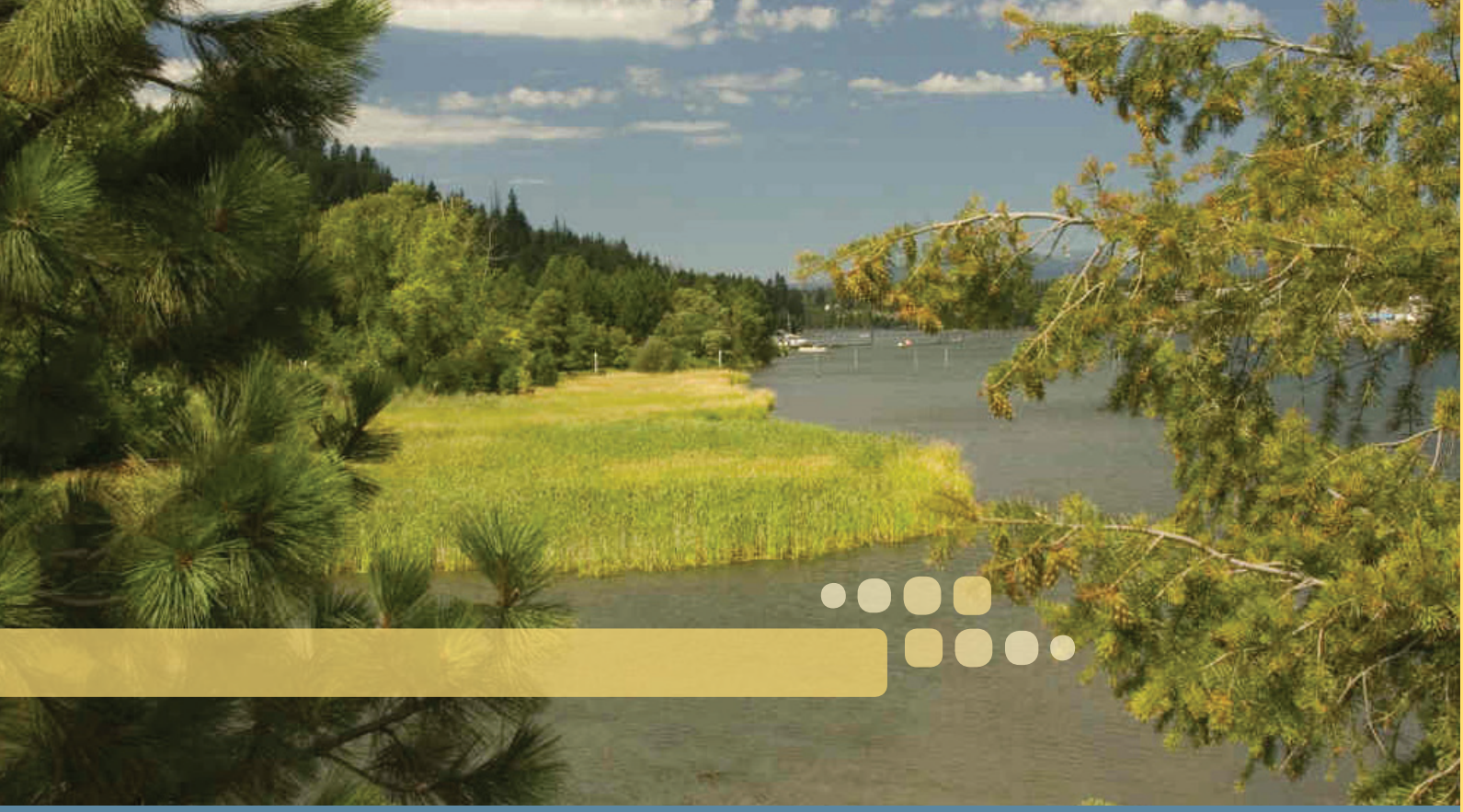

SPOKANE RIVER WATERSHED

Nonpoint Source Phosphorus Reduction Plan

August 2011 Draft

GeoEngineers

Hubbard Gray Consulting, Inc

HDR Engineering, Inc.

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List of Acronyms

ASA – Aquifer Sensitive Area

BASINS – Better Assessment Science Integrating Point and Nonpoint Sources

BMP – Best Management Practice

CAFO – Confined Animal Feeding Operation

CARA – Critical Aquifer Recharge Area

CBOD – Carbonaceous Biochemical Oxygen Demand

CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act

CWA – Clean Water Act

DEM – Digital Elevation Model

DEQ – Idaho Department of Environmental Quality

DO TMDL – Dissolved Oxygen Total Maximum Daily Load

EPA – Environmental Protection Agency

EQUIP – Environmental Quality Incentives Program

FERC – Federal Energy Regulatory Commission

FSA – U.S. Department of Agriculture Farm Service Agency

GIS – Geographic Information System

HUC – Hydrologic Unit Code

LA – Load Allocation

LID – Low-Impact Development

LMP – Lake Management Plan

MGD – Million Gallons per Day

MOS – Margin of Safety

MS4 – Municipal Separate Storm Sewer Systems

NHD – National Hydrography Dataset

NLCD – National Land Cover Dataset

NPAC – Nonpoint Source Advisory Committee

NPDES – National Pollutant Discharge Elimination System

NPS – Nonpoint Source

NRCS – Natural Resources Conservation Service

PCB – Polychlorinated Biphenyl

QAPP – Quality Assurance Project Plan

SCCD – Spokane County Conservation District

SMZ – Streamside Management Zone

STEP – Septic Tank Elimination Program

SVRP – Spokane Valley Rathdrum Prairie (Aquifer)

TBD - -To Be Determined

TMDL – Total Maximum Daily Load

USGS – United States Geological Survey

WLA – Wasteload Allocation

WQAP – Water Quality Attainment Plan

WQIP – Water Quality Implementation Plan

WRIA – Water Resource Inventory Areas

WSDA – Washington State Department of Agriculture

WSDOT – Washington State Department of Transportation

WWTP – Wastewater Treatment Plant

WWTF – Wastewater Treatment Facility

Using this Plan

This Nonpoint Source Reduction Plan (NPS Reduction Plan) is expected and intended to be used as a resource document for achieving nonpoint source phosphorus reductions and returned to for frequent reference throughout the implementation phases.

Based on individual, agency and organizational needs, interests and situations, it is anticipated that different chapters of this plan will be referenced for specific information and recommendations. Since this NPS Reduction Plan is a summary of an extensive effort to examine nonpoint source phosphorus pollution within the Spokane River Watershed, it is a detailed and lengthy document. This section is meant to orient the reader to the layout of the document and provide suggestions on how to readily find information applicable to each reader's interest and situation.

Much of this NPS Reduction Plan as detailed in Chapters 1 through 8 provides the foundation for the recommended activities in Section 5 of Chapter 9 and Sections 5 of each subbasin Chapters 10 through 19. The intent is for individuals, agencies, and organizations to execute these activities and put the plan into practice locally by taking action, implementing best management practices (BMPs) and executing the recommendations as they pertain to each subbasin.

Document Layout

The NPS Reduction Plan has three major parts:

- Background Information, Research and Assessments (Chapters 1 through 8).
- Subbasin-Specific Recommended Actions and BMPs (Chapters 9 through 19).
- Considerations Associated with Implementing Actions (Chapter 20).

Chapter Organization

For the three major parts, the contents of the chapters are described as follows.

Chapters 1 through 8 – Background Information and Summary of Nonpoint Source Phosphorus Study Research and Assessments

Information in Chapters 1 through 8 summarizes Spokane River Watershed: 1) background information relating to nonpoint source phosphorus issues; and 2) work completed under the Bi-State Nonpoint Source Phosphorus Study, 2001 through 2011. This information was considered and provides the foundation for nonpoint source phosphorus reduction recommendations described in Chapters 9 through 18 that focus on "what" actions to take and "where" to implement them. The chapters include:

- Chapters 1 and 2 – Background and issues; summary of nonpoint phosphorus sources, loads and load allocations.
- Chapter 3 – Assessment of land use and nonpoint sources of phosphorus at the subbasin level.

- Chapter 4 – Assessment of existing information and data; development of nonpoint source phosphorus database for Spokane River Watershed; prioritization of sources and subbasins.
- Chapter 5 – Field reconnaissance and data collection to fill high priority data gaps in the Little Spokane and Lower Spokane River subbasins.
- Chapters 6 and 7 – Advanced analysis of surface water and groundwater to assess nonpoint source phosphorus distribution and loading.
- Chapter 8 – Identification of nonpoint source phosphorus control measures and BMPs; prioritization of applicable BMPs for the Spokane River Watershed.

Chapters 9 through 19 – Spokane River Watershed Subbasin-Specific Recommendations for Nonpoint Source Phosphorus Reduction

Chapter 9 provides applicable nonpoint source phosphorus reduction recommendations and activities that should be considered for all Spokane River Watershed subbasins. Chapters 10 through 19 provide subbasin-specific considerations and recommendations regarding nonpoint source phosphorus reduction. Chapter 9 recommendations should be considered in tandem with subbasin-specific recommended actions. Where applicable, other chapters are referenced, including Chapter 8 for information about BMPs referenced in the recommendations. The chapters include:

- Chapter 9 – Nonpoint source phosphorus management considerations, priorities, regulatory authorities, strategy and recommended actions applicable to all Spokane River Watershed subbasins.
- Subbasin-specific nonpoint source phosphorus management strategy and recommendations related to "what" actions to take and "where" to implement them.
  - Chapter 10 – Lower Spokane River Subbasin.
  - Chapter 11 – Upper Spokane River, WA Subbasin.
  - Chapter 12 – Little Spokane River Subbasin.
  - Chapter 13 – Hangman Creek Subbasin.
  - Chapter 14 – Upper Spokane River, ID Subbasin.
  - Chapter 15 – Coeur d'Alene Lake Subbasin.
  - Chapter 16 – Upper Coeur d'Alene River Subbasin.
  - Chapter 17 – South Fork Coeur d'Alene River Subbasin.
  - Chapter 18 – St. Joe River Subbasin.
  - Chapter 19 – Pend Oreille Lake Subbasin.

Chapter 20 – Considerations Associated with Implementing Spokane River Watershed Nonpoint Source Phosphorus Reduction Actions

This NPS Reduction Plan is intended to identify "what" actions are needed and "where" to implement them. It is not intended to describe "how" or "when" to implement the actions. The intent of Chapter 20 is to provide references, information and recommendations relating to

implementation and to serve as a starting point for agencies, stakeholders and property owners considering implementation of nonpoint source phosphorus reduction actions and BMPs. This part of the report includes:

- Chapter 20 – Implementation considerations including funding sources, long-term monitoring of phosphorus, adaptive management and reasonable assurances.

Executive Summary

Current water quality conditions in portions of the Spokane River Watershed do not meet Washington State water quality standards. Specifically, dissolved oxygen in Lake Spokane is impaired due to excessive nutrients, particularly total phosphorus, which causes aquatic growth and decay. As a result, nutrients delivered from the Spokane River Watershed need to be reduced. Reductions in both point and nonpoint source phosphorus are necessary to improve water quality conditions.

The Spokane River Watershed Phosphorus Nonpoint Source Reduction Plan (NPS Reduction Plan) provides a historical perspective of nonpoint source phosphorus issues and documents the extensive efforts of the Bi-State Nonpoint Source Phosphorus Study (NPS Study) to examine nonpoint source phosphorus within the watershed. Most importantly, it provides a framework for nonpoint source phosphorus reduction.

The NPS Reduction Plan

- Recommends actions to reduce nonpoint source phosphorus.
- Provides a list of actions and BMPs by subbasin and category for reducing nonpoint source phosphorus.
- Identifies land use, areas, and land owners at the subbasin level to highlight potential nonpoint sources of phosphorus.
- Suggests who should take the next steps to identify local projects (actions) that would reduce nonpoint source phosphorus.

Nonpoint source phosphorus pollution is any unconfined and diffuse source of phosphorus that enters the water from any dispersed land-based or water-based activities, including but not limited to atmospheric deposition, surface water runoff from agricultural lands, urban areas, or forest lands, and subsurface or underground discharge. Nonpoint source pollution is controlled using a combination of regulatory and non-regulatory management programs and implementation actions.

The NPS Reduction Plan provides answers to the following key questions:

- ‘What’ should be done to reduce nonpoint source phosphorus?
- ‘Where’ reductions of nonpoint source phosphorus should be focused?

The answers to these questions provide crucial information that will help decision makers take action. Actions are the steps taken, from planning through achievement, to reduce nonpoint source phosphorus reduction. BMPs are the core of the action; whereas actions themselves encompass the entire process from the identification of the targeted source to the selection and implementation of the BMP through post monitoring. BMPs for addressing nonpoint sources of phosphorus include structural (i.e., physical) and non-structural (i.e., educational) measures.

A range of interested parties may use and apply the NPS Reduction Plan in a variety of ways. Based on individual, agency and organizational needs and interests, it is anticipated that different

chapters of the NPS Reduction Plan will be referenced for specific information and recommendations. The NPS Reduction Plan organization includes:

- Chapters 1 through 8 – Background information and summary of nonpoint source phosphorus study research and assessments.
- Chapters 9 through 19 – Spokane River Watershed subbasin-specific recommendations for nonpoint source phosphorus reduction.
- Chapter 20 – Considerations associated with implementing Spokane River Watershed nonpoint source phosphorus reduction actions.

The section, **Using this Plan,** provides additional information about the organization of the NPS Reduction Plan and is intended to assist users to navigate directly to the pertinent section(s) of interest.

Recommendations: Subbasin-Specific Actions and BMPs

Achieving water quality targets identified by the Washington State Department of Ecology (Ecology) will be challenging and require participation by numerous organization in the Spokane River Watershed. Every acre of the landscape does not need to be saturated with multiple BMPs. However, a significant portion of the watershed will need BMPs, requiring a high level of engagement and substantial action by stakeholders.

Based on Ecology's target reductions and an average cost for the priority BMPs of $320/pound of phosphorus reduced (see Chapter 8), approximately $1.5 million of public and private funds will need to be spent annually on BMPs (Chapters 10 through 19). This total expenditure will be divided across organizations and land owners throughout the watershed. Additional funding will be necessary for studies, designs, grant writing, administration, operation and maintenance, monitoring, reporting, and collaborative meetings. Overall expenditures may be reduced by combining funds for multiple purpose projects that directly, indirectly, or with modification reduce nonpoint source phosphorus. Actions identified in other plans and supported by the NPS Reduction Plan are identified under the heading *Supporting Existing and Planned Activities* (Chapters 9 through 19).

Expenditures to reduce nonpoint source phosphorus will not only improve water quality, but also provide benefits for drinking water, fisheries, recreation, habitat, aesthetics, soil conservation, reduced flooding potential, food production, reduced energy consumption, and reduction of other pollutants (Chapter 9). Available funds may be spent to take the recommended actions or implement BMPs immediately. Additionally, since the NPS Study was conducted at the subbasin scale, recommended actions or BMPs of interest may need locally specific project feasibility studies or designs to be completed first. The number of subbasin-specific recommended actions described in Chapters 9 through 19 is summarized in Table 1.

Table ES-1. Number of Identified Actions and BMPs Recommended by Subbasin

Subbasin	Chapter	Regional Phosphorus Management	Agriculture Related Activities	Forestry Related Activities	Range Related Activities	Urban/Suburban Related Activities	Support Existing and Planned Activities	Supporting Phosphorus Reduction Activities	Additional Activities
Spokane River Watershed	9	4	-	-	-	-	-	2	3
Lower Spokane River	10	-	5	6	1	11	4	-	2
Upper Spokane River WA	11	-	5	6	1	11	4	-	4
Little Spokane River	12	1	5	6	1	11	6	-	3
Hangman Creek	13	-	6	6	1	12	6	1	2
Upper Spokane River ID	14	-	5	4	1	13	5	-	3
Coeur d'Alene Lake	15	-	5	5	1	13	4	-	3
Upper Coeur d'Alene River	16	-	-	5	1	-	2	-	1
South Fork Coeur d'Alene River	17	-	-	4	1	12	3	-	1
St. Joe River	18	-	-	4	1	13	1	-	1
Pend Oreille Lake	19	-	-	4	1	11	3	-	2

Over 100 BMPs were identified for potential use to reduce nonpoint source phosphorus in the Spokane River Watershed (Chapter 8). The list was prioritized based on the greatest reduction efficiency, at the lowest cost, with the greatest estimated longevity and implementation effectiveness. The result was 22 priority BMPs. Of the 22 priority BMPs, the four highest prioritized BMPs are:

- Riparian Zones and Buffer Strips.
- Stream Bank Stabilization.
- Streamside Management Zones.
- Vegetated Buffer/Filter Strips.

The review and prioritization of BMPs provided the recommendations for 'what' should be done to reduce nonpoint source phosphorus. While different BMPs may apply and be selected when taking recommended actions, the high priority BMPs are referenced in the recommended actions in Chapters 10 through 19.

Over thirty analytical methods and tools were identified that sufficiently met the model selection criteria for examining nonpoint source phosphorus throughout the Spokane River Watershed. The PLOAD model, which is part of EPA's BASINS software, was selected. PLOAD was used to prioritize land uses and sub-subbasin areas. The PLOAD analysis identified the following land uses as typically yielding the greatest phosphorus loads:

- Range and barren land.
- Agricultural land; including cropland and pasture, and other agriculture and agricultural associated facilities.
- Urban/suburban land; especially commercial and service, and parks and other urban open spaces.

While there are recommended actions for each of the land uses, the actions are described by subbasin in Chapters 10 through 19. The review and analysis using PLOAD provided the recommendations for 'where' nonpoint source phosphorus reductions should take place.

Findings: Background Information and Research

The NPS Reduction Plan recommendations are based on findings from the NPS Study, which included:

- Literature reviews.
- Compilation of phosphorus data in the NPS Database.
- Land use characteristics and considerations (Chapter 3).
- Field monitoring of two previously unmonitored areas (Chapter 5).
- Analyses and assessments (Chapter 4), as well as advanced analyses and PLOAD modeling (Chapters 6 and 7).
- BMP research and prioritization (Chapter 8).

Each of these led to the next steps in the NPS Study by providing critical insights and the basis for the recommendations. Phosphorus loading rates of 0.005 to 0.5 lbs/ac/yr in groundwater discharge areas and 0.01 to 0.5 lbs/ac/yr in surface water runoff were computed. The field monitoring in the Deep/Coulee Creek and Deadman/Little Deep Creek drainages was completed for a two month period. Extrapolating this limited dataset yields similar phosphorus loading rates of 0.01 to 0.2 lbs/ac/yr. The analyses suggested that groundwater-based total phosphorus loading directly to Lake Spokane is significant. The late spring is usually when the greatest total phosphorus loads throughout most of the watershed occur. Geographic proximity to Lake Spokane and nearshore to waterbodies were determined to be priorities for nonpoint phosphorus source reductions. However, this does not preclude the need or benefit of reducing possible and practical nonpoint sources of phosphorus in other areas throughout the watershed.

Execution: Considerations Associated with Actions

Additional considerations beyond taking actions or implementing BMPs are required for the successful long-term reduction of nonpoint source phosphorus. These considerations include: potential funding sources, measuring progress, and adaptive management (Chapter 20). Potential funding sources including federal, state, and other sources are identified to provide avenues for meeting the anticipated expenditures needed. Measuring progress includes tracking of actions and performance monitoring of BMPs to evaluate the magnitude of nonpoint source phosphorus reduction. Adaptive management provides a means to adjust priorities and recommendations based on findings from measuring progress.

Vision: Improved Watershed Management and Water Quality

The NPS Reduction Plan is one of many components associated with water quality improvements in the Spokane River Watershed. The Spokane River and Lake Spokane Dissolved Oxygen TMDL (Spokane River DO TMDL) includes a Managed Implementation Plan section that describes many of the additional actions that will be implemented to reduce nutrients and improve dissolved oxygen in Lake Spokane. Meeting the Spokane River DO TMDL nutrient reduction requirements, from both point and nonpoint sources, will be challenging and require concerted efforts and funding from numerous stakeholders. For the vision to be achieved, organizations and stakeholders will need to stay focused, collaborate and implement actions and BMPs over a relatively short time-frame, as depicted in Figure ES-1.

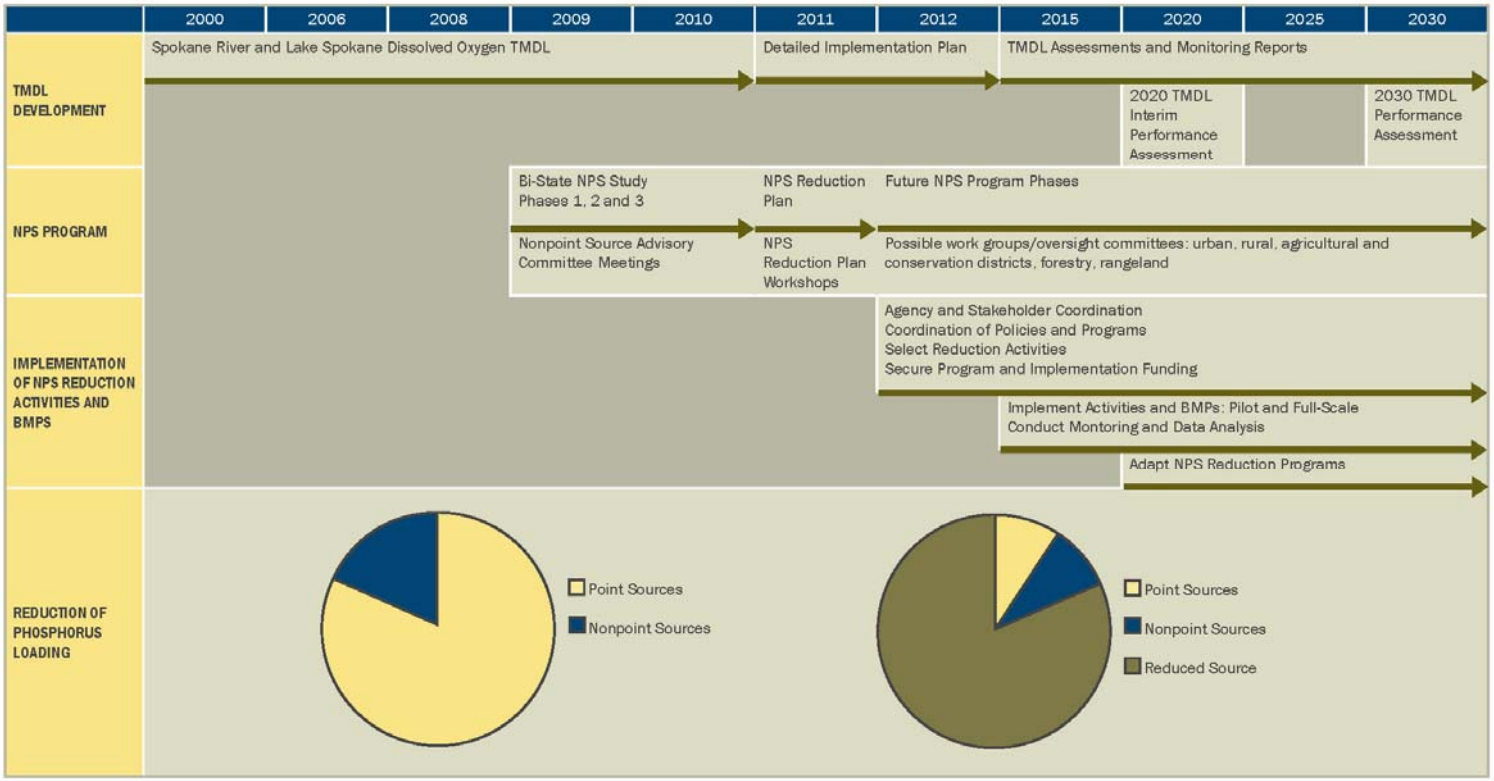

Figure ES-1. Vision for Improved Spokane River Watershed Management and Water Quality

Chapter 1

Spokane River Watershed Nonpoint Source Phosphorus Background and Issues

1.1 Introduction

Current water quality conditions in portions of the Spokane River Watershed do not meet Washington State water quality standards during all times of the year. Specifically, dissolved oxygen levels in Lake Spokane (also known as Long Lake) are seasonally impaired because of excessive nutrient loading, particularly total phosphorus, which facilitates aquatic growth and decay. To bring dissolved oxygen conditions into compliance with State water quality standards, nutrients delivered from the Spokane River Watershed need to be reduced. Reductions in both point and nonpoint source phosphorus are necessary to improve water quality conditions.

