cost	Average Control Cost ($/per lb./day)
Eliminating discharge from the river	19.7	4.6	15.1	$ 7,690,000	$ 1,395
Tributary BMPs	121.0	61.0	60.0	$ 3,076,000	$ 140
Notes:					
Eliminating discharge from the river: For the purposes of this illustrative analysis, draft TMDL information is used to identify the 2009 and 2015 Target Load (see Spokane River Draft TMDL, Figure 10, page 27, revised 4-11-05). Eliminating discharge from the river represents a potential technology step to reach the 2015 target. However, this should be used only for demonstration purposes as the TMDL collaboration process continues to investigate the technologies available to point source dischargers. It is possible that eliminating discharge from the river would not be needed to reach the 2015 Target Load. Figure 4 represents only one potential scenario to illustrate potential differences in average cost to control.					
Tributary BMPs: Target Load and Reduction Achieved taken from Figure 2 Current Load and Low Control					
Annualized cost assumes 20 year financing at 4.5%					
Point sources' capital cost estimated at $100 million [6]					
Tributaries BMP capital cost estimated at $40 million[7]					

Even using rough estimates, Figure 4 demonstrates the order of magnitude difference between the potential cost of control between dischargers and the nonpoint sources in the tributaries. Nonpoint sources in the tributaries could be controlled using a variety of BMPs for a lower cost than dischargers could reduce their load. In summary, the scenario examined in Figure 4 suggests that trading between dischargers and nonpoint sources appears to demonstrate significant financial attractiveness. This analysis, however, should only be used for illustration purposes as there is not yet certainty around the

[6] Exact capital costs are not yet known, but $100 million is used as a conservative estimate for illustration purposes.
[7] Exact BMP costs are not yet known, but $40 million represents the Spokane Soil Conservation Districts' conservative estimate – see the appendix for additional detail.

point source discharger's true technology options, nor is there certainty around the potential to control nonpoint sources load.

Section 3: Future Trading Plans

Based on the potential for trading suggested by the first two steps of the water quality trading assessment process, the recommended next steps suggest some technical gaps to fill before market initiation concepts could be acted on.

There are several outstanding technical issues to resolve before pursuing a trading policy.

- Refine dischargers technology options
- Refine nonpoint source control options and determine the potential to measure or otherwise verify any reductions
- Refine more accurate cost of control for both the dischargers and nonpoint sources
- Refine background load estimation for nonpoint sources
- Determine water quality equivalence ratios

Should the remaining technical questions continue to support the potential for trading, four potential trading scenarios appear possible:

1) Sources identified by the NPS workgroup overcontrol for the City of Spokane wastewater treatment plant
2) Sources identified by the NPS workgroup overcontrol for the County wastewater treatment plant
3) Sources identified by the NPS workgroup overcontrol for the City and County of Spokane wastewater treatment plants
4) Sources identified by the NPS workgroup overcontrol for all dischargers

In all situations, sources identified by the Nonpoint Source Workgroup are likely to overcontrol on behalf of point source dischargers. As noted above, the most promising areas of overcontrol appear to be in the tributaries.

Market Infrastructure

Watersheds around the country have employed a variety of approaches to develop a market infrastructure to support trading. One model, in particular, seems promising given the scenarios above. It may be feasible for dischargers to contribute to a "bank" to offset their needed reductions. This bank would then invest in BMPs. Prices for phosphorus reduction credits could be set according to best estimates for BMP controls (plus a margin of safety).

This type of market structure would require bank/transaction administration, investment oversight, and reduction verification. Other trading markets have set-up new non-profit entities to conduct these functions or assigned these responsibilities to an existing regulatory agency. The advantage of a bank in this situation will be lower transaction costs compared to one-to-one trading.

Stakeholder Readiness

The current TMDL collaboration process provides the ideal framework to engage all stakeholders required to initiate a trading market. All necessary parties are present in conversations in a way that suggests stakeholders can decide whether or not to engage in trading should the market emerge. No additional work would be needed in this area.

Conclusion

Based on the initial assessment, there appears to be potential for phosphorus trading between the point source dischargers and nonpoint sources in the Spokane River watershed. However, there are several outstanding questions that require follow-up before a trading demonstration project could be initiated. The TMDL collaborative process that is currently in place is a suitable vehicle to pursue the remaining technical questions. Should further information and resulting conditions support trading as a possible policy tool, this same group of stakeholders would be well positioned to carry through in designing a market.

Appendix
Nonpoint source supporting materials

Nonpoint Source Category	Authoring Agency
Hangman (Latah) Creek …………..….	Spokane Soil Conservation District
Little Spokane River …………………	Spokane Soil Conservation District
Lake Spokane ……………….………	Washington Department of Ecology
Lake Coeur D'Alene ………..……….	City of Coeur d'Alene
Spokane Valley Aquifer ……………..	Spokane County Public Works
Stormwater ………………..……….	City of Spokane

The information in this appendix was developed by members of the NPS workgroup of the Spokane TMDL Collaboration effort. This information does not suggest consensus support from those involved in the collaboration effort nor in the NPS workgroup. Nor has Ross & Associates made attempt to verify or corroborate this information. Further study may be necessary to explore nonpoint source control options. When the workgroup shared the information as input to the full group process, they did so under the following terms and qualifications:

- The workgroup agreed on the format to deliver the information, including agreeing on the level of detail to be articulated.

- The designated area champions researched and drafted the information for the matrix and the supporting narrative

- Although the workgroup supported the "champion" approach to generating the inputs to the attached matrix, the time constraints limited the opportunity for review and discussion. The workgroup is supportive of the efforts made by the "champions," but no attempt was made to certify or independently corroborate the estimates put forward.

Hangman (Latah) Creek Watershed

Current Conditions

Total Phosphorus Load: 39 lbs./day

Comments on the load: The total loading number used for the TMDL is a snapshot of water quality monitoring data from 2001. This was a low flow year; the average annual flow for water year 2001 was 83.7 cfs. The 52-year average flow (1948–2001) was 235 cfs. Therefore, confidence in this number is relatively low and presumed to underestimate the sediment/phosphorus contributions to the Spokane River. The SCCD further evaluated the loading by adjusting the flows on the current number and compared this to the recent (2004) Hangman Creek TMDL monitoring data.

To estimate the loads, the Hangman Creek monthly flows used in the Spokane River TMDL were compared to the USGS (USGS Streamflow Station #12424000) monthly mean streamflows for April through October. The streamflows used in the Spokane River TMDL were found to be approximately half of the USGS monthly mean flows. The monthly loads presented in the TMDL were adjusted for the difference in monthly average discharge. To check this adjustment, the current Hangman TMDL TP sample results were used to estimate the monthly loads.

From the current Hangman Creek TMDL data, the discharge and total phosphorus (TP) were regressed to form a predictive equation. TP is estimated based on the discharge using the equation:

$$TP=1.51 \text{ X } 10^{-4}(\text{discharge}) + 0.05$$

This equation was used to estimate the average TP concentration for each month. The average TP concentration and USGS mean monthly flow was then converted to pounds per day phosphate (Table 1). The average for the season of interest (April though October) was then estimated. This adjusted loading included the average loading of the Waste Water Treatment Plants (WWTP) in the watershed (Table 2.). During the later summer months, the WWTPs appear to be the primary source of TP loading in the watershed.

The SCCD believes that the amount of TP leaving the Hangman Creek Watershed is better represented as 39 lbs/day through the period of April through October. However, the question of sediment delivery to the Spokane River has not been adequately addressed. Hangman Creek contributes, on average, 186,000 tons of sediment every year. Associated TP concentrations have been recorded as high as 10,000 lbs in a single storm event (January 2004). This TP is stored in the sediments and pulsed through the system during the year and could provide a significant source of TP that may be underestimated by the TMDL group.

Agricultural influences

Sediment transport

Table 1. Spokane River NPS TMDL loading adjustment

	Apr	May	Jun	Jul	Aug	Sep	Oct	Avg.
Qmm (cfs)	343	194	75.4	22.5	13.4	13.5	18.0	NA
Q TMDL (cfs)	136	92.9	29.2	10.5	6.7	6.4	12.7	NA
TMDL Load (lbs/day)	44.5	44.5	0.0	0.0	0.0	0.0	0.0	12.7
Adjusted TMDL Load (lbs/day)	130.8	113.9	6.45	4.83	4.29	4.74	1.72	38.1
Estimated TP (mg/l)	0.10	0.08	0.06	0.05	0.05	0.05	0.05	NA
SCCD Load (lbs/day)	172.5	80.01	19.65	1.63	0.0	0.0	0.43	39

Notes:
1. Qmm is the monthly mean flow from the USGS.
2. cfs is cubic feet per second.
3. TMDL is Total Maximum Daily Loads.
4. lbs/day is pounds per day.
5. TP is total phosphorus.
6. mg/l is milligrams per liter.
7. NA is not applicable.
8. All loads have been adjusted to WWTP inputs.