The Spokane River and Lake Spokane Dissolved Oxygen Total Maximum Daily Load (Spokane River DO TMDL): Water Quality Improvement Report, approved by the U.S. Environmental Protection Agency (EPA) on May 20, 2010, establishes wasteload allocations to mitigate low dissolved oxygen conditions, excessive algae blooms and degradation of water quality in the Spokane River and Lake Spokane. The Spokane River DO TMDL establishes wasteload allocations for ammonia, total phosphorus and carbonaceous biochemical oxygen demand (CBOD); considers the cumulative dissolved oxygen impacts from all point sources in both Idaho and Washington; considers nonpoint sources of phosphorus; and assigns a dissolved oxygen responsibility to Avista Utilities for the operation of the Long Lake Dam hydroelectric facility.

During the development of the Spokane River DO TMDL, the need for a Bi-State Nonpoint Source Phosphorus Study (NPS Study) was identified as a step in the process toward nonpoint source phosphorus load reductions in the Spokane River Watershed. The study area for the NPS Study includes subbasins draining to Coeur d'Alene Lake, the Spokane River and its tributaries Hangman Creek (also known as Latah Creek) and Little Spokane River, and Lake Spokane (Figure 1-1).

The NPS Study began in 2009, administered by Spokane County and funded by EPA (Phase 1) and the Washington State Department of Ecology (Ecology) (Supplemental Phase 1 and Phases 2 and 3). Existing studies and data were compiled in a project database and analyzed to understand data availability and watershed conditions. The NPS Study also included an exploration of potential control measures and management strategies for nonpoint source phosphorus. These tasks led to the identification of possible opportunities for nonpoint source reduction and provided the foundation for this report. Results of the various assessments completed for the NPS Study are summarized and referenced in this Nonpoint Source Phosphorus Reduction Plan (NPS Reduction Plan). The NPS Reduction Plan represents the final report for the NPS Study and includes:

- Chapters 1 and 2 – Background and linkages to the Spokane River DO TMDL.

- Chapter 3 – Assessment of land use and nonpoint sources of phosphorus.
- Chapter 4 – Assessment of existing information and data.
- Chapter 5 – Field data collection to fill high priority data gaps.
- Chapters 6 and 7 – Advanced analysis of surface water and groundwater.
- Chapter 8 – Identification and prioritization of phosphorus control measures and best management practices (BMPs).
- Chapters 9 through 19 - Subbasin management strategies and actions for land owners, regulatory agencies, and stakeholders.
- Chapter 20 – Implementation considerations, including potential funding opportunities, long-term monitoring of phosphorus, and adaptive management.

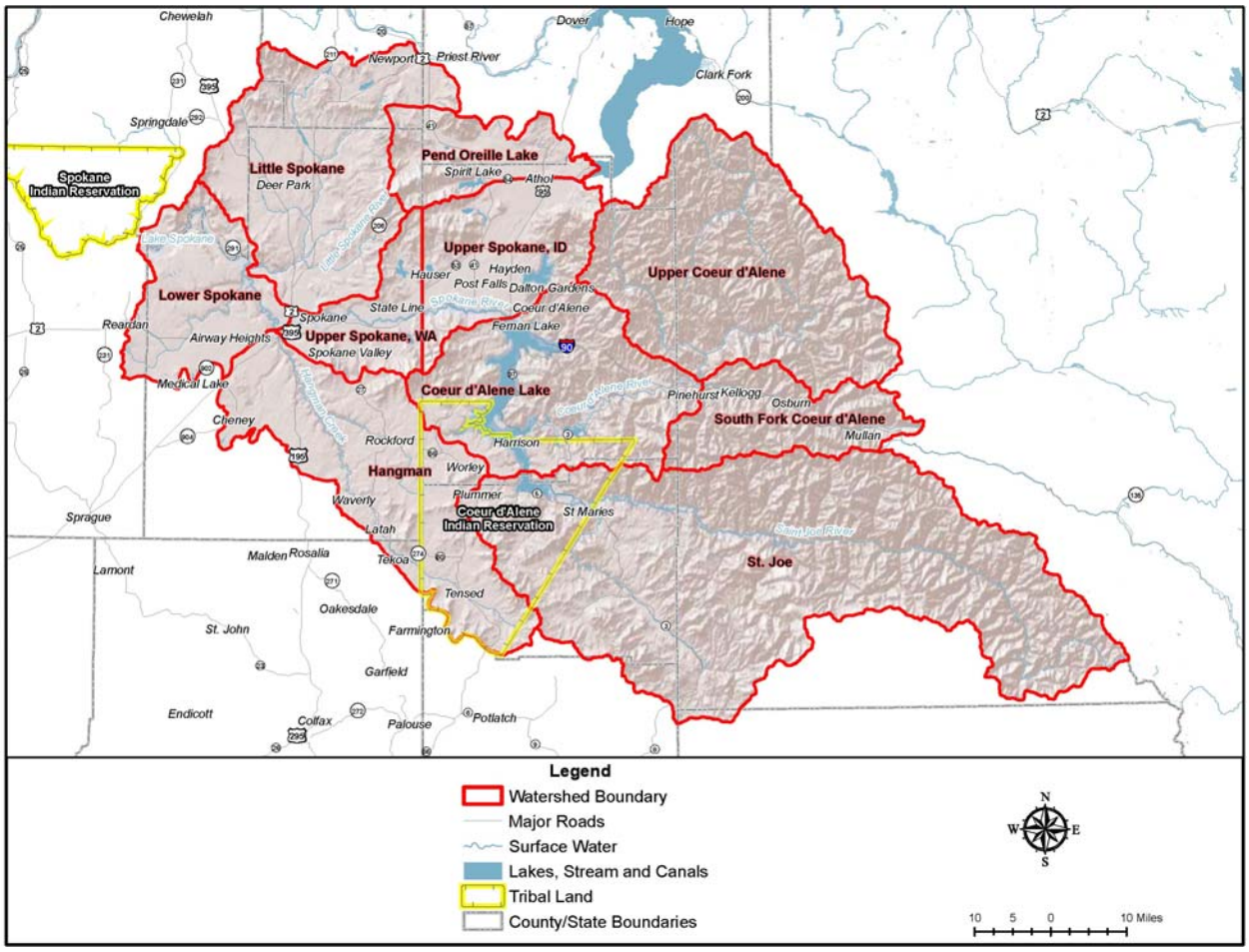

Figure 1-1. Map of the Spokane River Watershed (Project Study Area)

1.2 Background

The following sections provide background information on water quality conditions in the Spokane River and Lake Spokane and development of the Spokane River DO TMDL.

1.2.1 Spokane Watershed Water Quality Considerations

Lake Spokane experiences low dissolved oxygen concentrations (Ecology, 2010). Eutrophication of the lake has been one of the major water quality concerns for the past 40 years (Cunningham, 1969; Soltero et al., various dated between 1973—1986; Singleton, 1981; Wagstafff and Soltero, 1982). Eutrophication is a process where excess aquatic plant growth occurs in a water body due to high nutrient levels. This plant growth can reduce the oxygen in the water to levels that are harmful for fish. Aquatic plants reduce oxygen levels in a water body in two ways: during the night when they respire and consume oxygen, and during their decomposition when biological processes consume oxygen to decay plant organic material.

Toxic algae blooms that occurred in Lake Spokane in the 1970s resulted in a court ordered phosphorus TMDL and the development of the 1989 Phosphorus Management Plan. The initial focus of the phosphorus TMDL was on preventing toxic blue-green algae blooms by requiring dischargers to reduce effluent phosphorus levels. During subsequent years, dissolved oxygen concentrations in Lake Spokane continued to be below Washington's water quality standards. These violations of water quality standards have resulted in the conclusion that beneficial uses continue to be impaired seasonally in some water body segments of the Spokane River and Lake Spokane (Ecology, 2008a), which require development of a Spokane River DO TMDL.

The 2008 303(d) listings for the Spokane River and Lake Spokane are shown in Table 1-1.

Table 1-1. Study area water bodies on Washington's 2008 303(d) list

Water Body	Parameter	Medium	2008 303(d) Listing ID	Township	Range	Section
Lake Spokane (Long Lake)	Dissolved Oxygen	Water	40939	27N	40E	15
Spokane River	Dissolved Oxygen	Water	15188	26N	42E	17
Spokane River	Dissolved Oxygen	Water	17523	25N	43E	02
Spokane River	Dissolved Oxygen	Water	15187	25N	43E	18
Spokane River	Dissolved Oxygen	Water	11400	25N	46E	06
Spokane River	Total Phosphorus[1]	Water	6373	26N	42E	07

[1] Total phosphorus is listed in Category 4A on the Washington Water Quality Assessments due to the total phosphorus TMDL completed in 1992. The Spokane River DO TMDL includes a revision of the allocations established in the original total phosphorus TMDL (Ecology, 2010).

1.2.2 Spokane River DO TMDL Development

The Clean Water Act (CWA) established a process to identify and clean up polluted waters. States set designated uses, also referred to as beneficial uses, to state waters to protect aquatic life, recreational, and water supply. Water quality standards are developed to protect, restore, and preserve the water quality necessary to meet these designated uses. Under section 303(d) of the CWA, states are required to evaluate their water bodies (including lakes, rivers, streams, or

marine waters) and their designated uses. Water bodies that do not meet water quality standards are identified as impaired and included on the CWA 303(d) list. Ecology uses the 303(d) list to prioritize and initiate TMDL studies across the state. The Spokane River and Lake Spokane are included on the 303(d) list and identified as polluted waters that require a TMDL.

Since the late 1990s, Ecology worked with area stakeholders to develop a strategy to address the algae blooms and low dissolved oxygen conditions in Lake Spokane. Development of the Spokane River DO TMDL went through several drafts and subsequent rounds of analyses using the CE-QUAL-W2 model. CE-QUAL-W2 is a 2-dimensional hydrodynamic and water quality model developed by the U.S. Army Corps of Engineers and Portland State University to simulate eutrophication processes in rivers and reservoirs.

Agencies and stakeholders involved with the development of the Spokane River DO TMDL included Ecology, the Idaho and Washington dischargers, local governments, the Idaho Department of Environmental Quality (DEQ), EPA, the Spokane Tribe, environmental groups, and Avista Utilities. The Idaho dischargers are the City of Coeur d'Alene, the City of Post Falls, and the Hayden Area Regional Sewer Board. The Washington dischargers are Liberty Lake Sewer and Water District, Inland Empire Paper, Kaiser, and the City of Spokane. Spokane County is constructing a new water reclamation facility and also participated.

Initial drafts of the Spokane River DO TMDL contained stringent wasteload allocations. Subsequent drafts accounted for nonpoint pollution sources; anticipated that pollutant trading might be used to help dischargers meet their load allocations; considered Avista Utilities' responsibility for impacts caused by Long Lake Dam; and made assumptions regarding the impact of Idaho dischargers.

The final Spokane River DO TMDL, approved by EPA on May 20, 2010, includes wasteload allocations for the Washington dischargers, load allocations for the nonpoint sources, presumed reductions by the Idaho dischargers, and improvements that Avista Utilities will make to mitigate the effect of Long Lake Dam. The Spokane River DO TMDL includes a Managed Implementation Plan which references this NPS Reduction Plan.

1.3 Purpose

The purpose of the NPS Reduction Plan is to answer the following questions within the Spokane River watershed (in both Idaho and Washington) for both surface and groundwater at the watershed and subbasin scale.

- "Where" are significant nonpoint sources of phosphorus?
- "What" actions may reduce phosphorus from these nonpoint sources?

This NPS Reduction Plan represents a step within the process of reducing nonpoint source phosphorus loads within the Spokane River Watershed. The NPS Reduction Plan is intended to serve as a roadmap or starting point for entities selecting where to target reductions and what measures to use. As part of the Spokane River DO TMDL implementation, it is anticipated that specific entities will take action to reduce nonpoint source phosphorus. Entities may need to then develop more specific plans that clarify "where" and "what" actions should be taken at a local scale and add "how" and "when" BMPs will be implemented.

1.4 Phosphorus Control Approach

The Spokane River DO TMDL includes a Managed Implementation Plan, which describes what will be done to improve water quality for the Washington State portion of the Spokane River (Ecology, 2010). Since the Idaho portion of the Spokane River Watershed is upstream of Lake Spokane, phosphorus reductions activities will also be necessary. The Managed Implementation Plan will become part of a detailed water quality implementation plan (WQIP) which will describe and prioritize specific actions planned to improve water quality and achieve water quality standards. The goals are to reduce phosphorus in the Spokane River and Lake Spokane from March through October to meet water quality standards. The approach includes reducing phosphorus loads from point sources, stormwater discharges, and nonpoint sources.

The Spokane River DO TMDL Managed Implementation Plan recognizes that the NPS Study identifies opportunities for nonpoint phosphorus reductions. Identifying reduction opportunities is a cornerstone of the regional nonpoint source reduction program. The program will include routine monitoring to identify cost-effective strategies and verification of actual phosphorus reductions. The monitoring will provide information to shift resources to other more effective actions for phosphorus reduction providing a long-term adaptive management approach. Successful phosphorus-reducing actions funded by the dischargers through this program may be recognized as contributing toward achieving dischargers' phosphorus wasteload allocations, provided that actions either reduce pollutants in the influent or meet the criteria as an offset. Ecology will manage the program and approve actions and offsets in Washington. DEQ and EPA will coordinate management of the program and approve actions in Idaho. In the process, Ecology, DEQ and EPA will continue to coordinate and monitor progress.

Ecology will consider the information and recommendations for nonpoint source phosphorus reduction contained in this NPS Reduction Plan as the detailed WQIP is developed. In addition, Ecology will use adaptive management to assess whether the actions necessary to solve the identified pollution problems are the correct ones and whether they are working (Ecology, 2010).

1.5 Watershed Description

The watershed description below provides an overview of the Spokane River Watershed. Subbasin-specific descriptions are included in Chapter 3 and provide additional detail with respect to the following subbasin characteristics:

- Location.
- Size.
- Topography.
- Hydrology.
- Water Quality conditions.
- Land Use.

These characteristics were used to evaluate phosphorus nonpoint sources, identify potential BMPs, and develop management strategies and actions presented in later chapters. For example, location and distance from Lake Spokane relates to the timing and amount of nonpoint source

phosphorus reaching the reservoir; land uses are associated with potential phosphorus export; and hydrology relates to delivery mechanisms and loading, such as higher loads during spring snowmelt.

1.5.1 Study Area

The study area for the NPS Study and this NPS Reduction Plan consists of the Spokane River Watershed upstream of Long Lake Dam (see Figure 1-1) and includes the entire contributing area that drains to Coeur d'Alene Lake and Lake Spokane. The study area includes ten subbasins (in general downstream to upstream order)

- Lower Spokane River.
- Upper Spokane River WA.
- Little Spokane River.
- Hangman Creek.
- Upper Spokane River ID.
- Pend Oreille Lake.
- Coeur d'Alene Lake.
- Upper Coeur d'Alene River.
- South Fork Coeur d'Alene River.
- St. Joe River.

The Spokane River Watershed is in the Columbia River Basin and drains an area of about 6,640 square miles in two states, with approximately 2,295 square miles within Washington and the remaining 4,345 square miles in Idaho (Ecology, 2009). Mean annual precipitation over the watershed varies from less than 10 inches per year to nearly 60 inches per year (Figure 1-2). The watershed contains forested, range, shrub and brush, agricultural and urban/suburban/rural land uses. The subbasins in Idaho are dominated by forested land while the subbasins in Washington generally have a greater diversity of land uses.

Six hydroelectric facilities are located on the main stem of the Spokane River within the study area. Avista Utilities owns and operates five of these hydroelectric facilities, one in Idaho (Post Falls Dam at river mile 100.8) and four in Washington (Upper Falls Dam at river mile 74.2, Monroe Street Dam at river mile 73.4, Nine-Mile Dam at river mile 57.6, and Long Lake Dam at river mile 33.9). The City of Spokane owns and operates Upriver Dam in Washington at river mile 79.9 (Ecology, 2010). Avista Utilities' Long Lake Dam is at the downstream end of the study area and creates Lake Spokane.

With ten subbasins and abundant land area, the watershed includes a variety of different features and land uses. Chapter 3 includes subbasin specific characteristics, figures, additional information about land use and potential pollution sources for each of the subbasins.

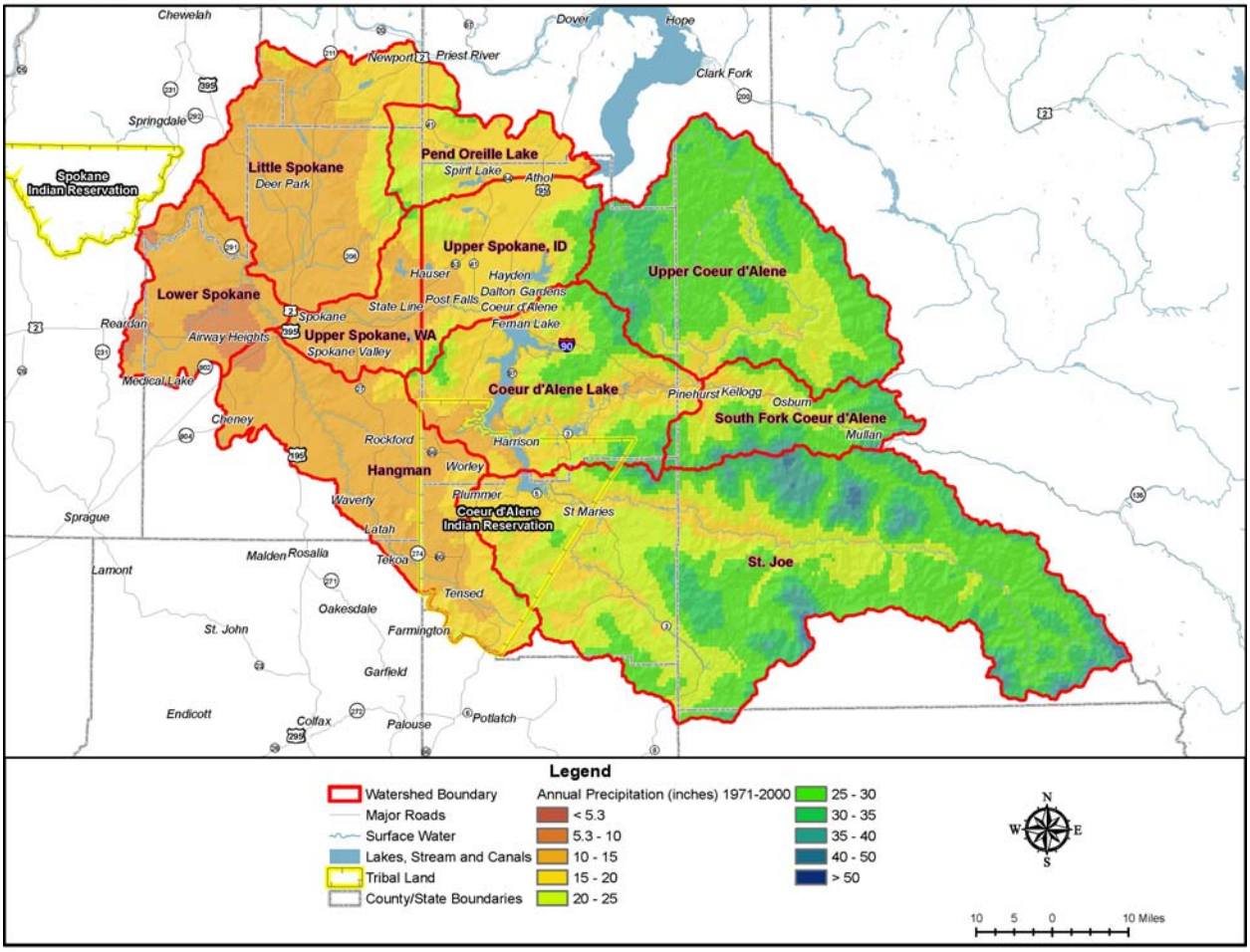

Figure 1-2. Annual Average Precipitation

Chapter 2

Spokane River DO TMDL Identification of Nonpoint Source Phosphorus Loads

2.1 Introduction

The NPS Study and the Spokane River DO TMDL have related objectives for improving water quality in the Spokane River Watershed. Some of Ecology's findings from the past Spokane River DO TMDL analyses (Ecology, 2010) relating to nonpoint source phosphorus include:

- 2001 was established as the critical Spokane River DO TMDL design year.
- Algal production significantly contributes to dissolved oxygen depletions beyond criteria during critical conditions in the river and lake.
- Phosphorus has the most significant impact on algal production in the lake and river, but dissolved oxygen is also impacted by CBOD and ammonia.
- Both point and nonpoint sources of pollutant loading contribute to violations of water quality criteria.
- Dissolved oxygen in the hypolimnion (bottom strata of the lake) is most impacted by nonpoint source pollution with some additional impacts from point sources.
- Current nonpoint source pollutant loading causes more than a measureable (0.2 mg/L) decrease in dissolved oxygen compared to "natural conditions."
- For the Idaho section of the Spokane River, dissolved phosphorus was found to cause a measurable (0.2 mg/L) dissolved oxygen depletion in Lake Spokane.
- The phosphorus nonpoint source load accounts for a large portion of the overall load, especially during the spring months.

The Spokane River DO TMDL (Ecology, 2010) identified point source and nonpoint source phosphorus contributions from:

- Dischargers (municipal and industrial) to the Spokane River.
- Spokane River tributaries (Hangman Creek, Coulee Creek, and the Little Spokane River).
- Groundwater inflow to the main stem of the Spokane River.
- Groundwater and runoff in the watershed immediately adjacent to Lake Spokane.
- Stormwater discharging to the Spokane River.

The dischargers and Avista may pursue actions to reduce nonpoint sources of pollution to the Spokane River and its tributaries, in order to meet the wasteload allocation (dischargers) and dissolved oxygen responsibility (Avista). (Ecology, 2010)

2.2 Summary of Nonpoint Source Phosphorus Sources

Ecology provides the following definition for nonpoint sources in the Spokane River DO TMDL:

> **Nonpoint source:** Pollution that enters any waters of the state from any dispersed land-based or water-based activities, including but not limited to atmospheric deposition, surface water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the National Pollutant Discharge Elimination System Program. Generally, any unconfined and diffuse source of contamination is a nonpoint source. Legally, any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act is a nonpoint source (Ecology, 2010).

Both groundwater and surface water were identified as sources or mechanisms to transport pollutants by the Spokane River DO TMDL (Ecology, 2010). However, the only nonpoint source specified in the Spokane River DO TMDL is on-site sewage treatment or septic tanks. This NPS Study provides a more robust identification of nonpoint sources within the Spokane River Watershed. See Chapters 3 through 7 for more detail on nonpoint source phosphorus sources identified by the NPS Study.

2.3 Summary of Phosphorus Wasteload and Load Allocations

The Spokane River DO TMDL establishes wasteload allocations for point sources (i.e., wastewater dischargers, combined sewer overflow, stormwater) and load allocations for nonpoint sources. To establish the wasteload and load allocations, the 2001 water year was chosen as the critical flow year in the CE-QUAL-W2 modeling simulations, based on comparisons of daily average flows described in Cusimano (2004). This low river flow period is expected to be the most critical period for pollutant loading effects in the river and Lake Spokane due to less dilution of nutrient concentrations and a longer retention time, both of which can exacerbate dissolved oxygen shortages. By using a representative critical low flow year, the water quality in Lake Spokane and the Spokane River should be adequately protected (Ecology, 2010).

2.3.1 Point Source Phosphorus Wasteload Allocations

Ecology (2010) assigned wasteload allocations for total phosphorus, CBOD and ammonia (expressed as pounds per day loads) to the following flows in Washington:

- Municipal and industrial discharges.
- Combined sewer overflows.
- Stormwater.

Wasteload allocations are based on modeling (using the 2001 water year) of seasonal average effluent pollutant concentrations for the critical period (March 1 to October 31) and projected point source discharger effluent flow rates for 2027. The wasteload allocations require reducing total phosphorus loading in treated wastewater effluent during the critical period by roughly 90 percent. In addition to installing advanced wastewater treatment technologies, it is anticipated that some wastewater treatment plants may also need to reduce nutrients through actions such as

obtaining offsets from nonpoint source reductions, water conservation, and wastewater reuse (Ecology, 2010).

While wasteload allocations are for point sources and this NPS Reduction Plan is focused on nonpoint sources, dischargers and combined sewer overflows are addressed only to understand the water quality issues in the watershed.

However, stormwater can contain high levels of pollutants, including phosphorus, and is a significant factor in the mobilization and transport of phosphorus from nonpoint sources. Many BMPs focus on the control and treatment of stormwater. Therefore, stormwater it is an important component of this NPS Reduction Plan.