Table 2. Hangman (Latah) Creek Watershed WWTP Sampling Data

Sample Date	Rockford			Fairfield			Tekoa		
	Discharge (gallons/day)	TP (mg/l)	Load (lbs/day)	Discharge (gallons/day)	TP (mg/l)	Load (lbs/day)	Discharge (gallons/day)	TP (mg/l)	Load (lbs/day)
Dec. 15, 03	NS	NS	NA	NS	NS	NA	269,000	1.157	2.59
Jan. 14, 04	239,040	2.269	4.52	109,617	3.030	2.77	278,000	0.247	0.57
Feb. 4, 04	158,400	2.280	3.01	185,122	1.980	3.06	403,000	1.910	6.42
Mar. 3, 04	138,440	1.583	1.78	258,706	1.447	3.12	369,000	0.982	3.02
Apr. 13, 04	230,400	3.640	6.99	127,952	1.967	2.10	285,000	1.320	3.14
May 3, 04	NS	NS	NA	101,601	2.012	1.70	212,000	1.352	2.39
Jun. 2, 04	NS	NS	NA	119,638	2.702	2.70	292,000	0.842	2.05
Jul. 7, 04	NS	NS	NA	28,641	3.017	0.72	178,000	2.500	3.71

Notes:
1. NS is not sampled.
2. NA is not applicable.
3. mg/l is milligrams per liter.
4. December and January sampling were not coordinated initially, and were sampled as close to the routine sampling date as possible.
5. Rockford treatment facility does not discharge during the summer months, and no samples were collected for the May through July sample months.

Control options

In watersheds that are dominated by agricultural land use, such as Hangman, the primary means of control is through the use of Best Management Practices (BMPs). Although the best way to address the phosphorus (P) issue may be to reduce/manage P inputs, it is not realistic to eliminate these because of their need for profitable crop production in the watershed. Therefore, it is important to focus on the P transport pathways such as overland flow. Reducing overland flow volume, increasing infiltration and sediment trapping will ultimately break the link between sources and pathways (Grubek et al 2000; Sharpley et al. 2000). This can be achieved by focusing on BMPs that increase vegetative cover and residue. An increase in vegetative cover lessens the ability of precipitation to induce surface erosion and overland flow (Isermann, 1990). Better infiltration will influence the size of peak discharges, reduce overall P and sediment inputs to stream, and minimize stream energy and associated stream bank erosion. Efforts should be prioritized according to critical source areas in the watershed.

A successful BMP program can effectively reduce sediment and P concentrations by 51 to 81 percent. This translates into an approximate reduction of 20 to 31 lbs of P in Hangman Creek (according to adjusted SCCD loading numbers). The program will require an installation and establishment period before results can be fully realized.

Control description	Range of effectiveness	Estimated Costs ($)	Comments
Conservation tillage	91%-97%[1]	16 M	The type of tillage operation is central to preventing sediment and P inputs by reducing overland flow to surface water.
Riparian/shoreline rehabilitation (tree and shrub planting)	55%-85%[2]	1.5 to 2 M	Approx. 75% of the riparian canopy has been removed or degraded.
Livestock fencing/watering systems	25%-81%[3]	150 to 300 K	BMPs will focus on streamside operations.
Catchment basins/grassed waterways	65%-95%[4]	500 K to 1 M	The installation of catchment basins would immediately reduce sediment and TP.
Buffer/filter strips	60%-95%[5]	200 to 450 K	30 to 50 ft vegetative strips are most effective.
Shoreline stabilization (structural)	10%-30%[6]	6 to 10 M	Costs are based on first 25 river miles (SCCD 2000)
NPS BMP Program (Overall)	**51%-81%**	**24.5 to 30 M**	Based on 20-year timeline. BMPs need time for installation and become established.