The stormwater wasteload allocation is established for entities discharging stormwater to the Spokane River that are regulated by the Washington National Pollutant Discharge Elimination System **(**NPDES) permits for Municipal Separate Stormwater Sewer Systems (MS4s). MS4s are systems (drains, pipes, etc.) owned by a public entity and designed to collect and convey stormwater. MS4s must have a stormwater management program to reduce contamination of stormwater and prohibit illicit discharge along with a NPDES permit to discharge the water. The City of Spokane, City of Spokane Valley, Spokane County and Washington State Department of Transportation (WSDOT) have MS4 permits, but the stormwater wasteload allocation was not divided between these entities. The stormwater wasteload allocation is based on average existing flows. The stormwater phosphorus wasteload allocation identified in the Spokane River DO TMDL is shown in Table 2-1. (Ecology, 2010)

The CE-QUAL-W2 model also included Idaho point source loads for the dischargers and stormwater. The estimated phosphorus load used in the model for Idaho is 2.4 lb/day. The stormwater load was not divided by the City of Coeur d'Alene and Post Falls.

Table 2-1. Stormwater Total Phosphorus Wasteload Allocation

Allocation	Average Existing Flow (MGD)	Allocation Concentration (mg/L)	Wasteload Allocation (lbs/day)
Stormwater	2.36	0.310	6.1

2.3.2 Nonpoint Source Phosphorus Load Allocations

The Spokane River DO TMDL focuses on strategies to reduce phosphorus loading because these strategies will often result in reductions to ammonia and carbonaceous biochemical oxygen demand. Ecology (2010) assigned phosphorus load allocations to:

- Mouths of the main Spokane River tributaries (Hangman Creek, Coulee Creek, and the Little Spokane River).
- Groundwater inflow to the main stem of the Spokane River upstream of Lake Spokane.

- Groundwater and surface water runoff in the watershed immediately adjacent to Lake Spokane.

The Spokane River DO TMDL states "the tributary load allocations are calculated by taking the nutrient loading above the natural load (human caused nonpoint source load) and applying the percent reductions identified to the human-caused (anthropogenic) nonpoint source load" (Ecology, 2010). The tributary phosphorus load allocations identified in the Spokane River DO TMDL are shown in Table 2-2 (Ecology, 2010). Allocations and loads are specific to total phosphorus and vary seasonally.

Table 2-2. Tributary **Spokane River DO** TMDL Total Phosphorus Load Allocations

Water Body and Season	Reduction Percentage	Flow (cfs)	Allocation Concentration (mg/L)	Load Allocation (lbs/day)
Hangman Creek				
March-May Average	20	229	0.113	140.2
June	40	31	0.044	7.5
July-October Average	50	9	0.030	1.4
Coulee Creek				
March-May Average	20	30	0.113	18.2
June	40	8	0.044	1.8
July-October Average	50	2	0.030	0.4
Little Spokane River				
March-May Average	36	565	0.034	102.5
June	36	426	0.023	53.9
July-October Average	36	364	0.016	32.2

The Spokane River has areas of both inflows (groundwater flowing in to the river) and outflows (river water loss to the groundwater) that complicate the river flow hydrology (Cusimano, 2004). Inflows within gaining stream reaches potentially are a significant source of phosphorus loads to the surface water system. To account for groundwater inflow-based loading, the groundwater natural background median total phosphorus concentration was estimated at 4 micrograms per liter (µg/L) and used as input for the Spokane River DO TMDL modeling (Ecology, 2010). Based on a concern that previous versions of the Spokane River DO TMDL did not adequately account for total phosphorus loading from groundwater that directly discharges to Lake Spokane, Ecology separated the allocated loads for this direct discharge from the other distributed inflows (i.e., groundwater upstream of Lake Spokane) in the final Spokane River DO TMDL. The phosphorus load allocations associated with groundwater upstream of Lake Spokane and groundwater/surface water runoff to Lake Spokane are shown in Table 2-3 (Ecology, 2010).

Table 2-3. Groundwater and Lake Spokane Watershed **Spokane River DO** TMDL Total Phosphorus Load Allocations

Water Body and Season	Flow (cfs)	Allocation Concentration (mg/L)	Load Allocation (lbs/day)
Groundwater – Upstream of Lake Spokane			
March-May Average	1946	0.0081	87
June	1583	0.0078	66
July-October Average	1165	0.0076	48
Groundwater / Surface Water Runoff – Lake Spokane Watershed			
March-May Average	588	0.025	79
June	225	0.025	30
July-October Average	180	0.025	24

Chapter 3

Subbasin Assessment Nonpoint Source Phosphorus

3.1 Watershed Nonpoint Source Phosphorus

Nonpoint sources of phosphorus in the Spokane River Watershed were assessed by reviewing land use and pollution sources at a subbasin-scale. The subbasins are the US Geological Survey (USGS) defined 8-digit Hydrologic Unit Code (HUC). This review assists in answering "where" nonpoint source phosphorus loads occur in the watershed. The 2001 National Land Cover Dataset (NLCD) from the USGS was the primary land cover data reviewed. This data provides land uses by common groups (i.e., agricultural land, developed urban/suburban land, forested land) in the project area.

The land uses around stream monitoring locations were compared for trends in phosphorus concentrations (based on the phosphorus data compiled in the Spokane NPS Database) (HDR, March, 2010). The results suggest that, developed, transitional and shrub/range/low vegetation areas appear to have the most consistent impact on phosphorus concentrations throughout the watershed. In relation to land use, specific areas and activities related to agriculture (crops and animals) and forestry throughout the watershed result in higher concentrations of phosphorus, but overall they appear to have less impact than developed land (HDR, March, 2010). The results also suggested that total phosphorus and orthophosphorus generally follow similar trends in concentrations and relationships to land uses (HDR, March, 2010).

Nonpoint sources of phosphorus include eroded soils (particulate, soluble and attached to soil particles), plant matter, wildlife, pet and agricultural animal wastes, human waste, and fertilizers. These sources may be associated with urban, residential, and farm runoff and on-site sewage systems and conveyed by stormwater and/or groundwater. As phosphorus may be transported from nonpoint sources via stormwater runoff and groundwater, this makes them an indirect source of nonpoint source phosphorus. Point sources of phosphorus include human wastes and compounds sent to wastewater treatment plants (WWTPs), industrial wastes, and confined animal feeding operation (CAFO) wastes, commonly associated with urban developed areas and agricultural operations. Table 3-1 lists nonpoint and point sources of phosphorus and associated land uses identified in this plan.

Table 3-1. Sources of Phosphorus

Nonpoint Sources	Typically Associated Land Uses
Agricultural Animal Waste	Agricultural
Agricultural Fertilizers	Agricultural
Atmospheric Deposition (indirect)	All
Geologic Sources	All
Industrial Releases	Urban/Suburban
Pet Waste	Urban/Suburban/Residential
Aquatic and Terrestrial Plants	All
Residential/Commercial Fertilizers	Suburban/Residential
Septic Systems including: Human Waste, Detergents, Soaps	Suburban/Rural/Residential
Soil Erosion	Agricultural, Forested Land
Stormwater and Groundwater (indirect)	All
Stream Sediments	All
Wildlife Waste	All
Point Sources	**Typically Associated Land Uses**
CAFOs and animal wastes	Agricultural
Industrial Discharges such as Process-by-Products	Urban/Suburban
Municipal Wastewater Effluent including: Commercial/Industrial Dish Washing Detergents, Residential Dish Washing Detergents – Banned, Commercial/Industrial Laundry Detergents, Residential Laundry Detergents, Food, Soaps	Urban/Suburban

Nonpoint sources of phosphorus may be reduced by implementing actions that include use of BMPs. Controlling the transport of phosphorus requires fundamental changes in land use activity and management practices (i.e., non-structural BMPs) and the interception and treatment of runoff (i.e., structural BMPs). BMPs are discussed in Chapter 8. Nonpoint source management practices may achieve additional environmental benefits, such as habitat improvement and erosion control, in the watershed, beyond phosphorus reduction alone.

Reductions from a combination of sources will be necessary to meet water quality improvement targets for the Spokane River. Methods of pollution reduction can be prioritized to identify simple, efficient, and/or cost effective reduction opportunities. According to Ecology (2010), "because nonpoint pollution comes from diffuse sources, all upstream watershed areas have the potential to affect downstream water quality. Therefore, all potential nonpoint sources in the watershed must use the appropriate best management practices to reduce impacts to water quality".

The Spokane River Watershed is predominantly forested land with areas of rangeland, agriculture, and urban/suburban/rural land uses. The subbasins in Idaho are dominated by forested land while the subbasins in Washington generally have a greater diversity of land uses. The similarities in land uses across the watershed result in similar phosphorus sources for the subbasins when viewed at the watershed scale. While efforts to minimize phosphorus from all sources are necessary, common nonpoint source phosphorus reduction opportunities across the watershed include:

- Control and treatment of stormwater runoff.
- Management and reduction of on-site sewage systems.
- Protection of groundwater recharge areas.
- Protection of riparian zones and minimization of stream bank erosion.
- Reduction of phosphorus loads from developed areas.
- Targeted potential reductions from agricultural areas.

The following sections describe the subbasins characteristics, land use and nonpoint source phosphorus assessment conducted as part of the NPS Study.

3.2 Lower Spokane River Subbasin

The Lower Spokane River subbasin has a mix of land uses with potential phosphorus sources generally associated with urban/suburban/rural development. Land uses and the associated phosphorus sources nearest the Spokane River are important to control because there are no major perennial tributaries within this subbasin. Few tributaries provide consistent transport of phosphorus from the upland areas. The two largest tributaries, Coulee Creek and Deep Creek, frequently infiltrate into groundwater before reaching the Spokane River, possibly altering the fate and delaying the transport of phosphorus before discharge to the river.

3.2.1 Lower Spokane River Subbasin Characteristics

The Lower Spokane River subbasin includes the portion of the watershed that extends from the confluence of Hangman Creek with the Spokane River to Long Lake Dam. Most of the subbasin area is located to the south-southwest of the Spokane River and includes the City of Airway Heights, Fairchild Air Force Base, most of the City of Medical Lake and extends into Lincoln County almost to the City of Reardan. Subbasin characteristics include:

- **Size:** The subbasin area is 218,451 acres or about 341 square miles. Compared to the other subbasins in the study area, it is relatively small. Only two of the ten subbasins are smaller.
- **Topography:** The Spokane River is the dominant topographic feature within the subbasin. It is deeply entrenched, with a relatively narrow valley floor, and dominated by unembedded cobble to boulder substrate in areas that are not affected by reservoir conditions (Tetra Tech, 2010). The area to the south rises to a high plateau and the area to the north rises to forested and shrub/scrub highlands. Surface elevation ranges from 1,360 feet near Long Lake Dam to 3,960 feet near Scoop Mountain.

- **Hydrologic** characteristics:
  - The Spokane River generally flows westward through the Lower Spokane River subbasin. There are two dams in the subbasin; Nine Mile Dam and Long Lake Dam (which forms the downstream end and topographic low of the study area).
  - Mean annual precipitation averages about 8 to 14 inches per year across the subbasin (PRISM Climate Group, 2006).
  - The Spokane River at Long Lake (USGS 12433000) stream gage at the downstream end of the subbasin has a median annual discharge flow of 7,675 cfs. The annual discharge ranges from a high of 13,450 cfs in 1974 to a low of 3,184 cfs in 1977 over the period of record. Monthly discharges are typically greatest in May due to snowmelt and precipitation and least in August. Monthly flows ranged from a high of 36,901 cfs in May 1997 to a low of 1,104 cfs in August 1994.
  - Phosphorus is delivered to the subbasin by runoff into waterways, the Spokane River upstream of the subbasin, and groundwater flow. Hangman Creek, Little Spokane River, and groundwater/surface water exchange provide the majority of the inflow to the Spokane River. Of these, the Spokane River at the upstream end of the subbasin provides the greatest inflow. Hangman Creek enters the Spokane River at the upstream end of the subbasin. The Little Spokane River enters the Spokane River just downstream of Nine Mile Dam. Several tributary streams drain from the high plateau to the south of the river (including Deep and Coulee Creeks) and the highlands north of the river. None of these tributaries have a year-round surface water flow connection to the Spokane River (Tetra Tech, 2010).
- **Water quality:** The Lower Spokane River subbasin is located at the downstream margin of the Spokane River Watershed and, as a result, is susceptible to water quality impacts associated with upstream portions of the watershed. Lower Spokane River subbasin water quality problems include low dissolved oxygen over the entire length of the Spokane River, elevated metals concentrations in Spokane River sediment, aquatic weed growth in Lake Spokane, elevated Spokane River polychlorinated biphenyl (PCB) levels (as determined by fish tissue analysis), and groundwater contamination (by solvents, nutrients, and other contaminants) in aquifers within the West Plains portion of the subbasin (Tetra Tech, 2010).

3.2.2 Lower Spokane River Subbasin Land Use

Land use within the Lower Spokane River subbasin includes a mix of land uses (Table 3-2 and Figure 3-1). The subbasin is dominated by rangeland throughout much of the eastern and northern halves near the Spokane River. Forested land is the second largest land use and is especially dominant in the northern half of the subbasin. Agriculture is the third largest land use and is predominantly in the southeastern part of the subbasin. There are several areas of urban/suburban development, including: the western part of the City of Spokane on the eastern side of the subbasin; the Suncrest development along Lake Spokane; Airway Heights; the northern part of Medical Lake; and the Fairchild Air Force Base (between Airway Heights and Medical Lake).

Table 3-2. Lower Spokane River Subbasin Land Use Area and Percent

Land Use Category	Land Use	Area (acres)	Percent (%)
Rangeland	Shrub and Brush Rangeland	60,415	28
	Herbaceous Rangeland	26,586	12
Forested	Evergreen Forest Land	53,026	24
Agriculture	Cropland and Pasture	49,127	22
Urban/Suburban	Urban or Built-Up Land	8,326	4
	Other Urban	7,374	3
	Residential	5,396	2
Water	Lakes	5,518	3
Other	Total of Eight Other Land Uses	2,683	~2

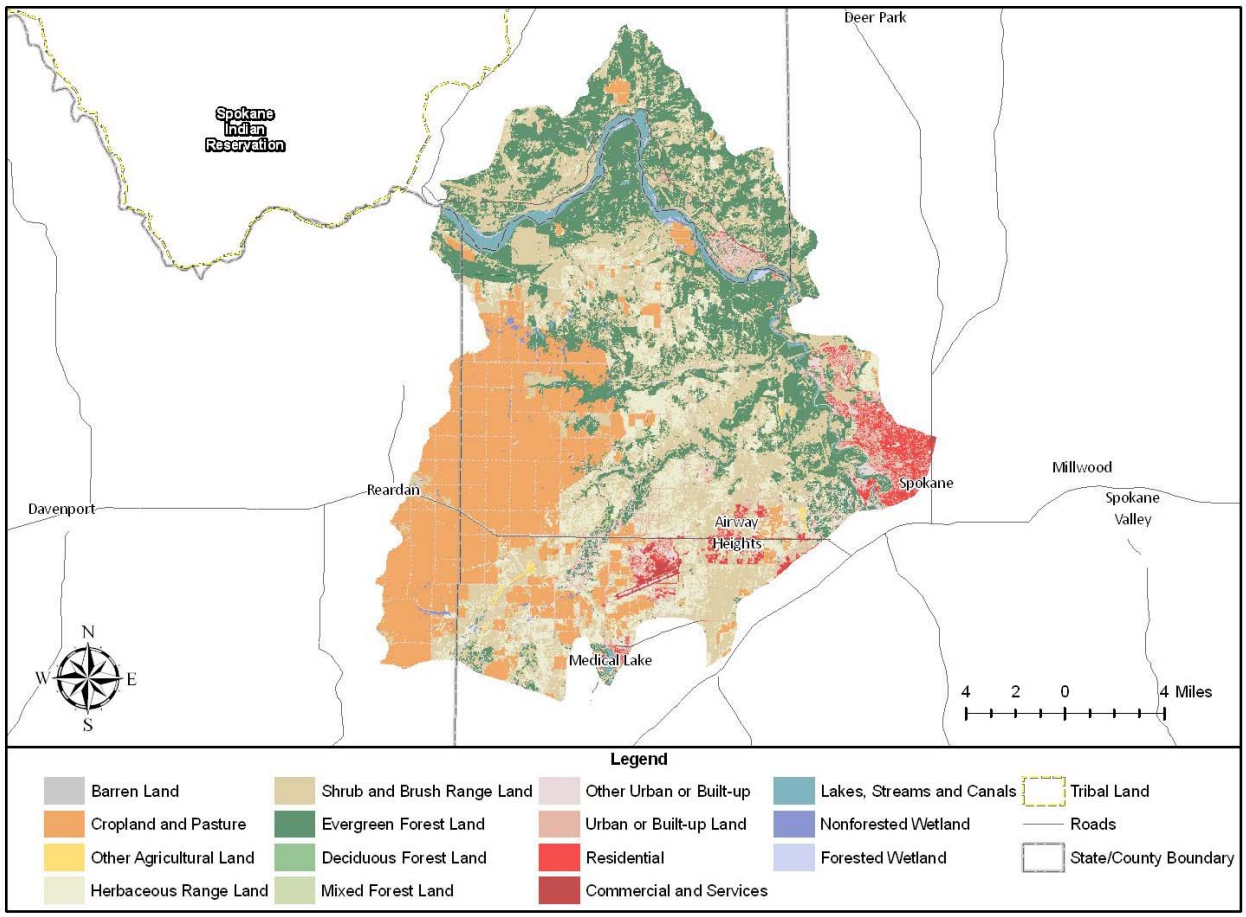

Figure 3-1. Lower Spokane River Subbasin Land Use

3.2.3 Lower Spokane River Subbasin Pollution Sources

Pollution sources in the Lower Spokane River subbasin for nonpoint source phosphorus include stormwater runoff and groundwater infiltration from developed areas (HDR, March, 2010) as well as on-site sewage systems and agricultural areas in the West Plains (GeoEngineers, September 15, 2009). Non-anthropogenic phosphorus loading also occurs through water/rock interaction as groundwater flows through and equilibrates with phosphorus-bearing basement rock and unconsolidated sediments and discharges to the Spokane River.

3.3 Upper Spokane River WA Subbasin - Nonpoint Source Phosphorus

The Upper Spokane River WA subbasin is largely characterized by urban/suburban development along the Spokane River and potential phosphorus sources are generally associated with this development. Control of phosphorus sources and stormwater runoff management are important strategies for developed areas. Phosphorus sources nearest the Spokane River are important to control as there are no major tributaries within this subbasin to provide consistent transport of phosphorus from the upland areas. However, the Spokane River is in direct hydraulic connection with the SVRP Aquifer throughout this subbasin and receives significant baseflow within gaining reaches (GeoEngineers, August 4, 2009). As a result, infiltration and groundwater transport of nonpoint sources of phosphorus are important mechanisms for Spokane River phosphorus loading.

3.3.1 Upper Spokane River WA Subbasin Characteristics

The Upper Spokane River WA subbasin extends from the Idaho-Washington state line to the confluence of Hangman Creek with the Spokane River. This drainage area contains most of the population within the watershed. The Spokane River bisects the communities of Liberty Lake, City of Spokane Valley, and City of Spokane. Subbasin characteristics include:

- **Size:** The area of the Upper Spokane River WA subbasin is 133,546 acres or about 209 square miles. It is the smallest of the ten subbasins in the study area.
- **Topography**:
  - The eastern portion of the Upper Spokane River WA subbasin consists of landforms typical of the Northern Rocky Mountains Province, which is characterized by north-south trending mountains and valleys that rise steeply from the Columbia Plateau. The mountains are rounded and are located to the north and the south of the Spokane Valley. The western portion of the subbasin generally is characterized by landforms typical of the Columbia Plateau Province, which include flat-topped basalt plateaus (Golder Associates, 2003).
  - Within the subbasin, there are areas of subdued topography that represent ancestral drainageways scoured into basement and basalt rocks and infilled by peri-glacial processes, including the Missoula Floods. The Spokane Valley represents the main Missoula Flood channel. The primary aquifers within the subbasin occur within these ancestral drainageways and are comprised of coarse-grained glaciofluvial unconsolidated sediments (e.g., the highly productive SVRP Aquifer) (Golder Associates, 2003).

- Surface elevation ranges from 1,261 feet near the banks of the Spokane River southeast of the Riverside Memorial Park Cemetery to 5,202 feet near Mica Peak.

- **Hydrologic characteristics**:
  - The mainstem of the Spokane River bisects the Upper Spokane River WA Subbasin and is the primary surface water body within the subbasin. Within this subbasin, the Spokane River is generally in direct hydraulic connection with the SVRP Aquifer, containing a series of both losing (in areas where the river elevation is above the adjacent groundwater table) and gaining (in areas where the river elevation is below the adjacent groundwater table) reaches.
  - Mean annual precipitation averages about 8 to 28 inches per year with most of the subbasin near the low end of the range (OSU, 2006).
  - The Spokane River at Spokane (USGS 12422500) stream gage at the downstream end of the subbasin has a median annual discharge flow of 6,721 cfs. The annual discharge ranges from a high of 12,310 cfs in 1974 to a low of 2,508 cfs in 1977 over the period of record. Monthly discharges are typically greatest in May due to snowmelt and precipitation and least in August. Monthly flows ranged from a high of 34,390 cfs in May 1997 to a low of 531 cfs in August 1994.
  - Phosphorus is delivered to the subbasin by runoff into waterways, the Spokane River upstream of the subbasin, and groundwater flow. No major tributaries to the Spokane River are located within the subbasin, primarily because of the high permeability of near-surface flood deposits that cause rapid infiltration of surface water to the SVRP Aquifer. As a result, tributary streams within the subbasin fully infiltrate (disappear) into the aquifer near aquifer boundaries. Infiltrated surface water recharges the SVRP Aquifer and may ultimately re-emerge within the Spokane River along gaining reaches.
  - In addition, several streams that originate within the subbasin drain across the state line to Idaho. For example, Blanchard Creek, which originates in the northeast portion of the subbasin, drains to the Rathdrum Prairie where it infiltrates into the subsurface and recharges the SVRP Aquifer within the Pend Oreille Lake subbasin (Golder Associates, 2003).

- **Water quality:** Water quality problems in the Upper Spokane River WA subbasin include low dissolved oxygen, elevated metals concentrations in Spokane River sediment, and elevated Spokane River PCB levels (as determined by fish tissue analysis).

3.3.2 Upper Spokane River WA Subbasin Land Use

The Upper Spokane River WA subbasin includes a mix of land uses, dominated by forested land and urban/suburban development (Table 3-3). The topographically low areas within the Spokane River valley include mostly urban/suburban land uses, and contain a large percentage of the population of the entire Spokane River Watershed (Figure 3-2). Communities along the Spokane River include the City of Spokane and Spokane Valley. Undeveloped forested land is in the southern portion and northern edge of the subbasin. Shrub and brush rangeland is the third largest land use and is predominantly in the fringe area between the urban/suburban core and the forested land. There are a few agriculture areas intermixed in the rangeland areas.