[1] Langdale et al. 1985; Mostaghimi et al. 1988; Veseth, 1988; Moldenhauer et al. 1983; Dillaha et al. 1988; McCool et al. 1993
[2] Parkyn, 2004; Lee et al. 2000; Truman et al. 2003.
[3] Sheffield et al. 1997; Nelson et al. 1996; Line et al. 2000
[4] Scwab et al. 1981; McCool and Molnau, 1978; USDA-NRCS Engineering Manual; Gregory and McCarty, 1986; Haan et al. 1994; Carter 1990; Robbins and Carter, 1975; Dandy and Cooper, 1984; Brown et al. 1981.
[5] Lee et al. 2000; Uusi-Kamppa et al. 2000; Lee et al. 1999; Moldenhauer et al. 1983; Haan et al. 1994; Parsons et al. 1991; Williams and Nicks 1988
[6] Zaimes and Schultz, 2002
M is million
K is thousand

TMDL Group Status

The Hangman Creek TMDL project began in September of 2003 and is scheduled for completion by December 2006. Water quality sampling has been conducted and completed. Joe Joy, TMDL Specialist for the Department of Ecology, is currently analyzing the water quality data and developing a load allocation for the basin (in coordination with the Spokane River TMDL). These analyses will be used to determine the type and amount of water pollution concerns and will also be used to establish goals or targets to bring the creeks into compliance with water quality standards. Joe should complete the first leg of his work by December 2005. The TMDL Workgroup is currently developing a list of recommended Best Management Practices (BMPs) that can be used to reduce various pollutants to streams and drainages. The water quality improvement plan (TMDL) will be completed early in 2006. However, there are past data, studies, and efforts that are important to the overall Spokane River TMDL process.

Next Steps

1. Conduct soil sampling study to determine sources and associated concentrations of P (cropland, stream banks, ditches, etc.). This work will help evaluate the resuspension of P stored in Hangman Creek sediments.
2. Identify Critical Source Areas throughout watershed.
3. Develop criteria and guidelines for a Comprehensive NPS BMP Program for Hangman Creek. Stable funding should be identified.
4. Develop and initiate long-term water quality monitoring plan to assess BMP effectiveness over time.

Little Spokane River Watershed

Current Conditions

Total Phosphorus Load: 82 lbs./day

Comments on the load: The total loading number used for the TMDL is a snapshot of water quality monitoring data from 2001. The flows used in the loading analysis were approximately 13 percent lower than the average annual flows as recorded by the USGS. Further evaluation and adjustment of the flows did not indicate any significant differences; therefore confidence in the current number is moderate to high.

Control Options

The Little Spokane River is heavily impacted by land uses that have direct influences on water quality. These uses are often within close proximity of surface water and involve the removal and/or alteration of natural riparian vegetative buffers. The abundance of hobby farms, rural residences, and livestock operations are believed to be the major inputs of TP to the system.

- ***Livestock***

Livestock grazing pastures can be a significant source of P to surface water. Excrement, and trampling of stream banks is the primary concern. The reduction of overland flow (nutrient pathways) should be addressed through Best Management Practices (BMPs) involving vegetative buffers, fencing, and off-creek watering facilities.

The SCCD performed an inventory (aerial photo-interpretation, ground-truthing, personal knowledge) to determine how many pastured areas are found adjacent to perennial streams in the watershed. The current estimated inventory is nearly 100,000 linear feet (19 miles) of streamside pasture. Stocking rates and other associated grazing management practices were not known. Therefore, it was difficult to accurately assess the TP contribution of these areas. It is assumed that these areas provide large contributions of TP during the wetter spring months and rain events.

- ***Septic Systems***

There is a proliferation of individual septic systems in the Little Spokane River Watershed (over 11,000). To better evaluate their impact on water quality, the SCCD inventoried the number septic systems within a 500-foot buffer of the major streams in the watershed and analyzed their potential contribution of TP to the river via groundwater. The SCCD used the steady state equation described in the “Simplified Method” by Robertson, et al. 2003 and HDR, 2005. The inventory reported approximately 312 septic systems within the 500-foot buffer. This inventory included the LSR mainstem, Deadman Creek, Dragoon Creek, and the West Branch of the LSR. According to the results, approximately 1.6 lbs/day of TP are contributed from these systems. This suggests that septic systems along the waterways are not a primary source of P contribution. However, this information does not preclude the potential cumulative impacts of septic systems on smaller streams, and/or high-density septic areas.

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- ***Rural Residences/Lawns***

Rural residences, especially those adjacent to streams, traditionally prefer to have an unobscured view of the stream. In order to accommodate this, riparian vegetation is removed and often replaced with manicured lawns. These lawns are frequently too close to the stream, over fertilized, and over irrigated. It is suspected that the combination of these factors presents a high potential for TP contribution to the local streams.

The SCCD performed an inventory (aerial photo-interpretation, ground-truthing, personal knowledge) of lawns in the watershed to determine how many are located adjacent to perennial streams in the watershed. The current estimated inventory is nearly 10,000 linear feet (approximately 2 miles). There was a concentration of rural residences and two golf courses in this area (river mile 10.0 to 19.2). Water quality data from the POCD report (2000) indicated that TP levels steadily increased from river mile 25.0 to river mile 10.0. After this point in the river, additional flow contributions from large tributaries and groundwater (aquifer) increased, while TP concentrations begin to decrease.

- ***Cropland/Agriculture***

Dryland and irrigated agriculture comprise approximately 25 percent of the land use in the watershed (110,000 acres). Approximately half of this land use is found in the Dragoon Creek watershed. The TP contribution of this land use is not known. A majority of the cropland is not directly adjacent to the streams, but there are areas that likely contribute to the TP problem. The implementation of a BMP program address the TP transport pathways, such as overland flow. Reducing overland flow volume, increasing infiltration and sediment trapping will ultimately break the link between sources and pathways (Grubek et al 2000; Sharpley et al. 2000). This can be achieved by focusing on BMPs that increase vegetative cover and residue. An increase in vegetative cover lessens the ability of precipitation to induce surface erosion and overland flow (Isermann, 1990). Efforts should be prioritized according to critical source areas in the watershed.

A successful BMP program can effectively reduce sediment and TP concentrations by 51 to 81 percent. This translates into an approximate reduction of 41 to 66 lbs of P in the Little Spokane River. The program will require an installation and establishment period before results can be fully realized.

Control description	Range of effectiveness	Estimated Costs ($)	Comments
Conservation tillage	91%-97%[1]	2 to 4 M	The type of tillage operation is central to preventing sediment and P inputs by reducing overland flow to surface water.
Riparian/shoreline rehabilitation (tree and shrub planting)	55%-85%[2]	500 K to 1M	Approx. % of the riparian canopy has been removed or degraded.
Livestock fencing/watering systems	25%-81%[3]	300 to 500 K	BMPs will focus on streamside operations.
Catchment basins/grassed waterways	65%-95%[4]	100 K to 200 K	The installation of catchment basins would immediately reduce sediment and TP.
Buffer/filter strips	60%-95%[5]	100 K to 250 K	30 to 50 ft vegetative strips are most effective.
Shoreline stabilization (structural)	10%-30%[6]	2.5 to 5 M	Costs are based on first 25 river miles (SCCD 2000)
Shoreline Stewardship Program (i.e. lawn education)	50%-80%	40 K	Annual cost. Program to work with shoreline landowners.
NPS BMP Program (Overall)	**51%-81%**	**5.5 to 11 M**	Based on 20-year timeline. BMPs need time for installation and become established.

[1] Langdale et al. 1985; Mostaghimi et al. 1988; Veseth, 1988; Moldenhauer et al. 1983; Dillaha et al. 1988; McCool et al. 1993
[2] Parkyn, 2004; Lee et al. 2000; Truman et al. 2003.
[3] Sheffield et al. 1997; Nelson et al. 1996; Line et al. 2000
[4] Scwab et al. 1981; McCool and Molnau, 1978; USDA-NRCS Engineering Manual; Gregory and McCarty, 1986; Haan et al. 1994; Carter 1990; Robbins and Carter, 1975; Dandy and Cooper, 1984; Brown et al. 1981.
[5] Lee et al. 2000; Uusi-Kamppa et al. 2000; Lee et al. 1999; Moldenhauer et al. 1983; Haan et al. 1994; Parsons et al. 1991; Williams and Nicks 1988
[6] Zaimes and Schultz, 2002
M is million
K is thousand