Table 3-3. Upper Spokane River WA Subbasin Land Use Area and Percent

Land Use Category	Land Use	Area (acres)	Percent (%)
Forested	Evergreen Forest Land	46,016	35
Urban/Suburban	Urban or Built-up Land	22,636	17
	Residential	12,827	10
	Other Urban	8,704	7
	Commercial and Service	3,091	2
Rangeland	Shrub and Brush Rangeland	21,295	16
	Herbaceous Rangeland	10,678	8
Agriculture	Cropland and Pasture	4,779	4
Other	Total of Seven Other Land Uses	3,520	~1

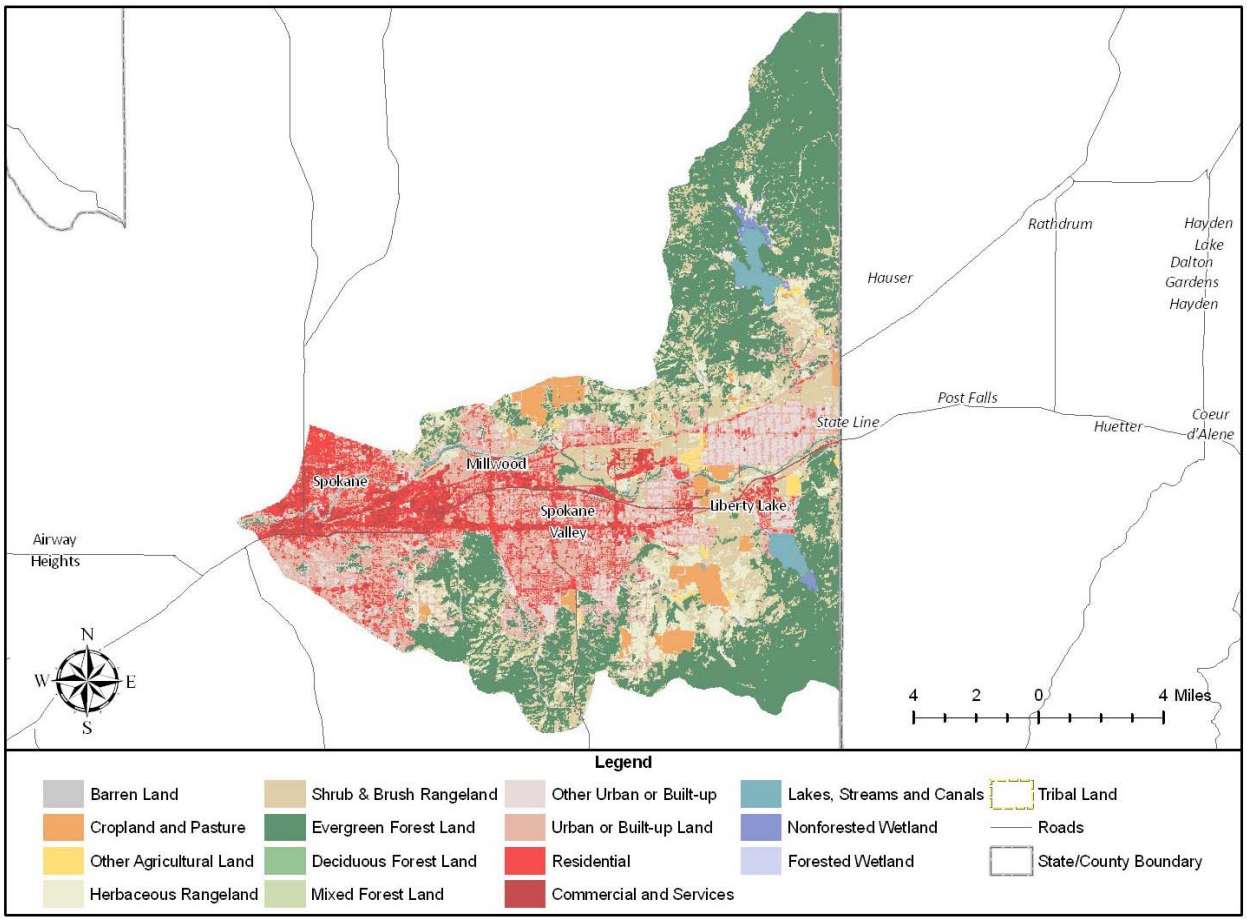

Figure 3-2. Upper Spokane River WA Subbasin Land Use

3.3.3 Upper Spokane River WA Subbasin Pollution Sources

Pollution sources in the Upper Spokane River WA subbasin for nonpoint source phosphorus include stormwater runoff from developed areas (HDR, March, 2010), on-site sewage systems and stormwater infiltration to groundwater (GeoEngineers, September 15, 2009).

3.4 Little Spokane River Subbasin - Nonpoint Source Phosphorus

The Little Spokane River subbasin has the widest distribution of land uses of all the subbasins. The various land uses and numerous lakes and tributaries provide a multitude of sources and delivery mechanisms of phosphorus to the Little Spokane River. As a result, the Little Spokane River subbasin is likely the most complex subbasin for developing management strategies to reduce phosphorus loads and improve water quality.

3.4.1 Little Spokane River Subbasin Characteristics

The Little Spokane River subbasin is bounded by the Lower Spokane River, Upper Spokane River WA, and Pend Oreille Lake (southwest portion) subbasins to the west, south, and east, respectively. In Washington, the subbasin includes the northern one-third of Spokane County, the southern portion of Pend Oreille County, and a minor portion of southeastern Stevens County. It also contains a small section of Bonner County in Idaho. The majority of the watershed is within Spokane County. Subbasin characteristics include:

- **Size:** The area of the Little Spokane River subbasin is 453,552 acres or about 709 square miles. Of the ten subbasins it is the third largest.
- **Topography:** The Little Spokane River subbasin includes hilly to mountainous terrain in the eastern and northern portions, and the broad, relatively level Little Spokane River valley in the central portion. Surface elevation ranges from 1,542 feet near the Little Spokane River banks in the vicinity of Aubrey L. White Park to 5,848 feet near Mt. Spokane.
- **Hydrologic characteristics:**
  - The Little Spokane River is one of the two major tributaries of the Spokane River (Hangman Creek being the other). The river discharges into the Spokane River at river mile 56.3, downstream of Nine Mile Dam. Major lakes within the subbasin include Eloika Lake, Diamond Lake, Sacheen Lake and Horseshoe Lake. These lakes are all located in the northern portion of the subbasin and are interconnected by surface water and groundwater flow.
  - Mean annual precipitation averages about 8 to 28 inches per year with most of the subbasin near the low end of the range (OSU, 2006).
  - The Little Spokane River at Dartford (USGS 12431000) stream gage at the downstream end of the subbasin has a median annual discharge flow of 288 cfs. The annual discharge ranges from a high of 626 cfs in 1977 to a low of 128 cfs in 1931 over the period of record. Monthly discharges are typically greatest in April due to snowmelt and precipitation and least in August. Monthly flows ranged from a high of 1,629 cfs in March 1997 to a low of 68 cfs in August 1931.
  - Phosphorus is delivered from the subbasin by runoff into waterways, numerous tributaries and groundwater. The largest stream tributary to the Little Spokane River is Dragoon Creek, which drains an area of approximately 177 square miles in the northwest portion of the subbasin. Other major streams include Deadman Creek, which drains an area of approximately 165 square miles in the eastern

portion of the subbasin, Little Deep Creek, Deer Creek and the West Branch of the Little Spokane River (Ecology, 1995).

- **Water quality:** Water quality problems in the Little Spokane River subbasin include: low dissolved oxygen; elevated temperature, fecal coliform, and pH; and elevated PCB levels in fish tissue (Golder Associates, 2003).To address the water quality problems in the Washington portion of the watershed, Ecology and the Spokane County Conservation District are working together on an ongoing (as of July 2010) water quality improvement project. Since sediments transport phosphorus, this project relates to the NPS Study. Potential sediment sources identified in a July 2010 Technical Status Report presentation include: streambank erosion from poor riparian management; livestock access; poor construction practices; natural sloughing of banks; uncontrolled stormwater runoff; and poor agricultural practices (Ecology, 2010b).

3.4.2 Little Spokane River Subbasin Land Use

The Little Spokane River subbasin is characterized by numerous and diverse land uses (Table 3-4). The Little Spokane River generally bisects the subbasin from north to south (Figure 3-3). The largest land use is forested land which mostly occurs in the western, northern and eastern portions of the subbasin. Shrub and brush rangeland is intermixed with agricultural and urban/suburban land uses in the central and southern portions of the subbasin. The agriculturally based areas are composed of a variety of uses, including fruit orchards, cultivated crops, grazing, and animal husbandry. The largest urban/suburban area is a portion of the City of Spokane, along with Deer Park, and development along the US-395 and US-2 corridors. There are wetlands areas around the numerous lakes and the lower portion of the Little Spokane River.

Table 3-4. Little Spokane River Subbasin Land Use Area and Percent

Land Use Category	Land Use	Area (acres)	Percent (%)
Forested	Evergreen Forest Land	258,864	57
Rangeland	Shrub and Brush Rangeland	64,528	14
	Herbaceous Rangeland	48,259	11
Agriculture	Cropland and Pasture	39,671	9
	Other Agricultural Land	4,563	1
Urban/Suburban	Urban or Built-up Land	13,776	3
	Other Urban	8,787	2
	Residential	6,068	1
Wetland	Nonforested Wetland	4,554	1
Other	Total of Six Other Land Uses	4,482	~1

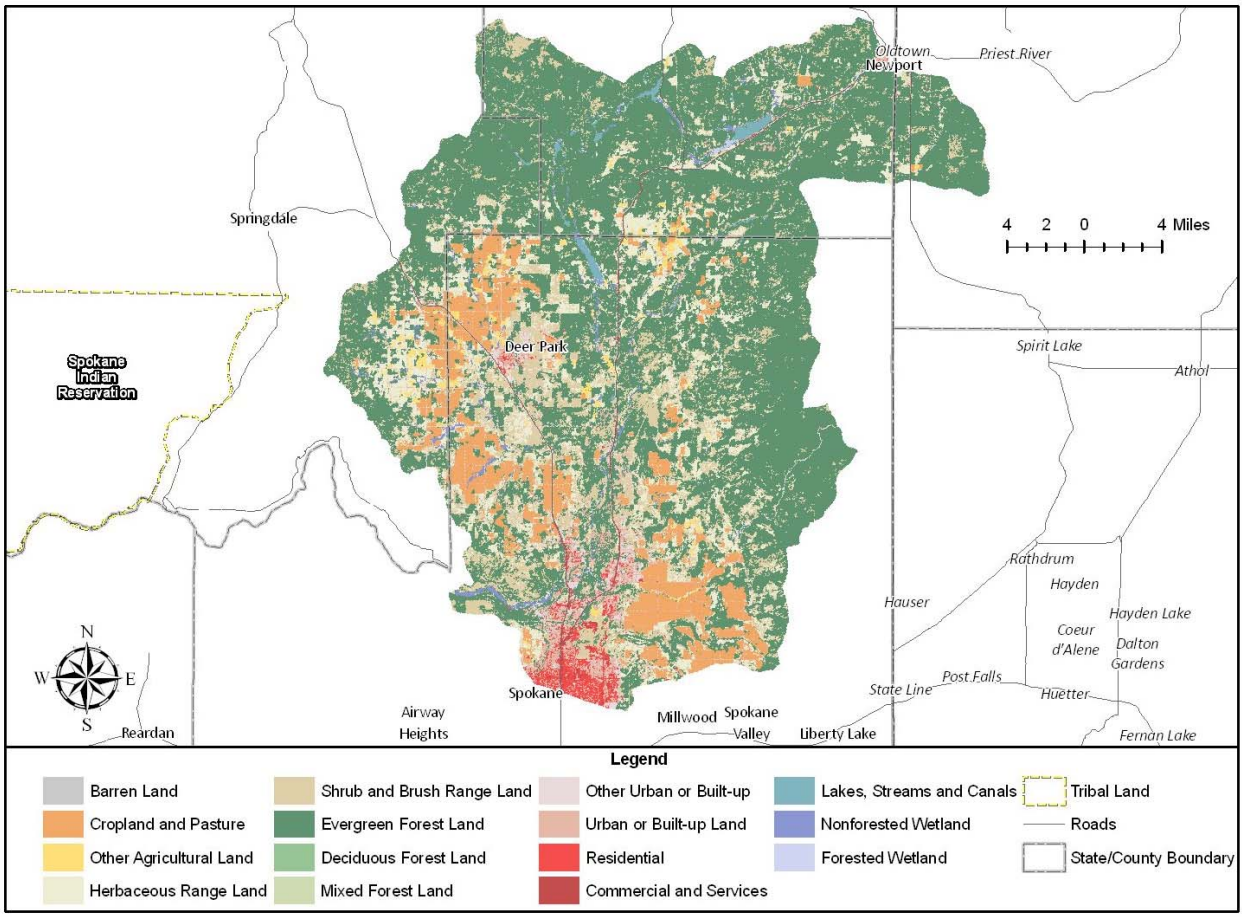

Figure 3-3. Little Spokane River Subbasin Land Use

3.4.3 Little Spokane River Subbasin Pollution Sources

Pollution sources in the Little Spokane River subbasin for nonpoint source phosphorus include stormwater runoff from developed areas and runoff from hay/pasture and agricultural areas (HDR, March, 2010) as well as small-scale agriculture, livestock and fertilizer (GeoEngineers, September 15, 2009). Six potential nonpoint sources were identified by the TMDL Workgroup for the Little Spokane River, which include: agricultural operations, livestock and wildlife, residential activities and land uses, on-site sewage systems, stormwater runoff, and recreational impacts (Ecology, undated).

3.5 Hangman Creek Subbasin - Nonpoint Source Phosphorus

The Hangman Creek subbasin has the highest percentage of agricultural land of all the subbasins. Historical agricultural practices have impacted water quality within the creek and its tributaries (Ecology 2009). The Spokane County Conservation District has been the lead agency working on improving water quality conditions in the creek with a focus on agricultural practices. Hangman Creek is the second largest tributary to the Spokane River and Lake Spokane, after the Little Spokane River.

3.5.1 Hangman Creek Subbasin Characteristics

The Hangman Creek subbasin is located south of the Lower Spokane River subbasin and extends from Washington into northern Idaho. More than 60 percent of the subbasin resides in eastern Washington State while the remaining portion, including the headwaters, originates in the western foothills of the Rocky Mountains near Sanders, Idaho. (Ecology, 2011) Hangman Creek joins the Spokane River west of downtown Spokane. Subbasin characteristics include:

- **Size:** The area of the Hangman Creek subbasin is 442,838 acres or about 692 square miles. Approximately 64 percent of the subbasin is in Washington and 36 percent in Idaho (SCCD, 2003). Of the ten subbasins, it is the fourth largest.
- **Topography:** Along its course, Hangman Creek flows from mountainous topography, across rolling hills in the Palouse, then into deep and narrow basalt canyons, and ultimately into a broad valley as it joins the Spokane River (SCCD, 2003). Surface elevation ranges from 1,708 feet near Spokane River banks to 4,926 feet near Moses Mountain.
- **Hydrologic characteristics**:
  - Hangman Creek is one of the two major tributaries to the Spokane River (Little Spokane River being the other). Hangman Creek primarily flows through the western portion of the subbasin.
  - Mean annual precipitation averages about 8 to 28 inches per year with most of the subbasin near the low end of the range (OSU, 2006).
  - The Hangman Creek at Spokane (USGS 12424000) stream gage at the downstream end of the subbasin has a median annual discharge flow of 225 cfs. The annual discharge ranges from a high of 629 cfs in 1997 to a low of 27 cfs in 1977 over the period of record. Monthly discharges are typically greatest in March due to snowmelt and precipitation and least in August and September. Monthly flows ranged from a high of 2,097 cfs in January 1997 to a low of 1 cfs in September 1992.
  - Phosphorus is delivered from the subbasin by runoff into waterways and numerous tributaries. Approximately 222 miles of perennial streams occupy the subbasin, with the largest tributaries being Rock Creek and California Creek in the northern portion of the subbasin (SCCD, 2003). Creeks within the Idaho portion of the subbasin include South Fork Hangman Creek, Tenas Creek, Martin Creek, Conrad Creek, Hill Creek, and Bunnel Creek of which some are not perennial.
- **Water quality**:
  - Water quality problems in the Hangman Creek subbasin include low dissolved oxygen and elevated fecal coliform, pH, temperature and turbidity.
  - To address water quality problems, DEQ developed sediment, bacteria and temperature TMDLs for seven named streams with the Idaho portion of the subbasin but outside of the Coeur d'Alene Indian Reservation, including Hangman Creek, South Fork Hangman Creek, Tenas Creek, Martin Creek, Conrad Creek, Hill Creek, and Bunnel Creek. These TMDLs were approved by EPA in 2007. Because sediments

transport phosphorus, the sediment TMDL is applicable to nonpoint source phosphorus reduction. The sediment TMDL identified roads, mass failures, and accelerated stream bank erosion as sources of sediment (DEQ, 2007a).

- In the Washington portion of the watershed, Ecology and the Spokane County Conservation District worked together on a fecal coliform bacteria, temperature, and turbidity TMDL. Because of the phosphorus content of suspended solids, the turbidity TMDL relates to the NPS Study. Ecology published the final report and EPA approved the report in 2009. Ecology and the Spokane County Conservation District have been developing an Implementation Plan outlining what needs to occur to meet water quality targets in the watershed and various commitments to the effort. The draft implementation plan was available for public review and comment from February 15 to March 18, 2011 (Ecology, 2011).
- The draft Implementation Plan primarily focuses on addressing nonpoint and stormwater sources of pollutants. Regarding sediment and nutrient pollution, it identifies the need for: agricultural BMPs that keep soil on fields and reduce erosion; riparian fencing with off-stream watering for livestock; education about proper household fertilizer and chemical use and disposal; education about proper maintenance and inspection of septic systems; measures to address sediment from gravel roads, sheer/undercut banks, and stormwater; and compliance with forestry management regulations (Ecology, 2011).
- Hangman Creek also has dissolved oxygen and pH impairments which are typically the result of excess nitrogen and phosphorus. A separate TMDL to address these parameters will be developed when funding become available. However, many of the Implementation Plan strategies from the fecal coliform, temperature, and turbidity TMDL are expected to also address nonpoint sources contributing to the dissolved oxygen and pH impairments (Ecology, 2011).

3.5.2 Hangman Creek Subbasin Land Use

The Hangman Creek subbasin is dominated by agricultural cropland and pasture land uses, especially dryland farming (Table 3-5). It has the most agricultural land of all the subbasins. Dryland farming, “particularly where soils are highly erodible as in the Palouse region”, results in the transport of sediments and phosphorus (Ecology, 2000).

Hangman Creek flows through the western portion of the subbasin (Figure 3-4). The southeastern and northwestern portions of the subbasin are characterized by significant areas of forested land. There is some shrub and brush rangeland in the transitional areas between the agricultural land and forested land. Small communities have developed throughout the subbasin, primarily based on agricultural economy. Communities include the southern part of the City of Spokane, and the City of Fairfield, Latah, Rockford, Spangle, Tekoa, and Waverly. Cheney is located off the main drainage within the western portion of the subbasin.

Table 3-5. Hangman Creek Subbasin Land Use Area and Percent

Land Use Category	Land Use	Area (acres)	Percent (%)
Agriculture	Cropland and Pasture	224,467	51
Forested	Evergreen Forest Land	116,146	26
Rangeland	Shrub and Brush Rangeland	40,571	9
	Herbaceous Rangeland	28,121	6
Urban/Suburban	Other Urban	17,297	4
	Urban or Built-up Land	9,375	2
	Residential	2,461	1
Other	Total of Nine Other Land Uses	4,400	~1

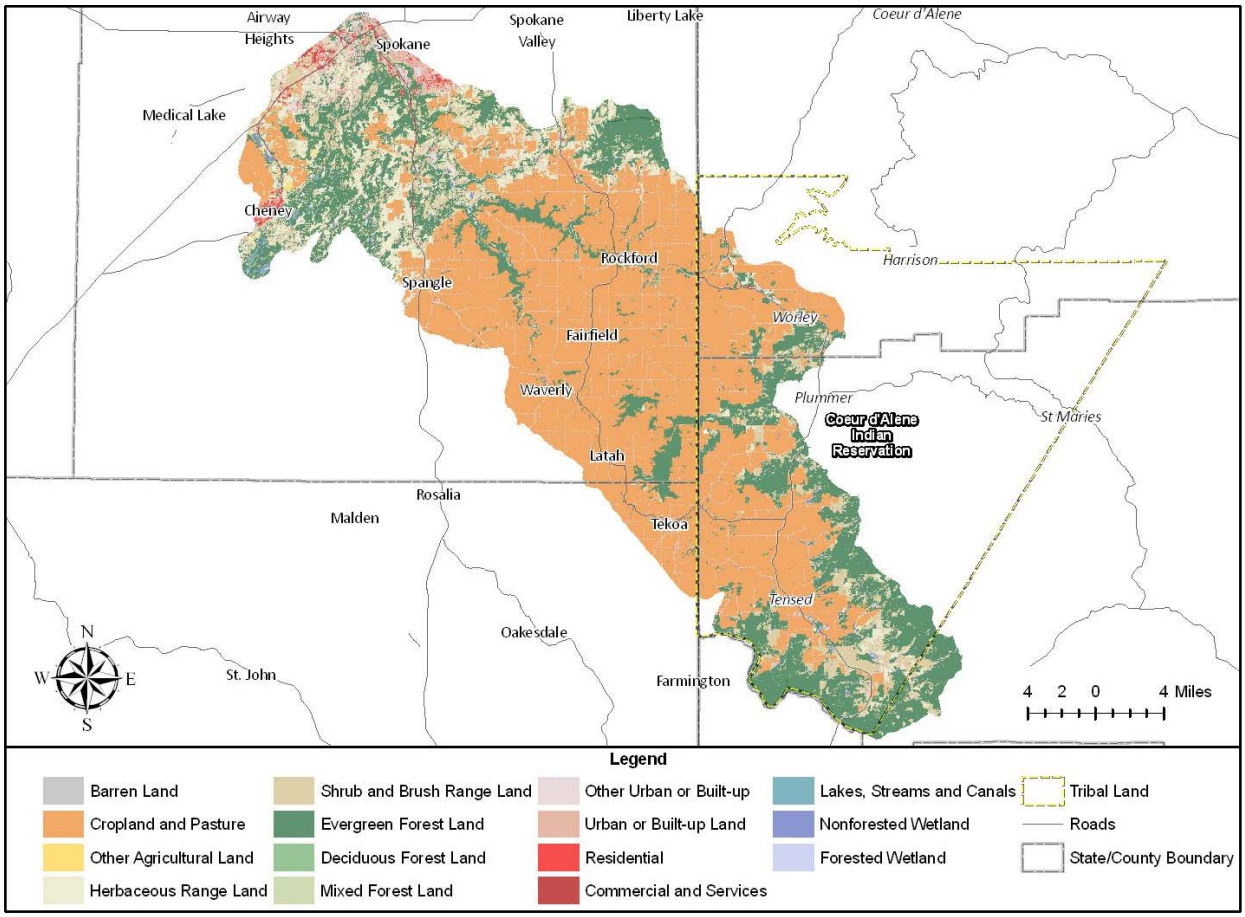

Figure 3-4. Hangman Creek Subbasin Land Use

3.5.3 Hangman Creek Subbasin Pollution Sources

Pollution sources in the Hangman Creek subbasin for nonpoint source phosphorus include stormwater runoff from developed areas and agricultural disturbance of soils (HDR, March, 2010), as well as runoff from agricultural areas (GeoEngineers, September 15, 2009). Six

potential nonpoint sources were identified by the Advisory Committee for Hangman Creek, which include: agricultural operations; livestock and wildlife; residential activities and land uses; agricultural field ditches; on-site sewage systems; and recreational impacts (Ecology, 2009).

3.6 Upper Spokane River ID Subbasin - Nonpoint Source Phosphorus

The Upper Spokane River ID subbasin is a transitional subbasin from the mostly forested land subbasins in the upper watershed to the more varied land uses in the lower subbasins. This subbasin contains much of the upgradient portion of the SVRP Aquifer.

3.6.1 Upper Spokane River ID Subbasin Characteristics

The Upper Spokane River ID subbasin is located in northwest Idaho and includes the Rathdrum Prairie, a 209 square mile area located west of the Coeur d'Alene Mountains, north of Coeur d'Alene Lake and south of Lake Pend Oreille. The subbasin extends from the outlet of Coeur d'Alene Lake to the Idaho-Washington state line, and is primarily located north of the Spokane River. Subbasin characteristics include:

- **Size:** The area of the Upper Spokane River ID subbasin is 242,535 acres or about 379 square miles. Of the ten subbasins, it is the sixth largest.
- **Topography:** The Rathdrum Prairie is located in the western portion of the Upper Spokane River ID Subbasin. The prairie is relatively flat and surrounded by uplands to the east, north and south. Surface elevation ranges from 1,473 feet near the banks of Spokane River downstream of river mile 95 to 5,658 feet near South Chilco Mountain.
- **Hydrologic characteristics**:
  - In the Upper Spokane River ID subbasin, the Spokane River flows from Coeur d'Alene Lake to the Washington-Idaho state line through the southwest portion of the subbasin. Coeur d'Alene Lake is situated southeast of the subbasin and Pend Oreille Lake is situated northeast of the subbasin. Several smaller lakes (including Hauser, Hayden, and Twin) are located within the subbasin and at the fringes of the Rathdrum Prairie.
  - Mean annual precipitation averages about 12 to 40 inches per year with the majority of the subbasin near the low end of the range and the greatest precipitation in the eastern mountains (OSU, 2006).
  - The Spokane River near Post Falls (USGS 12419000) stream gage near the middle/downstream end of the subbasin has a median annual discharge flow of 6,246 cfs. The annual discharge ranges from a high of 11,600 cfs in 1974 to a low of 2,143 cfs in 1977 over the period of record. Monthly discharges are typically greatest in May due to snowmelt, precipitation, and operations at Post Falls Dam and least in August. Monthly flows ranged from a high of 34,930 cfs in May 1997 to a low of 185 cfs in August 1958.
  - Phosphorus is delivered from the subbasin by runoff from stream flows in the mountains adjacent to the prairie and either into the lake basins or onto the prairie, where these streams infiltrate rapidly into the underlying SVRP

Aquifer. The lakes at the margin of the prairie discharge in part, or fully, to the SVRP Aquifer at aquifer boundaries" (DEQ, 2000). Streams in the subbasin such as Fish Creek and Rathdrum Creek typically have flows less than 100 cfs and discharge either to one of the lakes or infiltrates to the SVRP Aquifer at the aquifer margins

- **Water quality:** The Spokane River, within the upper Spokane River ID subbasin, has identified water quality issues related to elevated total phosphorus, cadmium, lead and zinc concentrations. Nutrient (total phosphorus) TMDLs were developed for Hauser, Hayden, and Twin Lakes and approved by EPA in 2001. The total phosphorous TMDL developed for Twin Lakes also addresses two of its tributaries, Fish and Rathdrum Creeks. The dissolved oxygen limitation of Hauser Lake is dependent on total phosphorous reductions.