Little Spokane River TMDL Project Status

The TMDL project began in 2003 with public meetings in April and May of 2004. The management plan portion is scheduled for completion in 2006, along with the TMDL being conducted by WSU. Water quality sampling is currently being conducted, but is not scheduled for completion until 2006. WSU will analyze the water quality data and develop a load allocation for the basin (in coordination with the Spokane River TMDL). These analyses will be used to determine the type and amount of water pollution concerns and will also be used to establish goals or targets to bring the watershed into compliance with water quality standards. The water quality management group is currently developing a list of recommended Best Management Practices (BMPs) that can be used to reduce various pollutants to streams and drainages. The water quality improvement plan will be completed early in 2006.

Next Steps

1. Identify Critical Source Areas throughout watershed (Evaluate forest land and natural background P contributions).
2. Develop criteria and guidelines for a Comprehensive NPS BMP Program for Little Spokane River. Stable funding should be identified.
3. Develop and initiate long-term water quality monitoring plan to assess BMP effectiveness over time.
4. Discussion of lawn fertilizer restriction zone (potential P ban).

Lake Spokane

Current Conditions

Total Phosphorus Load: 6 lbs/day

Comments on the load: The load estimate is derived from Soltero (1991), using June-September average lbs/day; minus Groundwater contribution (673 lbs./day ÷ 120 days = 6 lbs/day). The confidence in this number is moderate since there has been significant population growth in the area. It is suggested that, in particular, shoreline wastewater systems may contribute additional load. In addition, the diversity of the plant community has changed with the introduction of Eurasian Milfoil since 1991 which exhibits early season release of nutrients to the water column during the growing season.

Control options

Control description	Range of effectiveness	Cost	Comments
Shoreline and/or Stevens County residential cluster septic tank elimination - through satellite treatment or sewering	Unknown	Unknown	
Fertilizer phosphorus ban or phosphorus reduction	Unknown	Unknown	See Stormwater category for more details.

Next Steps

1. Investigate septic tank systems around Lake Spokane and throughout Stevens County – particularly a detailed study of the higher density residential areas and the feasibility of sewering, septic elimination, and package satelite treatment.

2. Continue to monitor the spread and extent of Eurasian Milfoil in Lake Spokane.

Lake Coeur d'Alene

Current Conditions

Total Phosphorus Load: 22 lbs./day

Comments on the load: The load estimate is derived from the Draft TMDL document (10/2004) Figure 9 ("Pie Chart"). This estimate is not based on monitoring data, but rather on modeling (for 2003, not 2001); consequently confidence in the figure is moderate. An alternative calculation using a mean concentration of 8.67 µg/L (based on 1984 input data and used in the CE-QUAL-2E model), an outlet flow of 993 MGD (based on Ecology's 1 in 10 year average summer flow), and attenuation of 72% (based on the CE-QUAL-2E model), results in a load of 20 lbs./day.

Also note that the workgroup has raised the question that a potential (significant) load may be coming from the Coeur D'Alene River that is not addressed in the TMDL nor has it been considered yet in the NPS workgroup.

Control options

Control description	Range of effectiveness	Cost	Comments
Lake aeration – deep area "tub basin" goes anoxic in the summer and consequently may release phosphorus; aerating the bottom layer could prevent the release	Unknown	Unknown	It is currently unknown whether aeration is possible without disturbing the hazardous heavy metal laden sediments.

Next Steps

1. Investigating the possibility of lake aeration without disturbing the sediments; if promising, a pilot test may be possible.
2. Investigate the possibility of additional load coming from the Coeur D'Alene River.

Aquifer

Current Conditions

Total Phosphorus Load: 37 lbs./day

Comments on the load: The load estimate is based on two previous studies. Soltero (1991) "Groundwater Contribution" suggests a load of 33 lbs/day (4966 lbs Jun-Sept = 33 lbs/day) and Patmont et al (1987) (quoted in Spokane Stormwater Plan page 3-11) suggests 11% of total load to Lake Spokane is from groundwater (11% * 360 lbs/day = 40 lbs/day). There are two primary anthropogenic phosphorous sources to the aquifer: septic tank leaching and drywell infiltration.