3.6.2 Upper Spokane River ID Subbasin Land Use

The Upper Spokane River ID subbasin is a transitional subbasin extending from the mostly forested land subbasins in the upper watershed to the more varied land uses in the lower subbasins. The Spokane River flows within this subbasin from Coeur d'Alene Lake to the Washington state line (Figure 3-5). The largest land use is forested land (Table 3-6) around much of the subbasin except for north of the Spokane River in the Rathdrum Prairie where there is a mix of rangeland, agriculture, and urban/suburban/rural land uses. Communities in the subbasin include the cities of Coeur d'Alene, Hayden, and Post Falls. The majority of the population of northern Idaho lives in this subbasin. Urban/suburban land uses can provide significant nonpoint source phosphorus loads.

Table 3-6. Upper Spokane River ID Subbasin Land Use Area and Percent

Land Use Category	Land Use	Area (acres)	Percent (%)
Forested	Evergreen Forest Land	147,298	61
Rangeland	Shrub and Brush Rangeland	30,566	13
	Herbaceous Rangeland	14,708	6
Agriculture	Cropland and Pasture	14,201	6
Urban/Suburban	Urban or Built-Up Land	14,325	6
	Other Urban	6,431	3
	Residential	4,898	2
Water	Lakes	5,336	2
Other	Total of Eight Other Land Uses	4,772	~1

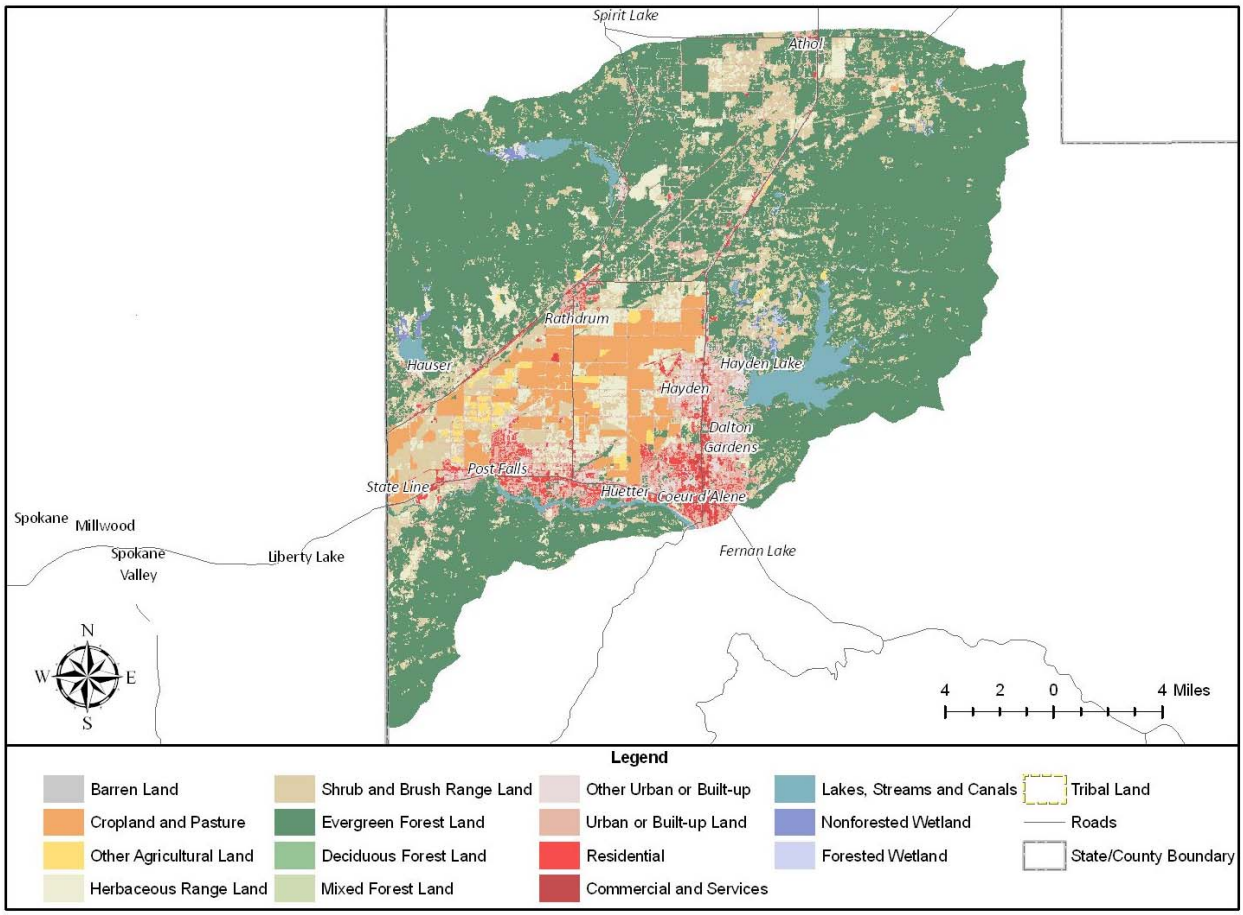

Figure 3-5. Upper Spokane River ID Subbasin Land Use

3.6.3 Upper Spokane River ID Subbasin Pollution Sources

Pollution sources in the Upper Spokane River ID subbasin for nonpoint source phosphorus include stormwater runoff from developed and forested areas (HDR, March, 2010), agricultural areas within the Rathdrum Prairie, and on-site sewage systems and stormwater infiltration to groundwater within developed area. (GeoEngineers, September 15, 2009). Because the sole-source SVRP Aquifer underlies a relatively large portion of the Upper Spokane River ID subbasin, protection of groundwater from surface water impacts is an important issue in the subbasin.

3.7 Coeur d'Alene Lake Subbasin - Nonpoint Source Phosphorus

The Coeur d'Alene Lake subbasin is dominated by Coeur d'Alene Lake and surrounding forested lands. Coeur d'Alene Lake is a transitional area from the upper watershed tributaries to the headwaters of the Spokane River.

3.7.1 Coeur d'Alene Lake Subbasin Characteristics

The Coeur d'Alene Lake subbasin is located in northern Idaho, includes the City of Coeur d'Alene at the western end, and extends east of the town of Cataldo. The majority of the

subbasin is south of Interstate 90 (I-90) and includes Coeur d'Alene Lake and portions of the Coeur d'Alene Indian Reservation. Subbasin characteristics include:

- **Size:** The area of the Coeur d'Alene Lake subbasin is 421,532 acres or about 659 square miles. Of the ten subbasins, it is the fifth largest.
- **Topography:** Coeur d'Alene Lake, at normal pool elevation, is 2,128 feet above sea level. "The lake's two principal tributaries are the Coeur d'Alene River and St. Joe River which drain the Coeur d'Alene and St. Joe Mountains, subsets of the Bitterroot Range" (DEQ, 1996). Surface elevation ranges from 2,118 feet near the Coeur d'Alene River banks to 6,406 feet near Latour Peak.
- **Hydrologic characteristics**:
  - Coeur d'Alene Lake is the primary surface water in the subbasin, which lies in a natural river valley. The lake stage elevation is controlled by Post Falls Dam. Flow discharges from the lake at its northwest margin to form the Spokane River. Coeur d'Alene Lake encompasses about 49.8 square miles at its normal full-pool elevation, with a maximum water depth of about 209 feet.
  - Mean annual precipitation averages about 12 to 40 inches per year with most of the subbasin near the low end of the range and greater precipitation in the surrounding mountains (OSU, 2006).
  - The Coeur d'Alene River near Cataldo (USGS 12413500) stream gage upstream of Coeur d'Alene Lake has a median annual discharge flow of 2,515 cfs. The annual discharge ranges from to a high of 4,057 cfs in 1996 to a low of 1,043 cfs in 1944 over the period of record. Monthly discharges are typically greatest in April due to snowmelt and spring precipitation and least in September. Monthly flows ranged from a high of 15,070 cfs in May 2008 to a low of 238 cfs in November 1929.
  - Phosphorus is delivered to the subbasin by runoff from tributaries surrounding the lake and groundwater flow from two upstream subbasins. The principal tributaries are the St. Joe's River and the Coeur d'Alene River, with numerous other smaller tributaries draining into the lake (DEQ and Coeur d'Alene Tribe, 2009). Such tributaries to the lake include Wolf Lodge Creek including its tributary Cedar Creek, Cougar Creek, Mica Creek, and Latour Creek including its tributaries Baldy and Larch Creeks.
- **Water quality:**
  - Water quality in Coeur d'Alene Lake has generally improved since the mid-1970s as large-scale mining-related activities upstream of the lake tapered off and environmental cleanup activities got underway in the Silver Valley. The primary environmental concern in Coeur d'Alene Lake is the potential for release of metal contaminants contained in the lake bottom sediments into the water column. The 2009 Coeur d'Alene Lake Management Plan goal is *to protect and improve lake water quality by limiting basin-wide nutrient inputs that impair lake water quality conditions, which in turn influence the solubility of mining-related metals contamination contained in lake sediments* (DEQ and Coeur d'Alene Tribe, 2009).

- A USGS study suggested that Coeur d'Alene Lake may retain about half of total phosphorus inflow load due to high iron concentrations and high adsorption as particulate phosphorus (Woods, 2004). A comparison of historically reported inflow and outflow loads of total phosphorus suggested a similar deposition rate in the range of 50 to 60 percent.
- A 1999 Coeur d'Alene Lake and River Subbasin Assessment and Proposed TMDL identified eighteen discrete water bodies within and surrounding the Coeur d'Alene Lake subbasin that are limited by at least one pollutant. Impairments included temperature, sediment and bacteria. The assessment resulted in sediment TMDLs for North and South Forks of the Coeur d'Alene River, Wolf Lodge Creek including its tributary Cedar Creek, Cougar Creek, Mica Creek, and Latour Creek including its tributaries Baldy and Larch Creeks. It also resulted in a bacteria TMDL for Mica Creek (DEQ, 1999).

3.7.2 Coeur d'Alene Lake Subbasin Land Use

The Coeur d'Alene Lake subbasin is dominated by surface water and surrounding forested land (Table 3-7). Coeur d'Alene Lake covers a large land area in the subbasin and is a transitional area from the upper watershed tributaries to the headwaters for the Spokane River (Figure 3-6). Shrub and brush rangeland is interspersed within the forested land. Agricultural land uses occur along the western portion along the border with the Hangman Creek subbasin. Wetlands are present along the lower South Fork of the Coeur d'Alene River. There is little urban/suburban land use except along the northern margin of Coeur d'Alene Lake and Fernan Lake, and within the City of Coeur d'Alene.

Table 3-7. Coeur d'Alene Lake Subbasin Land Use Area and Percent

Land Use Category	Land Use	Area (acres)	Percent (%)
Forested	Evergreen Forest Land	263,663	63
Rangeland	Shrub and Brush Rangeland	72,155	17
	Herbaceous Rangeland	11,835	3
Water	Lakes	33,087	8
Agriculture	Cropland and Pasture	17,844	4
Wetland	Forested Wetland	4,806	1
	Nonforested Wetland	3,929	1
Urban/Suburban	Urban or Built-up Land	4,489	1
	Other Urban	4,229	1
Other	Total of Seven Other Land Uses	5,495	~1

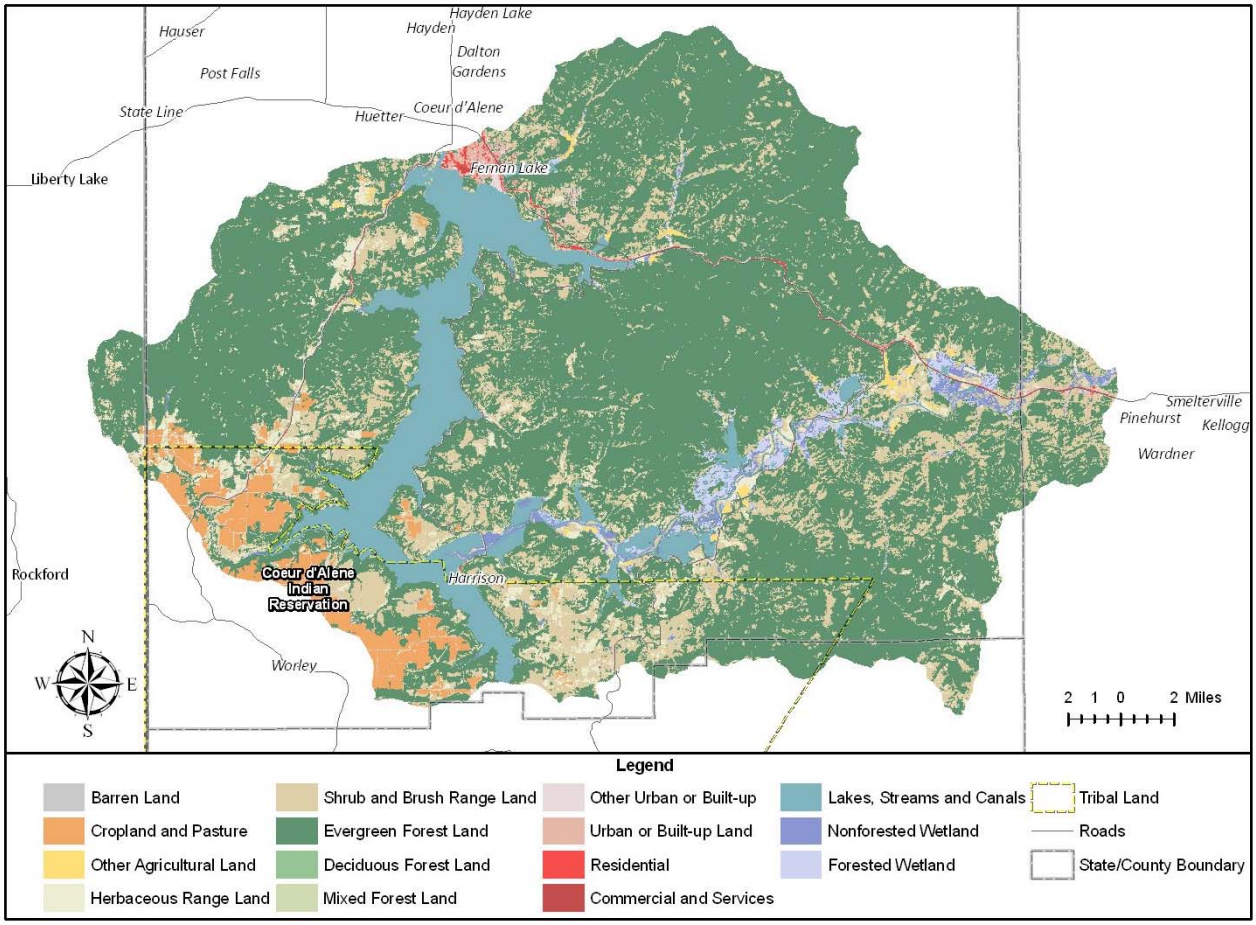

Figure 3-6. Coeur d'Alene Lake Subbasin Land Use

3.7.3 Coeur d'Alene Lake Subbasin Pollution Sources

Pollution sources in the Coeur d'Alene Lake subbasin for nonpoint source phosphorus include agricultural disturbance of soils, stormwater runoff from developed, rural and forested areas, and wetlands (HDR, March, 2010). Additional sources include: on-site sewage systems near the lake; and numerous tributaries that provide a delivery mechanism from upstream areas that are disturbed by agricultural and forestry activities; bank erosion; stormwater runoff from near-shore development; and natural cycling of lake organic matter (GeoEngineers, September 15, 2009).

3.8 Upper Coeur d'Alene River Subbasin - Nonpoint Source Phosphorus

The Upper Coeur d'Alene River subbasin primarily consists of forested lands. Forestry management is an important activity for protecting water quality in the headwaters of the Spokane River Watershed. Much of the subbasin is part of the Coeur d'Alene National Forest.

3.8.1 Upper Coeur d'Alene River Subbasin Characteristics

The Upper Coeur d'Alene River subbasin is situated in the northeastern portion of the Spokane River Watershed reaching to the Idaho-Montana border. It is north of I-90 and the City of Kellogg. Subbasin characteristics include:

- **Size:** The area of the Upper Coeur d'Alene River subbasin is 573,387 acres or about 896 square miles. It is the second largest subbasin in the study area.
- **Topography:** The Upper Coeur d'Alene River Subbasin is forested and mountainous. Elevations rise from 1,600 feet near the confluence of the North Fork Coeur d'Alene River and the Coeur d'Alene River to the mountains in the north and east. Maximum surface elevation within the subbasin is about 6,814 feet near Granite Peak.
- **Hydrologic characteristics**:
  - "The Coeur d'Alene River discharges into Coeur d'Alene Lake near the town of Harrison, Idaho. The river has three major reaches, the North Fork, the South Fork, and the reach downstream of the two forks" (DEQ, 1996).
  - Mean annual precipitation averages about 12 to 40 inches per year with most of the subbasin greater than 20 inches per year (OSU, 2006).
  - The North Fork Coeur d'Alene River at Enaville (USGS 12413000) stream gage near the downstream margin of the subbasin has a median annual discharge flow of 1,932 cfs. The annual discharge ranges from a high of 3,281 cfs in 1974 to a low of 599 cfs in 1977 over the period of record. Monthly discharges are typically greatest in April due to snowmelt and spring precipitation and least in September. Monthly flows ranged from a high of 12,210 cfs in May 2008 to a low of 167 cfs in September 2001.
  - Phosphorus primarily is delivered to the subbasin by runoff from tributaries. The upper Coeur d'Alene River subbasin includes the North Fork and its numerous tributaries including Tepee Creek, East Fork Eagle Creek, Prichard Creek and Beaver Creek.
- **Water quality:** A 2001 Subbasin Assessment and TMDL of the North Fork Coeur d'Alene River identified sediments and metals as pollutants of concern. The assessment resulted in subbasin-wide sediment TMDLs for the entire North Coeur d'Alene River; a TMDL addressing cadmium, lead and zinc for East Fork Eagle Creek; and recommendations for additional metals TMDLs (DEQ, 2001). As of 2009, elevated temperature impairment has been identified throughout much of the subbasin, with metals impairment identified in Prichard and Beaver Creeks. Temperatures exceedances have been determined based on criteria for salmonid spawning and cold water aquatic life. While causes have not yet been determined, a lack of shade resulting from harvesting activities or forest fires is a potential cause.

3.8.2 Upper Coeur d'Alene River Subbasin Land Use

Land use within the Upper Coeur d'Alene River subbasin consists primarily of forested lands (Table 3-8). The subbasin is in the northeastern portion of the watershed extending to the Idaho-Montana border (Figure 3-7). There are few paved roads or communities in the subbasin; however there over 1,000 miles of forest service roads. DEQ (1996) reports that, "Activities within the Coeur d'Alene River basin include recreation, logging, agriculture, mining and ore processing. Mining and ore processing activities are located mostly in the South Fork Basin."

Table 3-8. Upper Coeur d'Alene River Subbasin Land Use Area and Percent

Land Use Category	Land Use	Area (acres)	Percent (%)
Forested	Evergreen Forest Land	536,569	94
Rangeland	Shrub and Brush Rangeland	29,275	5
Other	Total of Eleven Other Land Uses	7,543	~1

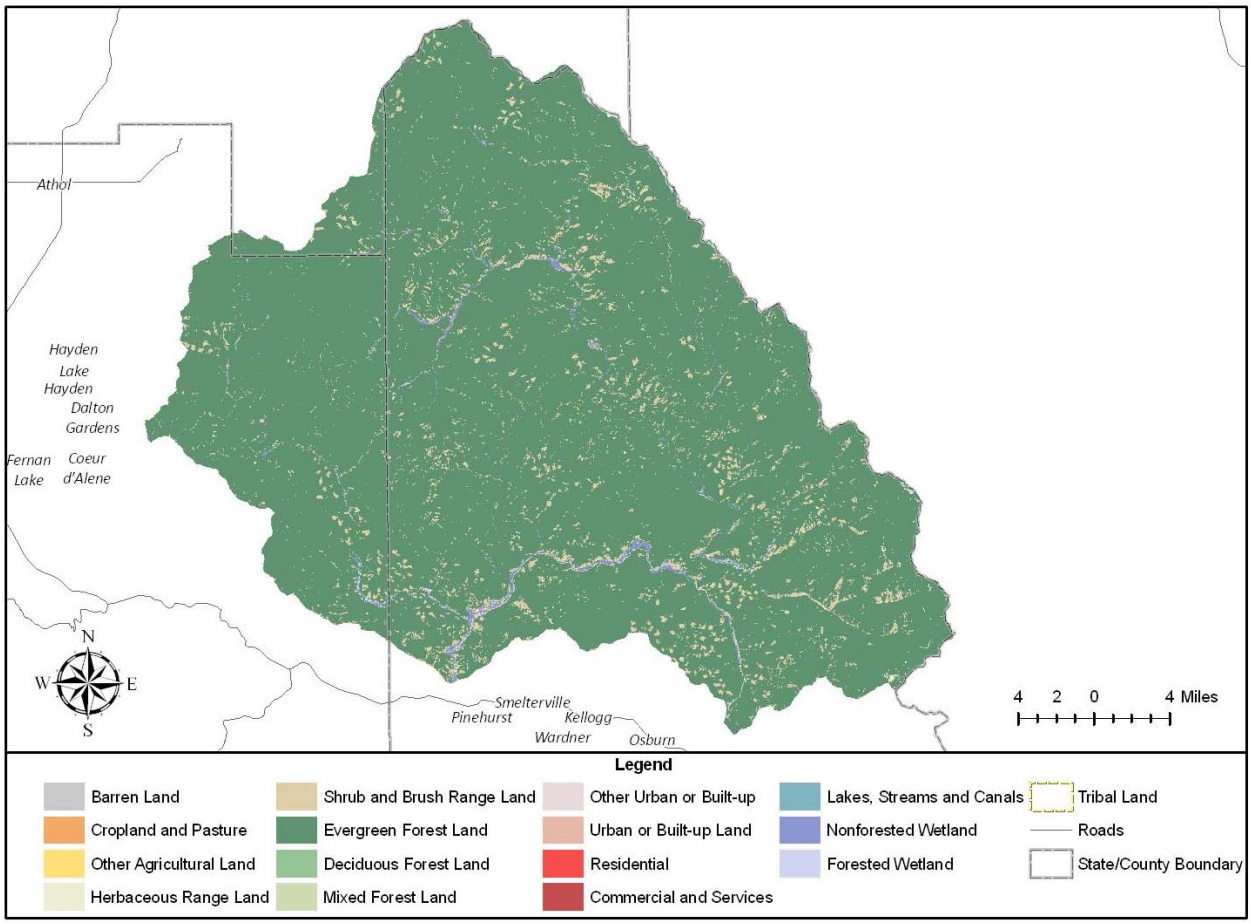

Figure 3-7. Upper Coeur d'Alene River Subbasin Land Use

3.8.3 Upper Coeur d'Alene River Subbasin Pollution Sources

Pollution sources in the Upper Coeur d'Alene River subbasin for nonpoint source phosphorus include stormwater runoff (HDR, March, 2010) and forestry practices that result in the disturbance of soils, especially from erosion caused by using unpaved roads and logged areas (GeoEngineers, September 15, 2009).

3.9 South Fork Coeur d'Alene River Subbasin - Nonpoint Source Phosphorus

The South Fork Coeur d'Alene River subbasin is also primarily forested lands and forestry management is an important activity for protecting water quality. Historical mining activities

have impacted water quality within the subbasin; remediation activities to address these impacts are ongoing.