Street surface contaminants have been found in significant concentrations in particles smaller than 250 microns. In our region, little or no runoff treatment takes place prior to runoff entering the drywells or infiltrating into the ground. The aquifer is characterized for having a high susceptibility to contamination. Pollutant travel time through the alluvium overlying the aquifer is estimated to range from days to weeks. As a result, contaminants present in the soils, adjacent vegetation, and roads has the potential to contaminate the aquifer. A study conducted in 1983 under the EPA's Nationwide Urban Runoff Program (NURP) sampled 28 projects which included 81 sampling sites, and more than 2,300 separate storm events. This study reported the following mean concentrations of soluble phosphorus: 143 µg/l for residential lands uses with 0.46 coefficient of variation (COV); 56 µg/l for mixed lands uses with 0.75 COV; 80 µg/l for commercial lands uses with 0.71 COV; and 26 µg/l for open non-urban lands uses with 2.16 COV.

Control options

Control description	Range of effectiveness	Cost	Comments
Septic Tank Elimination Program	2 to 14 lbs per day into the aquifer	Program funded at $75 million over 20 years – now in the last 6 years	Original commitment was to remove all designated tanks within the urban growth area by 2015 (currently ahead of schedule, but may be delayed until additional treatment capacity is brought online). An estimated additional 10,000 septic tanks will be eliminated
Dish detergent phosphorus ban – would impact remaining septic tanks	8 % to15% of the p that would reach the aquifer from septic tanks	Unknown	
Education – garbage disposal and/or composting education to reduce organic material contribution to septic tanks	1% ††	Unknown	

Street sweeping - It is recommend to sweep streets monthly using dustless air regenerative equipment. Currently, the City of Spokane Valley budgeted $430,000 for street sweeping in 2005. Our current budget allows sweeping arterials twice annually and residential streets annually. The additional budget should allow street sweeping on a monthly	Unknown	$300,000 additional per year	According to Ecology Stormwater Management Manual for Eastern Washington (SMMEW), high efficiency vacuum sweepers have the capability of removing 80 percent or more of the accumulated street dirt particles whose diameters are less than 250 microns (Sutherland 1998). In addition, it is reported that regenerative air sweepers and tandem sweeping operations (mechanical sweeper followed by a vacuum sweeper) have the capability of removing 25 to 50 percent of dirt particles smaller than 250 microns. This assumes reasonably expected accumulated conditions and pavements that are in good condition. basis 9 times a year.
Ditch, Catch Basin & Drywell cleaning: excessive runoff velocities can lead to ditch erosion and sediment deposition. Catch basins and drywells naturally accumulate sediment and debris.	Unknown	$200,000 additional per year	The SMMEW indicates that roadside catch basins can remove from 5 to 15 percent of the pollutants present in the stormwater. However, they don't perform well when catch basins are about 60 percent full of sediment. Vactor Trucks can be utilized to clean structures from March to November
Vegetation Maintenance: Grassed filter strips, swales, and bioretention facilities require periodic vegetation maintenance to enhance performance. Grassed filter strips and swales require a dense stand of vegetation in order to function properly and to prevent export of sediment from unstabilized planting areas.	Unknown	$25,000 additional per year	Several seasons of planting and re-seeding of sparsely vegetated areas may be needed in order to reach optimum performance. Grassed filter strips and vegetated swales require periodic mowing to remove excess vegetation and stored nutrients.
Provide Treatment or Catchbasin prior to drywell disposal	Unknown	$300,000 per year	The SMMEW reports that bioinfiltration swales are expected to achieve a goal of 50% total phosphorus

In our region, little or no runoff treatment takes place prior to runoff entering the drywells or infiltrating into the ground.			removal when designed, maintained, and operated per the SMMEW. Recommend installation of bioinfiltration swales to treat roadside runoff whenever practicable and use engineering soils. When not feasible to provide vegetative BMPS, install catchbasins prior to drywell disposal.
† HDR breakthrough analysis †† Educated estimate Sources: Washington Department of Ecology (2004), Chapter 8 in the, Stormwater Management Manual for Eastern Washington, Publication 03-10-076 Environmental Protection Agency (99), Preliminary Data Summary of Urban Stormwater Best Management Practices, Chapter 4, EPA-821-R-99-012			

Next Steps

1. Complete the Septic Tank Elimination Program by Spokane County, which is being impacted by the need for treatment plant capacity.
2. Consider implementation of regional phosphorus ban in dish washing detergent.
3. Education program regarding loading to septic tanks from garbage disposals.
4. Completion of a detailed non-point source study to evaluate the loads from non-point sources, control measures and development of an implementation plan.

Stormwater
(City of Spokane separated storm system)

Current Conditions

Total Phosphorus Load: 16 pounds

Comments on the load: The primary load estimates for Stormwater are derived from the "Stormwater Management Plan March 2004" table 3.9 (5,774 lbs/year ÷ 365 days = 16 lbs/day). While this calculation does not account for seasonal variation (which is likely significant), 16 lbs/day also matches the draft TMDL document Figure 10. As for Combined Sewer Overflow (CSO), the Workgroup suggests that CSO be considered a relatively small contribution since overflow volumes are much lower in the (drier) critical period. Furthermore, federally mandated improvements will result in CSO system storage capacity to be built that reduces overflows to one event per year, per outfall. This will likely further reduce overflows during the critical period.

Control options

Control description	**Range of effectiveness**	**Cost**	**Comments**
P reduction in fertilizer- allow only maintenance levels of phosphorus (a ratio of Nitrogen-Phosphorus-Potassium of 4-1-2 or less) to keep P below saturation levels[†]	Unknown	Unknown	Phosphorus in fertilizer generally does not leach into the ground water, but is taken up by root systems; P usually enters the watershed by runoff. If soils have sufficient natural P levels, a fertilizer at the proper ratio will prevent oversaturation which is more prone to runoff. Similar actions elsewhere in Washington state and Minnesota provide exceptions to the rule for new lawns, gardens, and commercial applications. Note, this would effectively ban organic fertilizers; however, reduced P fertilizer is commonly available. [†]
Ban on phosphorus in fertlizer	0%-19% net impact (Carpenter)	Unknown	Banning phosphorus in fertilizer would eliminate P runoff from fertilizer. It may, however, be unnecessarily aggressive [†], or a possible detriment.
Education/Outreach - educate non-commercial fertilizer users to prevent mis-application.	Unknown	Unknown	The greatest risk for surface water contamination from fertilizer P is probably due to (mis)application to impervious surfaces in the vicinity of the lawn. It is essential to sweep or blow fertilizer back into the turf area

			when this happens. †
Add swales to drainage areas – filters stormwater through grassy depressions equipped with an overflow for large storms	Up to 90% of P that enters is removed by swales	Unknown	Filter out many pollutants and aids in reducing road problems (puddling)
Street Sweeping & Leaf Pickup- removes organic material that would otherwise make it to the stormwater system.	Up to 42% reduction (sweeping once a week)	Unknown	
Construction BMPs- establish buffer areas and BMPs to reduce runoff at constructions sites.	Unknown	Unknown	
Weed Control- removes the biomass that can wash into the stormwater system.	Unknown	Unknown	
Doggie Dootie Stations – particularly at waterside parks or recreation areas.	Unknown	Unknown	Encourages owners to pick up after their pets and aids in education.
Waterfowl-particularly at Riverfront Park*	Unknown	Unknown	Post signs discouraging the feeding of waterfowl (and why), clean up of guano should include pick up not spray down or sweeping into river. Removal of "problem species" if necessary.

*Pounds not yet determined
† Miltner, Eric. *Phosphorus Fertilization of Turfgrass and Potential Impacts on Water Quality*. Whitepaper 2005.

Other sources include:
City of Spokane "Combined Sewer Overflow Reduction Plan January 1994"
City of Spokane "Stormwater Management Plan March 2004"
"Expert Input Regarding Dane County Phosphorus in Lawn Fertilizer Ordinance: Complete Responses to Questions" Dane County Lakes and Watershed Commission 11/13/03 http://www.danewaters.com/pdf/20031124_phosphorus_expert_responses.pdf

Next Steps

1. Continue implementing City of Spokane wet weather program
2. Ecology issues NPDES Phase II Municipal Stormwater Permit (2006?)
3. Will seek to differentiate CSO and Stormwater Phosphorus contribution