3.9.1 South Fork Coeur d'Alene River Subbasin Characteristics

The South Fork of the Coeur d'Alene River drains a region known as the Silver Valley in Shoshone County, Idaho. I-90 bisects the subbasin from near Pinehurst, Idaho to the Idaho-Montana border. The towns of Kingston, Pinehurst, Smelterville, Kellogg, Wardner, Osburn, Silverton, Wallace and Mullan are located along I-90 and are within the subbasin. Subbasin characteristics include:

- **Size:** The area of the South Fork Coeur d'Alene River subbasin is 191,232 acres or about 299 square miles. Compared to the other subbasins in the study area, it is relatively small. Only one of the ten subbasins is smaller.
- **Topography:** The South Fork Coeur d'Alene River flows through the middle of the subbasin and parallels I-90. The river gains elevation from west to east. The lower elevations are to the west, along I-90 and the broader river valley. Areas to the south and north of the river gain elevation. To the east, the subbasin extends to Lookout Pass on I-90 at the Idaho-Montana border with an elevation of 4,680 feet. Surface elevation ranges from 2,158 feet near the South Fork Coeur d'Alene River and the sawmill outside of Enavilla to 6,822 feet near Stevens Peak.
- **Hydrologic characteristics**:
  - In the upper reaches of the South Fork of the Coeur d'Alene River, above the town of Wallace and near the town of Mullan, the river is in a narrow valley and receives flow from numerous tributaries with steep slopes. In the lower reaches below Wallace, the valley broadens and the river flows over alluvial deposits (DEQ, 1993).
  - Mean annual precipitation averages about 12 to 40 inches per year with less precipitation in the valley and greater precipitation in the mountains (OSU, 2006).
  - The South Fork Coeur d'Alene River near Pinehurst (USGS 12413470) stream gage at the downstream end of the subbasin has a median annual discharge flow of 521 cfs. The annual discharge ranges from a high of 846 cfs in 1997 to a low of 232 cfs in 2001 over the period of record. Monthly discharges are typically greatest in May due to snowmelt and precipitation and least in September. Monthly flows ranged from a high of 2,940 cfs in May 2008 to a low of 75 cfs in September 2001.
  - Phosphorus is delivered to the subbasin by runoff from tributaries. Numerous small tributaries flow into the river from the north (i.e., Canyon Creek, Ninemile Creek, Moon Creek) and south (i.e., Placer Creek, Big Creek, Pine Creek).
- **Water quality:** A 2002 South Fork Coeur d'Alene River Sediment Subbasin Assessment and TMDL identified sediments and metals as pollutants of concern. The assessment resulted in a sediment TMDL that encompasses Canyon Creek, Ninemile

Creek, East Fork Ninemile Creek, Government Gulch, Pine Creek, East Fork Pine Creek and the South Fork from the Canyon Creek confluence to the mouth. The TMDL also states that the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedial action plan will address mining impacts in the watershed (DEQ, 2002).

3.9.2 South Fork Coeur d'Alene River Subbasin Land Use

The South Fork Coeur d'Alene River subbasin is dominated by forested land (Table 3-9). It is the smallest subbasin by land mass. The subbasin is bisected by I-90 from near Pinehurst, Idaho to the Idaho-Montana border (Figure 3-8). Rangeland is interspersed throughout the subbasin with larger shrub and brush areas located in the western portion of the subbasin. Urban/suburban areas are mostly concentrated along the I-90 corridor and include the cities of Kellogg, Mullan, Osburn, Pinehurst, Smelterville, and Wallace. Historical mining activities have impacted the watershed, which are undergoing remediation.

Table 3-9. South Fork Coeur d'Alene River Subbasin Land Use Area and Percent

Land Use Category	Land Use	Area (acres)	Percent (%)
Forested	Evergreen Forest Land	140,975	74
Rangeland	Shrub and Brush Rangeland	41,057	22
	Herbaceous Rangeland	2,415	1
Urban/Suburban	Urban or Built-up Land	1,605	1
	Residential	1,596	1
Other	Total of Eleven Other Land Uses	3,584	~1

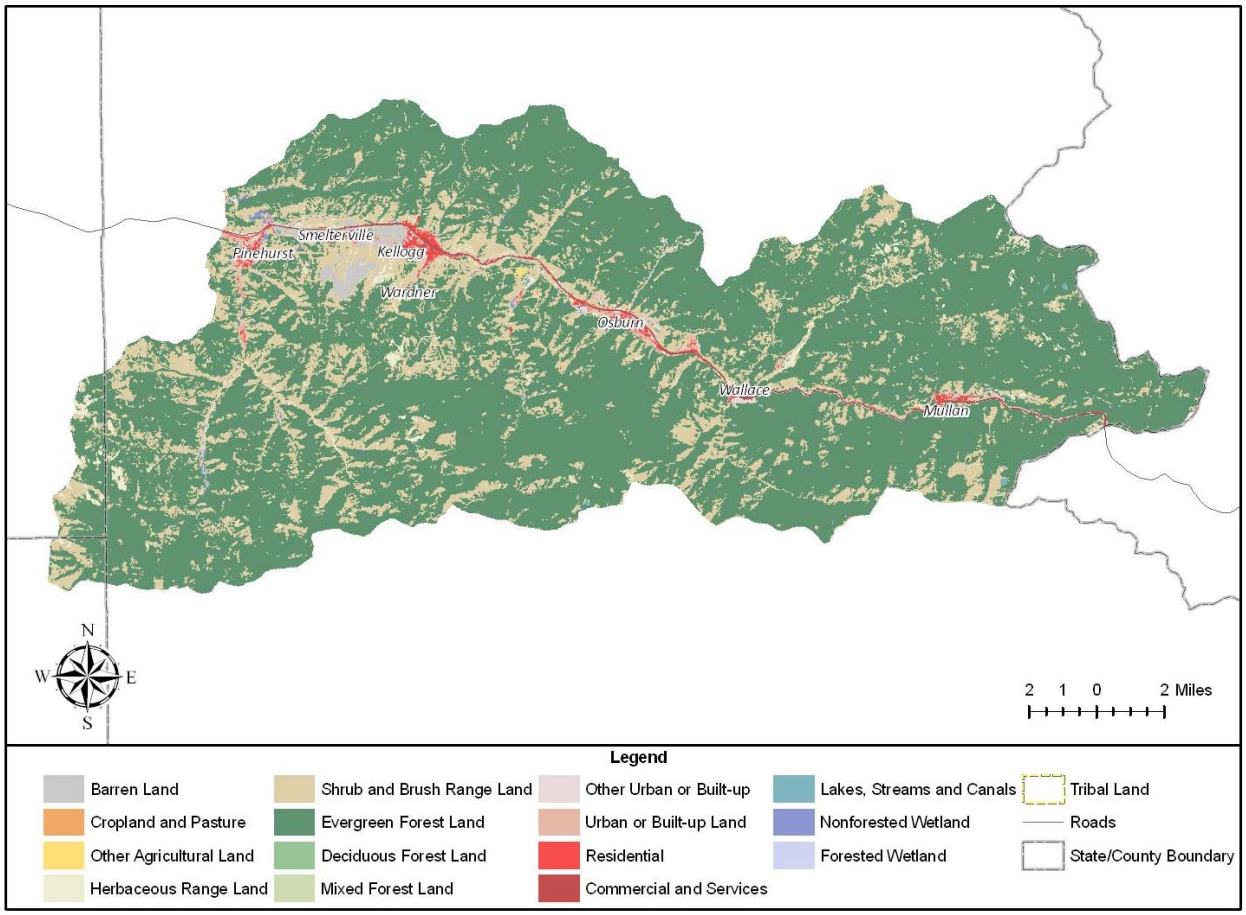

Figure 3-8. South Fork Coeur d'Alene River Subbasin Land Use

3.9.3 South Fork Coeur d'Alene River Subbasin Pollution Sources

Pollution sources in the South Fork Coeur d'Alene River subbasin for nonpoint source phosphorus include stormwater runoff from developed areas (HDR, March, 2010), forestry practices resulting in the disturbance of soils (especially from roads and bank erosion), and surface and groundwater impacts from current and historical mining activities (GeoEngineers, September 15, 2009).

3.10 St. Joe River Subbasin - Nonpoint Source Phosphorus

The St. Joe River subbasin is dominated by forested lands and forestry management is an important activity for protecting water quality. It is the largest subbasin by land mass. The subbasin extends from the southern portion of Coeur d'Alene Lake to the Idaho-Montana border. The Coeur d'Alene Indian Reservation encompasses 345,000 acres in the western portion of the subbasin.

3.10.1 St. Joe River Subbasin Characteristics

The St. Joe River subbasin is located south of the Coeur d'Alene Lake and South Fork Coeur d'Alene River subbasins and east of the Hangman Creek subbasin. It extends from the upper end

of Lake Coeur d'Alene east to the Idaho-Montana border. The towns of St. Maries and Calder are located within the subbasin. Subbasin characteristics include:

- **Size:** The St. Joe River subbasin is the largest subbasin in the Spokane River Watershed. It is 1,180,579 acres or about 1845 square miles in area.
- **Topography:** The St. Joe River generally flows east to west through the middle of the subbasin. It is noted for being the highest elevation, fully navigable river in the United States. Its headwaters are at the eastern edge of the subbasin at the Idaho-Montana border. The lower elevations are to the west. The St. Maries River is in the southern portion of the subbasin. Areas to the south and north of the St. Joe and St. Maries Rivers also gain elevation and ascend into upland areas. Surface elevation ranges from 2,125 feet near the bank of Benewah Lake to 7,500 feet near Illinois Peak.
- **Hydrologic characteristics**:
  - The headwaters of the St. Joe River are at the Idaho-Montana border where it flows west-northwest and ultimately discharges into the southern end of Coeur d'Alene Lake. The St. Joe River is joined by the St. Maries River at the City of St. Maries (DEQ, 1996).
  - Mean annual precipitation averages about 12 to 56 inches per year with less precipitation in the valley and greater precipitation in the mountains (OSU, 2006).
  - The St. Joe River at the Calder (USGS 12414500) stream gage near the downstream end of the subbasin has a median annual discharge flow of 2,287 cfs. The annual discharge ranges from a high of 3,955 cfs in 1974 to a low of 1,059 cfs in 1944 over the period of record. Monthly discharges are typically greatest in May due to snowmelt and spring precipitation and least in September. Monthly flows ranged from a high of 14,990 cfs in May 1997 to a low of 204 cfs in January 1929.
  - Numerous tributaries flow from the higher forested elevations and mountains into both rivers and provide the delivery mechanism for phosphorus. Tributaries include Gold Center Creek, Gramp Creek, Flewsie Creek, Emerald Creek, and Santa Creek.
- **Water quality**:
  - Pollutants of concern identified in the St. Joe River include sediment, nutrients, bacteria, dissolved oxygen and temperature. A 2003 St. Joe River Assessment and Total Maximum Daily Loads resulted in temperature TMDLs for all 303(d) listed segments; sediment TMDLs for Mica, Fishhook, and Bear Creeks; and recommendations for delisting some streams and pollutants (DEQ, 2003).
  - Pollutants of concern identified in the St. Maries River also include sediment, nutrients, bacteria, dissolved oxygen and temperature. A 2003 St. Maries River Assessment and TMDL resulted in: a sediment TMDL for the entire St. Maries subbasin; temperature TMDLs for Gold Center Creek (including Gramp, Flewsie, Emerald, and Santa Creeks), as well as the St. Maries River and its West and Middle Forks; and recommendations for delisting some streams and pollutants (DEQ, 2003).

3.10.2 St. Joe River Subbasin Land Use

The St. Joe River subbasin is mostly forested land with some shrub and brush rangeland (Table 3-10). The Coeur d'Alene Indian Reservation encompasses 345,000 acres in the western portion of the subbasin. The St. Joe River discharges to the southern end of Coeur d'Alene Lake near the city of St. Maries (Figure 3-9). Shrub and brush rangeland is interspersed throughout the subbasin. Communities include the cities of Plummer and St. Maries. Recreation and logging are the dominant activities; very little mining activity has occurred in the St. Joe River basin" (DEQ, 1996).

Table 3-10. St. Joe River Subbasin Land Use Area and Percent

Land Use Category	Land Use	Area (acres)	Percent (%)
Forested	Evergreen Forest Land	864,172	73
Rangeland	Shrub and Brush Rangeland	276,919	24
Other	Total of Fifteen Other Land Uses	39,488	~3

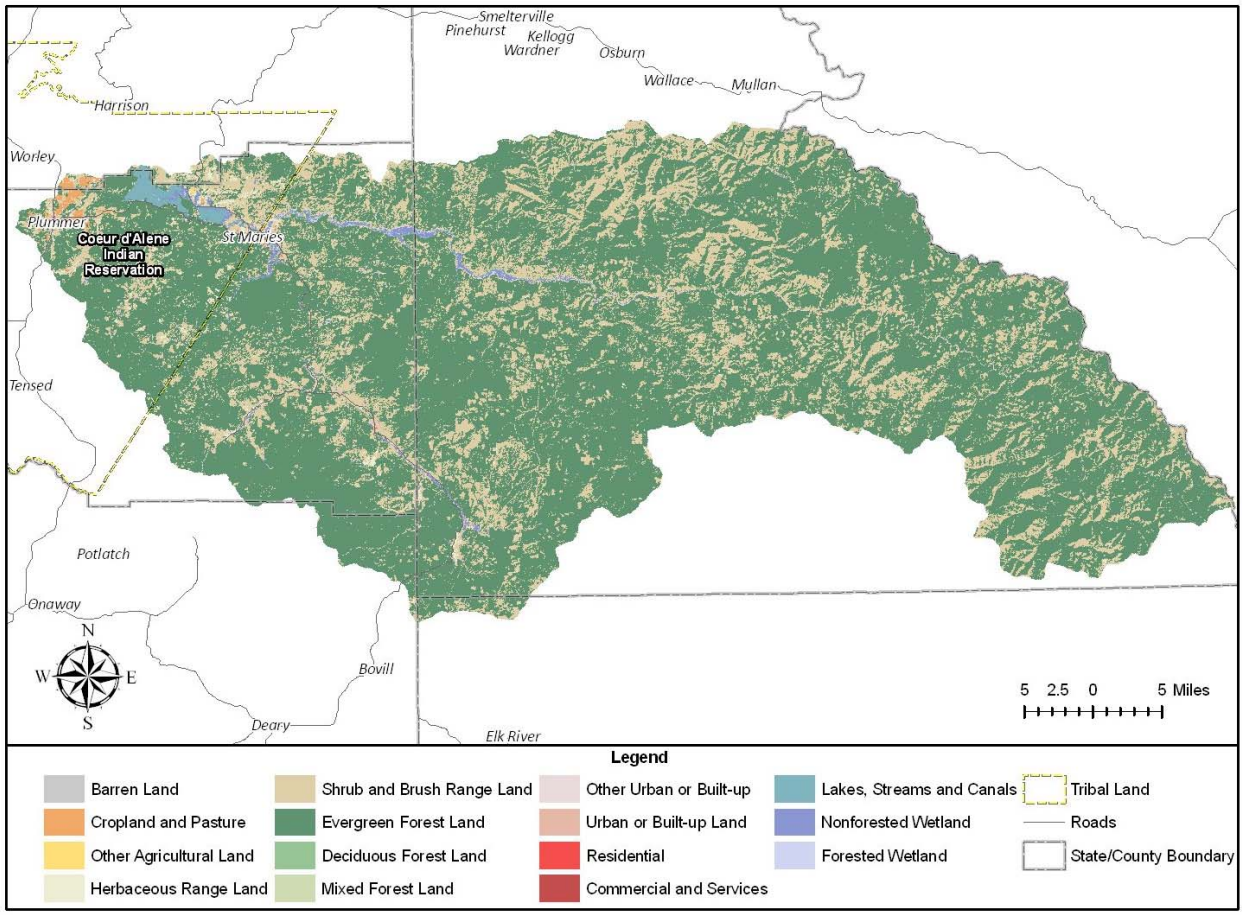

Figure 3-9. St. Joe River Subbasin Land Use

3.10.3 St. Joe River Subbasin Pollution Sources

Pollution sources in the St. Joe River subbasin for nonpoint source phosphorus include stormwater runoff from developed areas (HDR, March, 2010) and forestry practices that result in the disturbance of soils, bank erosion, and agricultural and grazing (GeoEngineers, September 15, 2009).

3.11 Pend Oreille Lake Subbasin - Nonpoint Source Phosphorus

The Pend Oreille Lake subbasin is dominated by forested lands and forestry management is an important activity for protecting water quality. This subbasin contains much of the upgradient portion of the SVRP Aquifer with the surface waters primarily infiltrating into the aquifer.

3.11.1 Pend Oreille Lake Subbasin Characteristics

The Pend Oreille Lake subbasin includes the portion of the watershed north of the Upper Spokane River ID subbasin and east of the Little Spokane River subbasin. The subbasin includes Spirit Lake and community of Spirit Lake. Parts of the Athol area are also in this subbasin. Subbasin characteristics include:

- **Size:** The area of the Pend Oreille Lake subbasin is 166,315 acres or about 260 square miles. Compared to the other subbasins in the study area, it is relatively small. Only one of the ten subbasins is smaller.
- **Topography:** The western and northern portion of the subbasin generally is underlain by shallow bedrock and has relatively higher topographic relief compared to the rest of the subbasin, which rests on a plateau composed of glacial sand and gravel. The highest points are Mount Spokane and Hoodoo Mountain. The SVRP Aquifer begins in Idaho between Spirit Lake and the south end of Lake Pend Oreille.
- **Hydrologic characteristics**:
  - Mean annual precipitation averages about 10 to 25 inches per year across the subbasin (OSU, 2006).
  - The Spirit Lake Watershed is estimated to provide about 100 cfs of recharge to the SVRP Aquifer (USGS, 2005).
- **Water quality:** Collected data indicate that Spirit Lake is meeting the total phosphorus goal and dissolved oxygen standards (DEQ, 2009). There is little additional surface water or groundwater quality data from the remainder of the subbasin and the majority of this data is from the rural residential areas and less from the upper forested parts (HDR, March, 2010). Phosphorus concentrations are generally low with some potential increasing trends in areas with greater development.

3.11.2 Pend Oreille Lake Subbasin Land Use

The Pend Oreille Lake subbasin (Figure 3-10) consists of mostly forested land with some shrub and brush rangeland (Table 3-11).

Table 3-11. Pend Oreille Lake Subbasin Land Use Area and Percent

Land Use Category	Land Use	Area (acres)	Percent (%)
Forested	Evergreen Forest Land	138,334	83
Rangeland	Shrub and Brush Rangeland	13,980	8
	Herbaceous Rangeland	5,601	3
Other	Total of Thirteen Other Land Uses	8,400	6

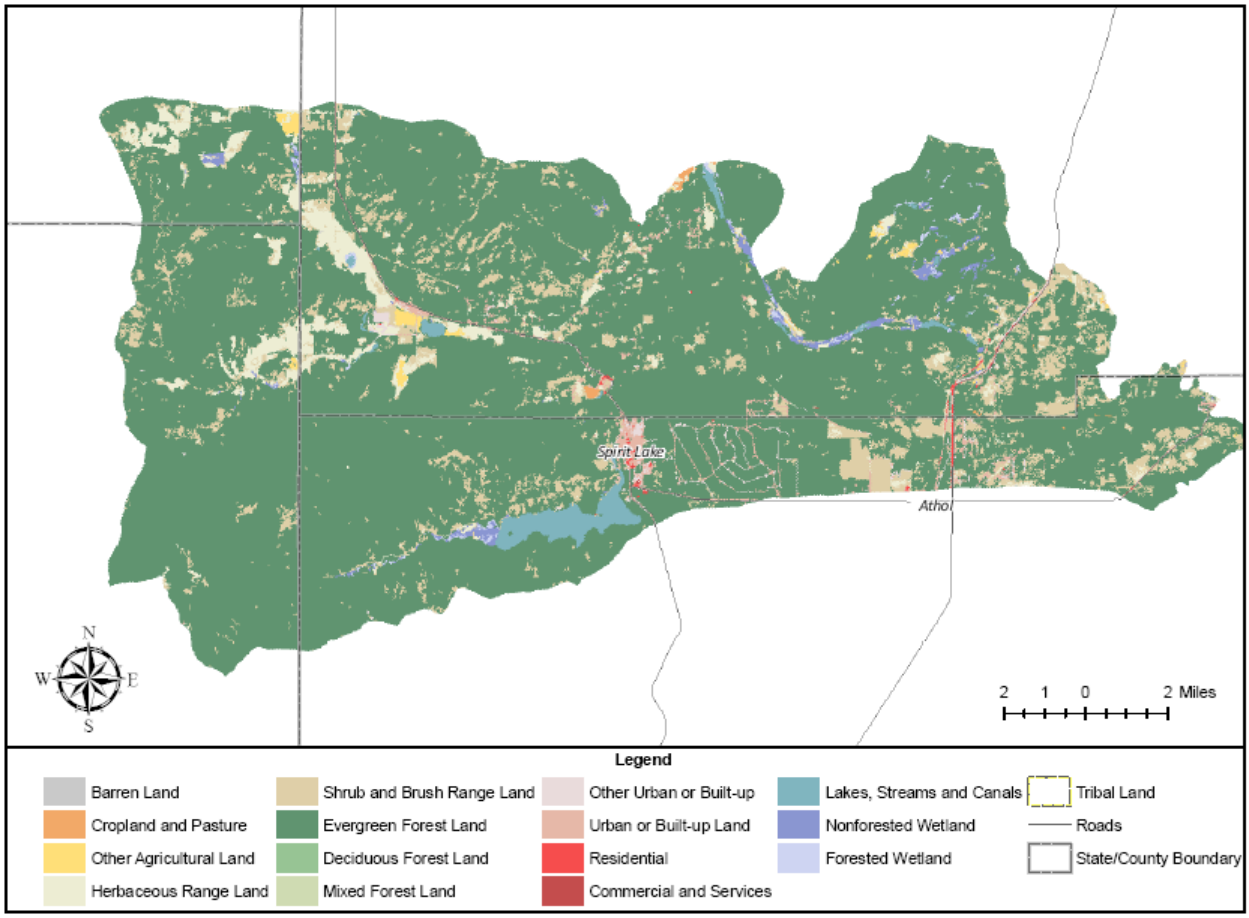

Figure 3-10. Pend Oreille Lake Subbasin Land Use

3.11.3 Pend Oreille Lake Subbasin Pollution Sources

Pollution sources in the Pend Oreille Lake subbasin for nonpoint source phosphorus include general rural- and forested-related impacts (HDR, March, 2010) and forestry practices that result in the disturbance of soils and bank erosion and associated mobilization of sediment. (GeoEngineers, September 15, 2009).

3.12 Conclusions

Land uses and associated nonpoint phosphorus pollution sources were reviewed in the Spokane River Watershed at the subbasin scale. Land use data was provided by the USGS in the 2001

NLCD and was categorized as: agricultural, developed urban/suburban land, forested land and rangeland. The Spokane River Watershed has large areas of forested land with areas of interspersed rangeland, agriculture and urban/suburban/rural land uses. The largest area of forested land occurs throughout much of the upper watershed in Idaho and the northern portion in Washington. Agricultural land use is prevalent in the southwestern portion of the watershed. Most of the urban/suburban development is located along the Spokane River.

Overlaying land uses and phosphorus loads at the watershed scale suggest that urban/suburban and agricultural land uses may result in a higher rate of nonpoint source phosphorus loading per unit surface area. The linkage between these land uses and loads at a local scale is related to specific sources typical of the land use (Table 3-1). By identifying these sources and implementing actions, improvements in water quality can be achieved. Watershed methods that could help reduce nonpoint source phosphorus include:

- Control and treatment of stormwater runoff.
- Management and reduction of on-site sewage systems.
- Protection of groundwater recharge areas.
- Protection of riparian zones and minimization of stream bank erosion.
- Reduction of phosphorus loads from developed areas.
- Targeted potential reductions from agricultural areas.

Selecting management activities involves identifying “what” nonpoint source phosphorus BMPs are appropriate, as discussed in Chapter 8. More detailed information on recommended management activities and BMPs for the individual subbasins is included in Chapters 10 through 19.

Chapter 4

Spokane River Watershed – Nonpoint Source Phosphorus

4.1 Water Quality Report Screening

An initial step in the NPS Study was a compilation of existing information and data regarding nonpoint sources of phosphorus within the Spokane River Watershed. Toward that end, over 100 water quality reports published between approximately 1970 and 2008 that potentially examined phosphorus concentrations in groundwater or surface water within the Spokane River Watershed were screened for relevant and credible data to use in the NPS Study. These data were then entered into the Spokane NPS Database for analysis. A methodology was developed to review and screen these reports based on the Washington State Credible Data Policy (Ecology, 2006). A flow chart with set criteria and decision points was developed as part of the methodology to provide a consistent screening of the reports (GeoEngineers, June 26, 2008). The Nonpoint Source Advisory Committee (NPAC) including DEQ, Ecology, and EPA reviewed and accepted the methodology.

The selection points in the methodology flow chart were documented along with comments, and a determination was made on the relevance and credibility of the reports. Approximately 70 percent of the reports were deemed relevant for the NPS Study. Of the reports deemed relevant, nearly 80 percent were deemed credible for the NPS Study.

4.2 Report and Data Credibility Assessment

The Spokane River Watershed was subdivided into subbasins. The subbasin boundaries primarily follow USGS HUC boundaries. An exception is the split of the Upper Spokane River subbasin into separate Idaho and Washington subbasins. The Lower Spokane River and Pend Oreille Lake HUC boundaries were also clipped to match the extent of the study area.

The distribution of the reports screened by subbasin was examined. The Upper Spokane River WA subbasin had the greatest number of reports followed by the Lower Spokane River and Coeur d'Alene Lake subbasins. The Pend Oreille Lake subbasin had the least number of reports followed by the Upper Coeur d'Alene River subbasin and the SVRP Aquifer. The number of relevant and credible reports followed a similar order, with the exception of the Little Spokane River subbasin surpassing the Coeur d'Alene Lake subbasin.

The distribution of reports by subbasin was also examined by the study type, groundwater, sediments, and surface water. Groundwater and surface water information followed a similar trend. For groundwater there are more reports for the Washington subbasins than Idaho subbasins, which include reports on the SVRP Aquifer. For surface water, the difference is not as large between Washington and Idaho subbasins; however, most of the Idaho reports are from the Upper Spokane River ID and Coeur d'Alene Lake subbasins. Most of the reports for sediments are also from the Upper Spokane River ID and Coeur d'Alene Lake subbasins.

4.3 Nonpoint Source Phosphorus Database

Phosphorus data from the credible reports were entered into a Microsoft Access database to create the Spokane NPS Database. This resulted in a project database consisting of nearly 65,000 data points. The Spokane NPS Database was made available to the NPAC via a project Sharepoint site, so that NPAC members could spatially view the data and/or perform independent analyses.

The Spokane NPS Database, including its structure and data entry specifications, was described in detail by GeoEngineers (November 18, 2008). For surface water, laboratory analytical information (such as laboratory name, date of analysis, phosphorus species, result, laboratory detection limits) is paired with sample information (such as source, date of sampling, location coordinates, depth, etc.). For groundwater, the above information is supplemented with specific information regarding well construction and ownership.

4.4 Summary of Phosphorus Dataset

4.4.1 Data Count

There are nearly 65,000 data points in the Spokane NPS Database from nearly 1,900 monitoring locations. The first step to summarizing this large dataset was to map watershed characteristics and then visually present the data. The watershed characteristics that were mapped to aide in interpretation included: percent impervious surface, slope, hillshade, flow gaging sites, and well locations.

The number of total phosphorus samples was mapped to indicate where relevant and credible data are available throughout the watershed. The mapping included groundwater and surface water samples for the entire Spokane River Watershed, along with maps scaled to provide greater detail for the SVRP Aquifer and individual subbasins.

The distribution of total phosphorus data for groundwater is relatively sparse throughout much of the Spokane River Watershed. Most groundwater data are associated with the SVRP Aquifer, particularly the portion of the SVRP Aquifer that is located in Washington. Surface water data generally are more widely distributed throughout the watershed, particularly in the Little Spokane River and Hangman Creek subbasins. For the Upper Spokane River WA and ID, and Coeur d'Alene Lake subbasins, surface water data are primarily around the Spokane River and Coeur d'Alene Lake. The eastern portion of the watershed has the least amount of data. Summaries of the distribution (and count) in total phosphorus concentrations in groundwater and surface water are presented in Figures 4-1 and 4-2, respectively.

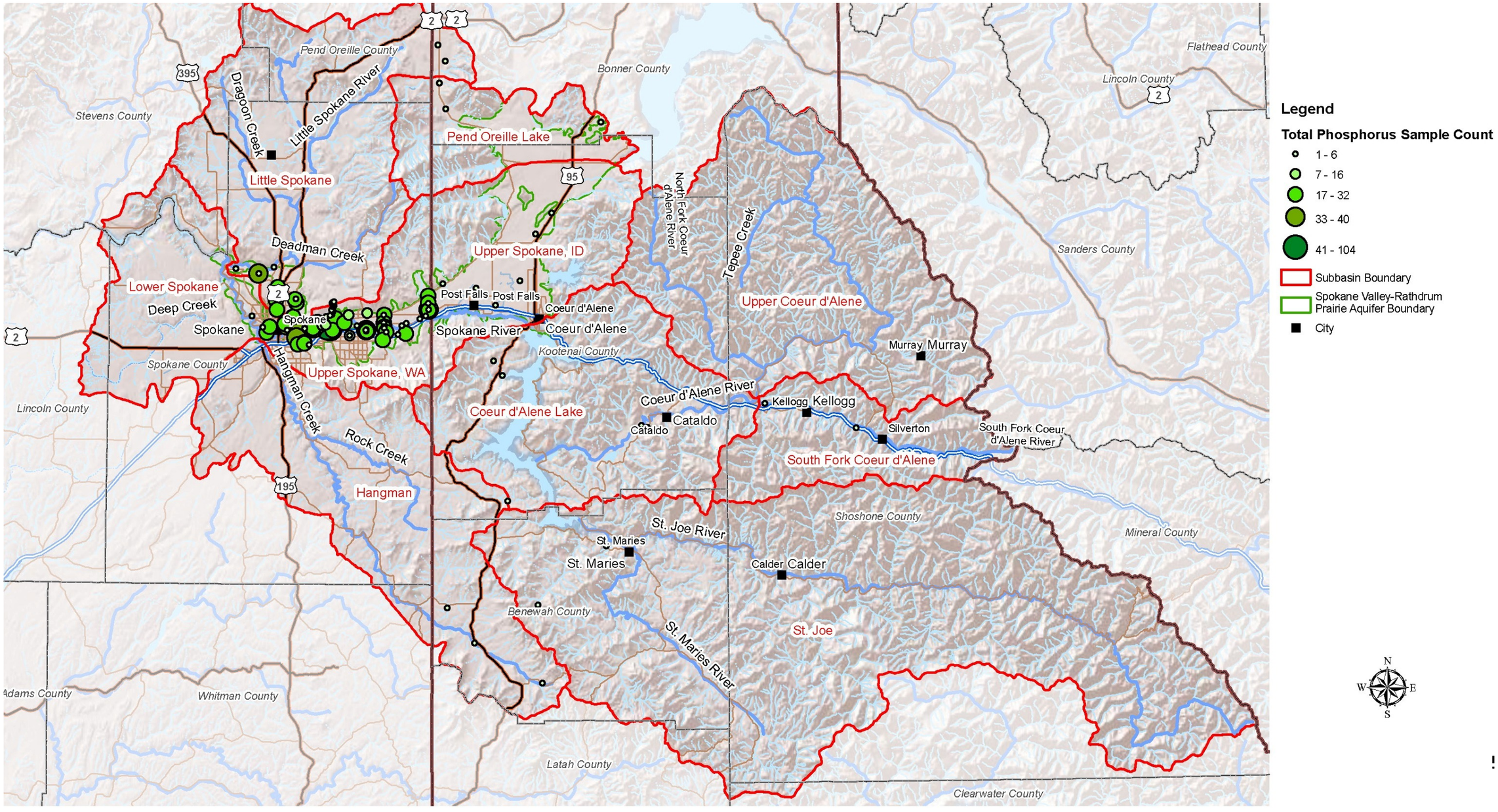

Figure 4-1. Total Phosphorus in Groundwater, Sample Count for the Project Area

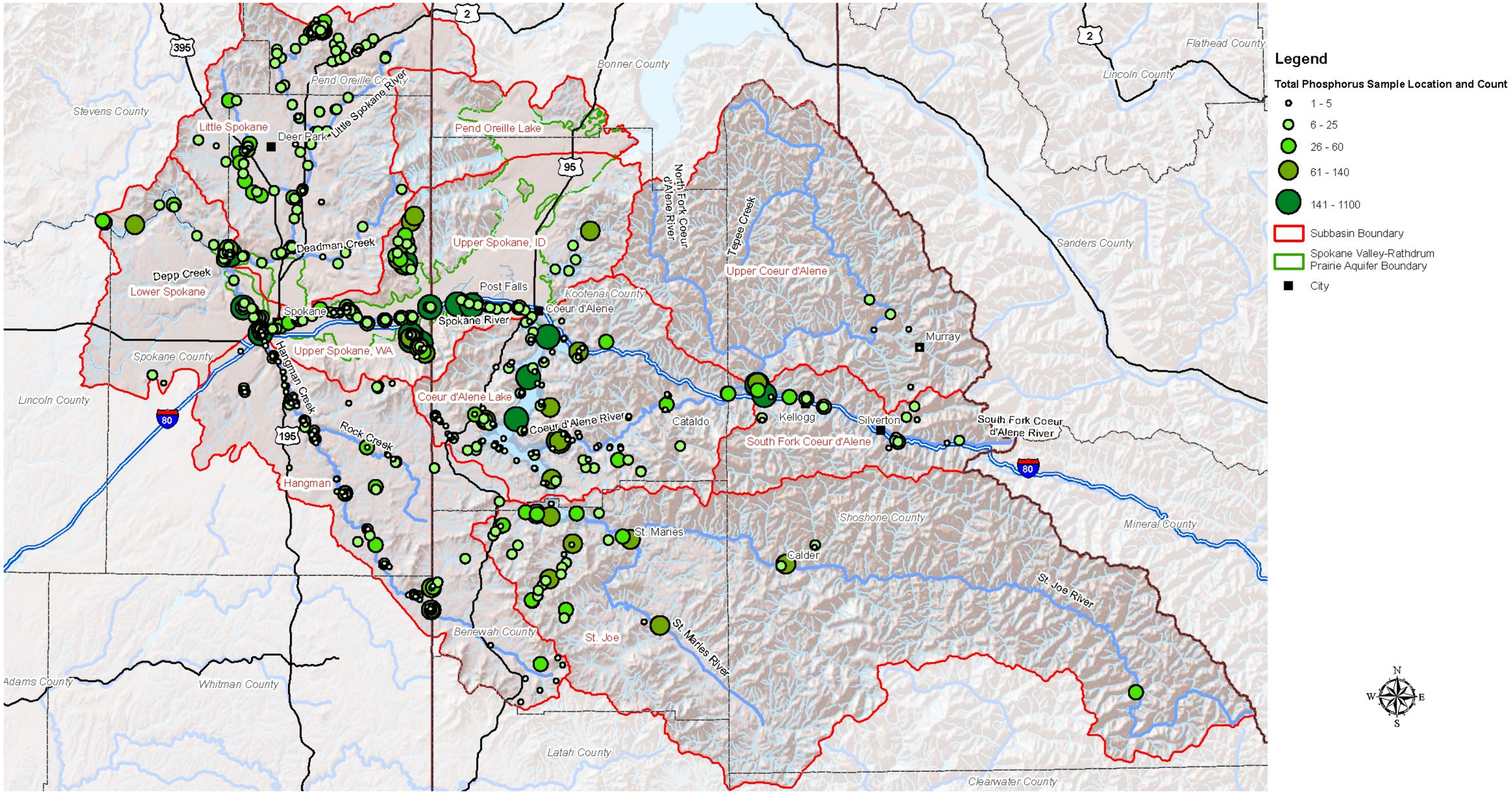

Figure 4-2. Total Phosphorus in Surface Water, Sample Count for the Project Area

4.4.2 Average Total Phosphorus Concentration

The average total phosphorus concentration at each pertinent sampling location was calculated and mapped to visually compare the data range and provide an indication of areas with relatively high total phosphorus concentrations. The greatest total phosphorus concentrations in groundwater were from the few wells in the southern portion of the watershed and the area of the Spokane Valley north of the Spokane River. The greatest total phosphorus concentrations in surface water were in Hangman Creek, the Spokane River, and the downstream reach of the Little Spokane River. Maps presenting average total phosphorus concentration in groundwater and surface water are provided in Figures 4-3 and 4-4, respectively.

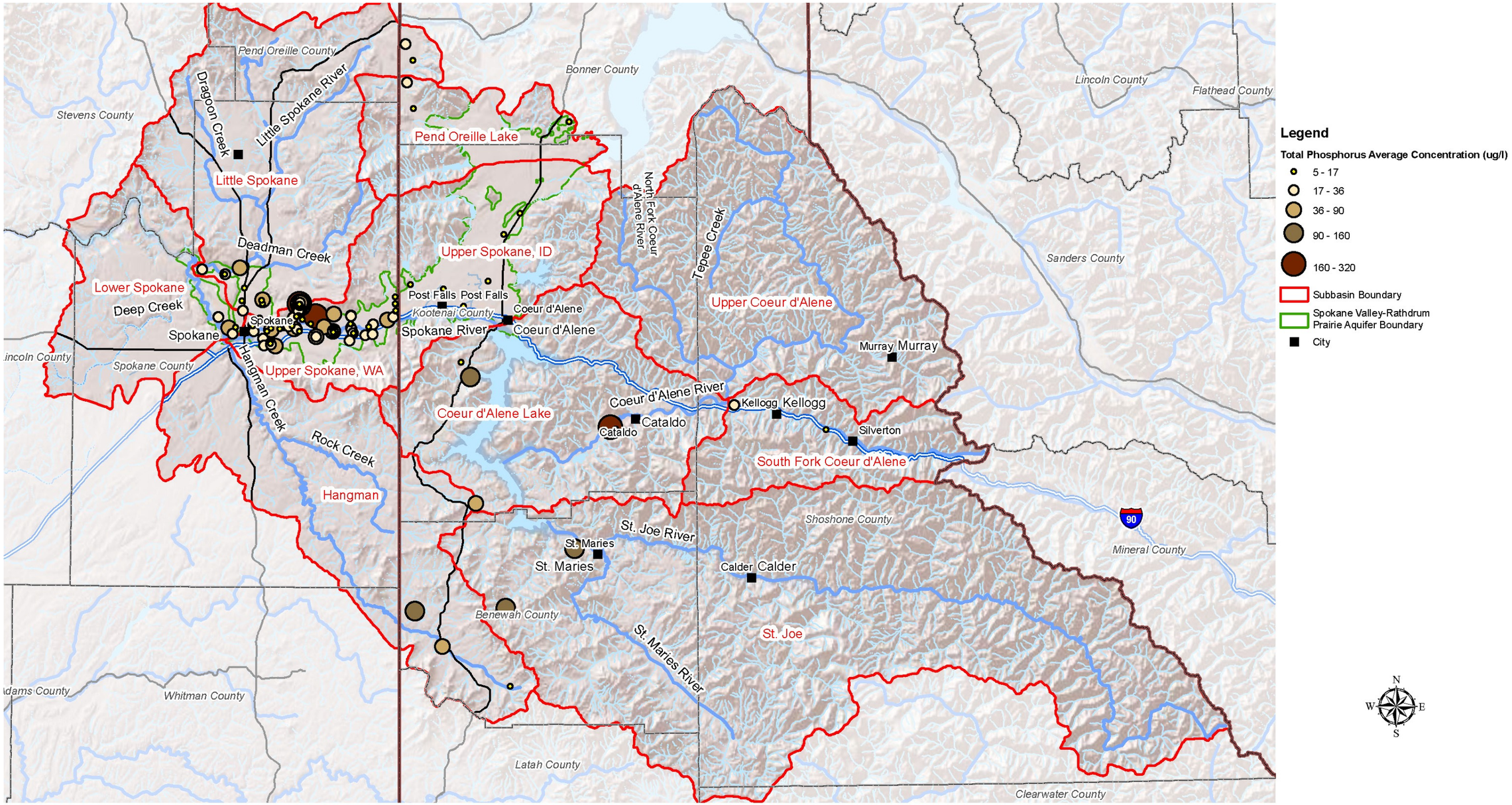

Figure 4-3. Total Phosphorus in Groundwater, Average Concentration for the Project Area

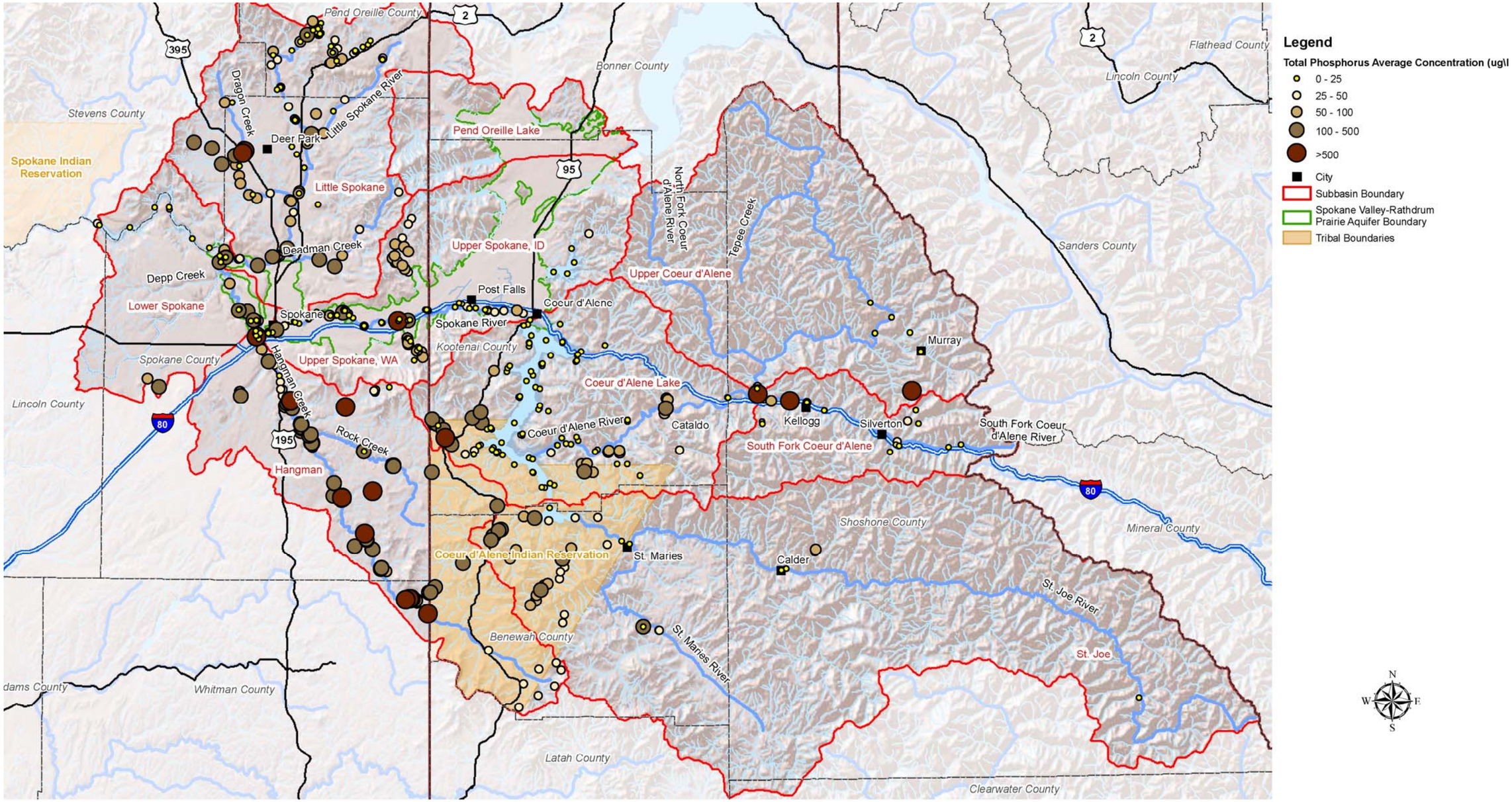

Figure 4-4. Average Total Phosphorus Concentrations in Surface Water for the Project Area

4.4.3 Total Phosphorus Loading

For each surface water sampling location that contains flow and total phosphorus concentration data, average total phosphorus load (average flow times average concentration) was calculated. The pattern of loads is similar to concentrations with the greatest loads occurring in the Spokane River below the City of Spokane. A summary of average total phosphorus loading in surface water is presented in Figures 4-5.

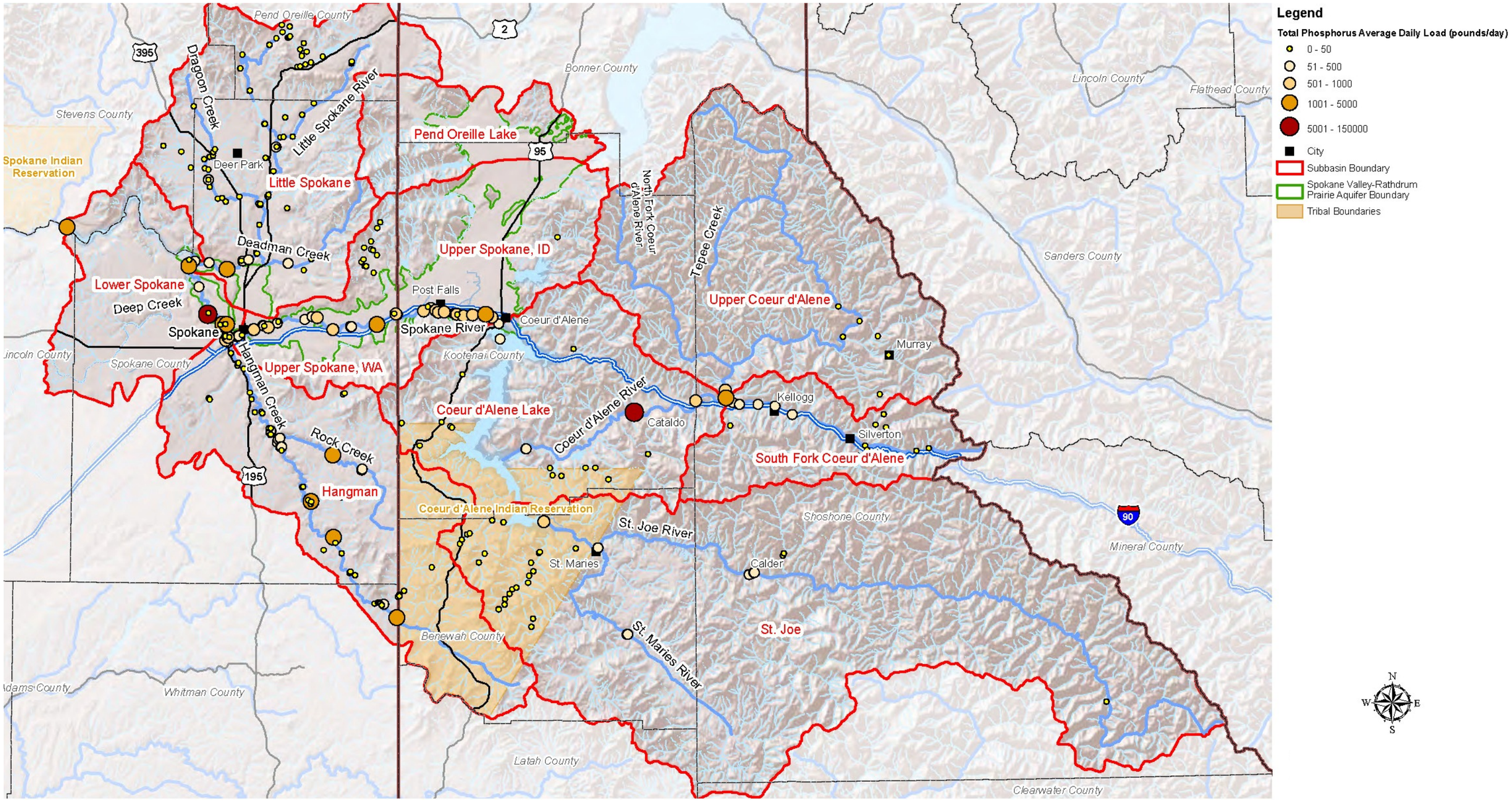

Figure 4-5. Average Daily Load, Total Phosphorus in Surface Water

4.4.4 Septic System Density

Areas with a high density of septic systems have a greater potential to overload soil capacity resulting in phosphorus breakthrough to groundwater. Additionally, areas with a high density of septic systems are more cost effectively connected to a sewer system that treats wastewater at a water reclamation facility than areas with diffuse septic systems.

Available septic system distribution data within the Spokane River Watershed were compiled using Geographic Information System (GIS). Analysis was performed to map septic system density within Spokane County, Washington and Kootenai County, Idaho using methods described by GeoEngineers (August 20, 2009). Development of the septic system density grid was completed using active septic tank locations and using the kernel density analysis tool in ArcGIS Spatial Analyst with a cell size of 500 feet and a radius search of 350 feet (GeoEngineers, August 20, 2009). It was found that the greatest densities occur in the Spokane Valley and in the Little Spokane River subbasin along US-2 north of the merge with US-395. Septic system density distribution is summarized in Figure 4-6.

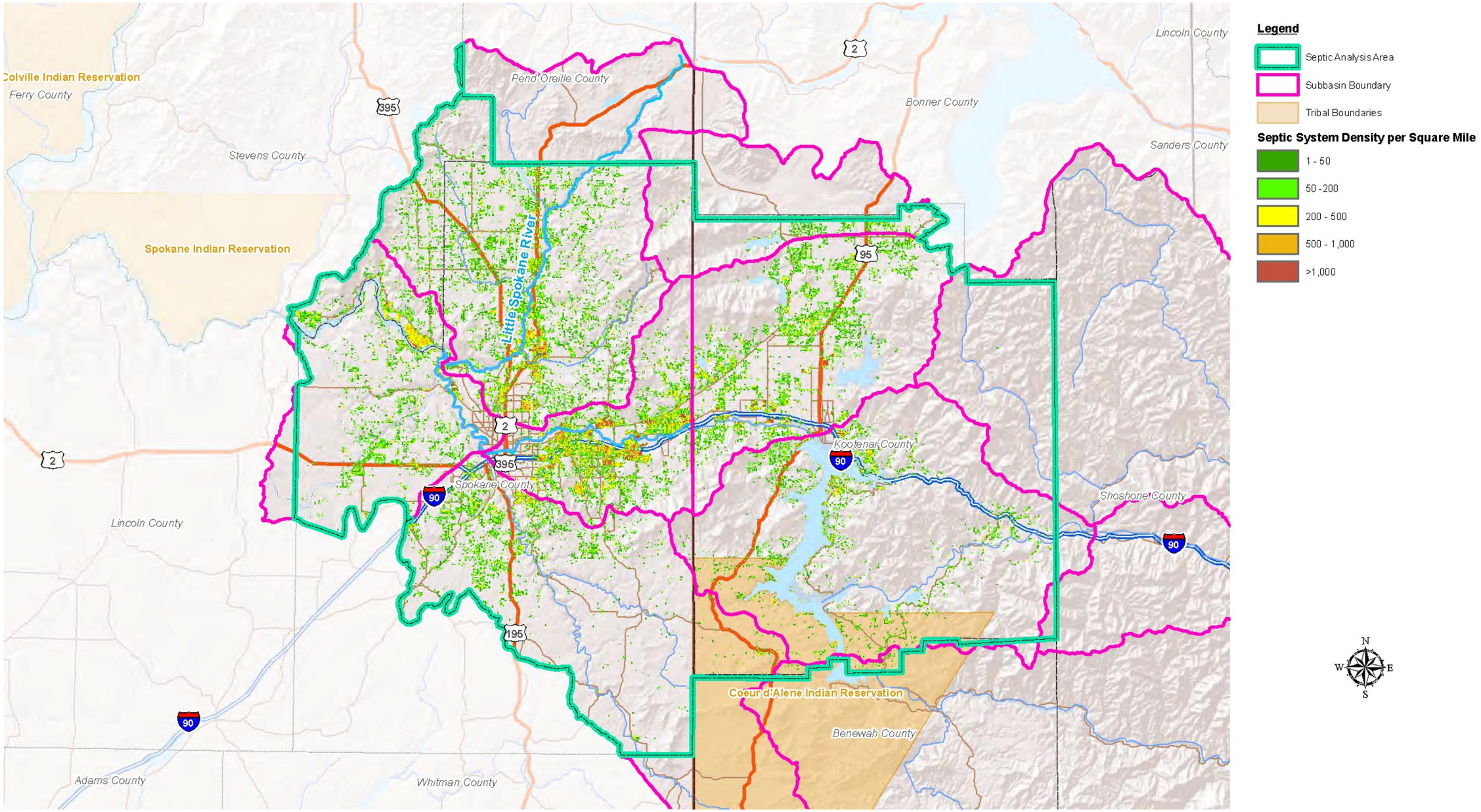

Figure 4-6. Septic System Density

4.5 Groundwater Total Phosphorus Data Analysis

As a component of the NPS Study, total phosphorus data were analyzed as a basis for estimating groundwater loading to surface water as documented in the following:

- GeoEngineers' Technical Memorandum titled *Preliminary Groundwater Loading Analyses, Bi-State Nonpoint Source Study*, dated August 4, 2009. This technical memorandum provides preliminary groundwater loading for the Spokane River and its tributaries by examining total phosphorus concentrations in groundwater adjacent to gaining stream reaches.
- GeoEngineers' Technical Memorandum titled *Preliminary Groundwater Loading Analyses – Lake Spokane Bi-State Nonpoint Source Phosphorus Study*, dated October 20, 2010. This technical memorandum evaluates total phosphorus loading directly into Lake Spokane from nearshore unconsolidated aquifers.

In GeoEngineers' August 4, 2009 technical memorandum, baseflow and total phosphorus concentration data were used to preliminarily estimate total phosphorus loads entering surface water from groundwater along gaining stream segments within the Spokane River Watershed. Sufficient data were available to develop loading estimates along the Spokane River, Little Spokane River, and Hangman Creek, as summarized below:

1. Spokane River (about 136.5 pounds per day [lbs/day]).
2. Little Spokane River (about 18.4 lbs/day).
3. Hangman Creek (about 6.2 lbs/day).

This yields a relative loading (from groundwater) contribution of about 85 percent, 11 percent and 4 percent, respectively for the Spokane River, Little Spokane River, and Hangman Creek, respectively. This does not include impacts from groundwater sources upgradient of Coeur d'Alene Lake and downgradient of Nine Mile Falls Dam.

The total phosphorus loads entering the Spokane River from the SVRP Aquifer are presented below as a function of stream segment, organized by decreasing loading rate:

1. Flora Road to Centennial Trail Bridge (about 85.9 lbs/day).
2. Centennial Trail Bridge to below Green Street (about 31.1 lbs/day).
3. Rifle Club Road to below Nine Mile Dam (about 7.6 lbs/day).
4. Spokane to T.J. Meenach Bridge (about 6.8 lbs/day).
5. T.J. Meenach Bridge to Rifle Club Road (about 5.1 lbs/day).

Preliminary loading estimates to the mainstem Spokane River, Little Spokane River, and Hangman Creek are summarized in Figure 4-7.

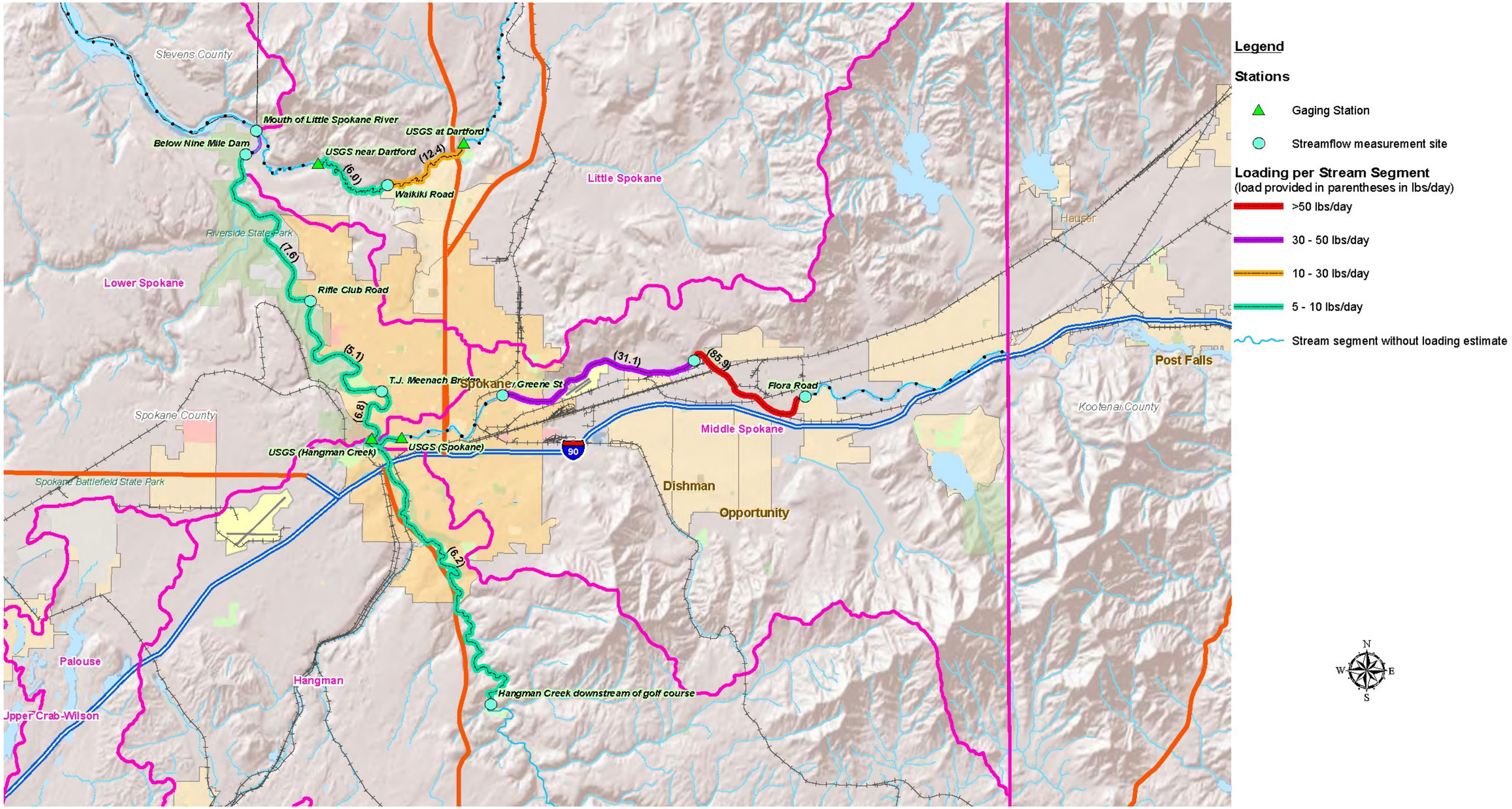

Figure 4-7. Total Phosphorus Loading from Groundwater

GeoEngineers (October 20, 2010) focused on the geometry and flow characteristics of nearshore unconsolidated aquifers adjacent to Lake Spokane, which is complicated by numerous zones of shallow bedrock and/or other low-permeability formations, creating numerous hydraulically distinct unconsolidated aquifers on both the north and south sides of Lake Spokane. Based on the geometry and hydraulic characteristics of the groundwater/surface water interface around Lake Spokane described by Soltero et al. (1992), GeoEngineers (October 20, 2010) estimated groundwater volumetric flow rate into and out of Lake Spokane from nearshore unconsolidated aquifers using a standard Darcy's Law-based analysis. Groundwater volumetric flow rate values are summed to yield a mean baseflow estimate of 41.5 cfs for the entire lake. About 14.6 cfs of this baseflow enters the lake from the north margin and about 26.8 cfs enters from the south margin.

Soltero et al. (1992) reported total phosphorus concentrations for seven study areas of limited size adjacent to Lake Spokane. GeoEngineers assigned a representative study area for each of the 41 lakeshore segments based on similar land use and hydrogeologic setting. Assumed total phosphorus and orthophosphate concentrations were assigned to each segment based on the mean total phosphorus and orthophosphate concentrations for the wells within the representative study areas, per examination of data reported by Soltero et al. (1992). Assumed total phosphorus concentrations ranged from 42 micrograms per liter (μg/l) to 324 μg/l.

Based on the above-described groundwater volumetric flow rates and phosphorus concentrations, the calculated groundwater-based total phosphorus loads to Lake Spokane ranged from 0.1 to 3.3 pounds per day (lbs/day) in individual lake segments. Total phosphorus loads were summed to yield a mean loading estimate of 42.1 lbs/day for the entire lake. About 15.6 and 26.5 lbs/day of loading are estimated for the north and south margins of the reservoir, respectively.

GeoEngineers (October 20, 2010) concluded that groundwater-based total phosphorus loading directly to Lake Spokane is significant, based on the following:

- The estimated total phosphorus load (42.1 lbs/day) is additional to the groundwater-based total phosphorus load estimated by GeoEngineers (2009) for the mainstem Spokane River, the Little Spokane River, and Hangman Creek, and represents over 26 percent of that previously estimated load.
- There is no significant attenuation of this load before it reaches Lake Spokane, the portion of the watershed primarily impacted by low dissolved oxygen conditions.

4.6 Groundwater Orthophosphorus Data Analysis

Orthophosphorus data were analyzed as a basis for estimating groundwater loading to surface water as documented in the following:

- A Technical Memorandum titled *Groundwater Loading Analyses-Orthophosphate, Bi-State Nonpoint Source Study*, dated November 5, 2010. This technical memorandum is complimentary to GeoEngineers' August 4, 2009 technical memorandum and provides groundwater loading estimates for the Spokane River and its tributaries by examining orthophosphorus concentrations in groundwater adjacent to gaining stream reaches.

- GeoEngineers' Technical Memorandum titled *Preliminary Groundwater Loading Analyses – Lake Spokane Bi-State Nonpoint Source Phosphorus Study*, dated October 20, 2010.

In GeoEngineers' November 5, 2010 technical memorandum, the groundwater loading analyses performed by GeoEngineers (August 4, 2009) were replicated using representative orthophosphate, rather than total phosphorus, concentrations based on comments from Ecology.

Orthophosphate loading estimates along the Spokane River, Little Spokane River, and Hangman Creek are summarized below:

- Spokane River (a net load of about 20.8 lbs/day).
- Little Spokane River (a net load of about 5.1 lbs/day).
- Hangman Creek (a net load of about 11.6 lbs/day).

This yields a relative orthophosphate loading (from groundwater) contribution of about 74 percent, 17 percent, and 9 percent, respectively for the Spokane River, Hangman Creek, and Little Spokane River, respectively. The orthophosphate loads entering the Spokane River from the SVRP Aquifer are presented below as a function of stream segment, organized by decreasing loading rate:

- Flora Road to Centennial Trail Bridge (about 55 percent).
- Centennial Trail Bridge to below Green Street (about 28 percent).
- Spokane to T.J. Meenach Bridge (about 8 percent).
- Rifle Club Road to below Nine Mile Dam (about 7 percent).
- T.J. Meenach Bridge to Rifle Club Road (about 2 percent).

This prioritization generally is consistent with the prioritization presented in GeoEngineers (August 4, 2009) for mainstem Spokane River total phosphorus loading. About 83 to 86 percent of the load occurs between Flora Road and Green Street for both orthophosphate and total phosphorus, with 14 to 17 percent of the load originating from downstream gaining reaches. Preliminary orthophosphate loading estimates to the mainstem Spokane River, Little Spokane River, and Hangman Creek are summarized in Figure 4-8.

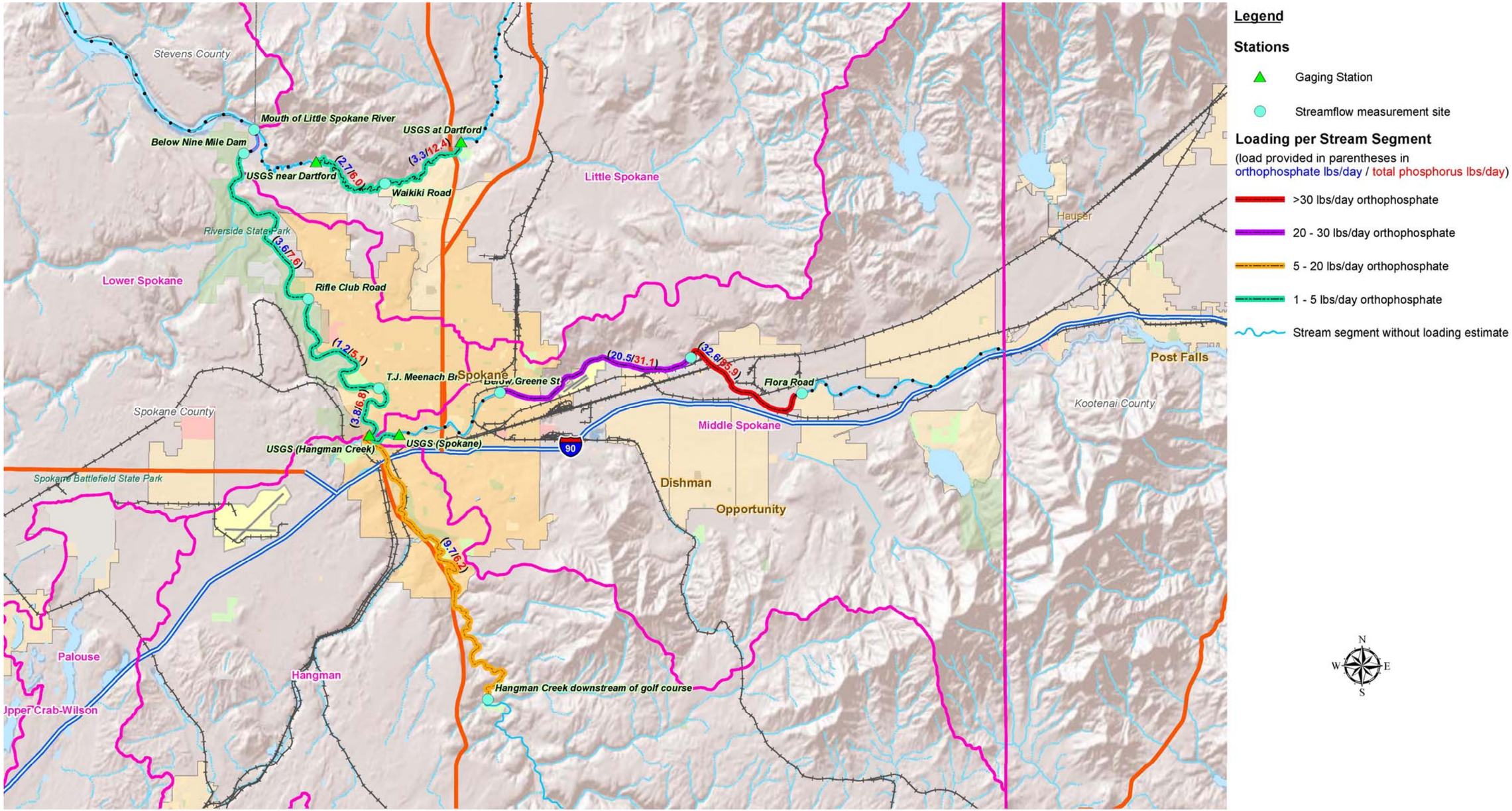

Figure 4-8. Orthophosphate Loading from Groundwater

GeoEngineers (October 20, 2010) focused on the geometry and flow characteristics of nearshore unconsolidated aquifers adjacent to Lake Spokane, and used an equivalent methodology to estimate orthophosphate loading as previously described for total phosphorus loading. Groundwater-based orthophosphate loads to Lake Spokane ranged from 0.01 to 3.3 lbs/day. Orthophosphate loads are summed to yield a mean loading estimate of 10.0 lbs/day for the entire lake. About 3.5 and 6.5 lbs/day of loading are estimated for the north and south margins of the reservoir, respectively.

GeoEngineers (October 20, 2010) concluded that groundwater-based orthophosphate loading directly to Lake Spokane is significant, based on the following:

- The estimated orthophosphate load (10.0 lbs/day) is additional to the groundwater-based orthophosphate load estimated by GeoEngineers (November 5, 2010) for the mainstem Spokane River, the Little Spokane River, and Hangman Creek, and represents about 14 percent of that previously-estimated load.
- There is no significant attenuation of this load before it reaches Lake Spokane, the portion of the watershed primarily impacted by low dissolved oxygen conditions.

4.7 Surface Water Total Phosphorus Data Analysis

As a component of the NPS Study, total phosphorus data were analyzed as a basis for estimating surface water loads as documented in the following:

- HDR's report titled *Spokane River Non-Point Source Analysis Project Phase 1 Surface Water Total Phosphorus Data Analysis*, dated June 2009. This report provides a preliminary assessment of the surface water total phosphorus data in the Spokane NPS Database from six locations using six straightforward analysis techniques to characterize the dataset.

Six locations were selected for the Phase 1 surface water analysis. These locations were either: 1) downstream points in tributary subbasins; or 2) intermediate locations along the mainstem of the Spokane River. These locations were selected as generally recognized reference points within the Spokane River Watershed. Additionally, these locations have some of the longest and most extensive sets of water quantity (flow) and water quality monitoring data. The six locations were:

1. Spokane River at Coeur d'Alene Lake (downstream of Coeur d'Alene Lake).
2. Spokane River at Stateline (the border between Idaho and Washington separating the Upper Spokane River ID and WA subbasins).
3. Spokane River at Spokane.
4. Spokane River at Lake Spokane headwaters (downstream of Nine Mile Dam and upstream of the confluence with the Little Spokane River).
5. Hangman Creek at Spokane River.
6. Little Spokane River at Spokane River.

Six analyses were selected and performed for the Phase 1 surface water analysis (HDR, June 2009). These analyses were selected because they could be completed relatively rapidly, with minimal intermediate computational steps, and provide a basis for a simple and straightforward

presentation. The selected analyses examined phosphorus concentrations and/or loads, both temporally and spatially. The six analyses were:

1. Times Series Plots.
2. Data Charts.
3. Average Monthly Phosphorus Loadings, Average Monthly Phosphorus Loadings by Year.
4. Average Monthly Phosphorus Loadings for 2001, Average Monthly Phosphorus Loading by Flows.
5. Average Seasonal Phosphorus Concentrations and Loadings.
6. Land Use to Phosphorus Correlation.

A summary of observations from the Phase 1 surface water analyses include the following:

- Hangman Creek has the greatest total phosphorus concentrations and the greatest maximum and average total phosphorus loads.
  - The greatest phosphorus concentrations appear to be correlated with population densities, e.g., the communities of Rockford, Fairfield, Tekoa, and Spangle. Higher phosphorus concentrations appear to correlate to large agricultural areas including middle California Creek, the reach between Latah and Waverly, near the confluence of Rattler Run Creek with Hangman Creek, and Little Hangman Creek and the area along the Stateline. Lower phosphorus concentrations appear to correspond with forestry and conservation program land uses.
- May is the month with generally the greatest total phosphorus loads throughout most of the watershed.
- Monthly total phosphorus loads decrease between Coeur d'Alene Lake and Stateline.
- During the lower flow months of September and August, there appears to be different loading mechanisms occurring between Coeur d'Alene Lake and Stateline than between Stateline and Spokane. The September loads for Stateline and Spokane are the second lowest of their twelve monthly loads; whereas, the September load for Coeur d'Alene Lake is the sixth greatest. The August loads for Stateline and Spokane are the lowest of their twelve monthly loads and less than 90 lbs/day; whereas the August load for Coeur d'Alene Lake is the third lowest but 226 lbs/day.

4.8 Surface Water Orthophosphorus Data Analysis

As a component of the NPS Study, orthophosphorus data were analyzed as a basis for estimating surface water loads as documented in the following:

- HDR's report titled *Spokane River Non-Point Source Analysis Project Supplemental Phase 1 Surface Water Orthophosphorus Data Analysis*, dated February 2010. This report provides a preliminary assessment of the surface water orthophosphorus data in the Spokane NPS Database from six locations using six straightforward analysis techniques to characterize the dataset.

Analysis of orthophosphorus data was performed for the same six locations (as described in Section 3.7) that were selected for the total phosphorus data analysis. The same six analyses were performed for these locations (HDR, February 2010). A summary of the observations from the analyses include the following:

- Hangman Creek has the greatest orthophosphorus concentrations and the greatest maximum and average orthophosphorus loads.
- Hangman Creek has the greatest total phosphorus concentration and loads as well.
- March is the month with the greatest orthophosphorus loads for Coeur d'Alene Lake, Hangman Creek and Little Spokane River, while for Stateline and Spokane it is May.
- May is the month with the greatest total phosphorus loads.
- Monthly orthophosphorus loads decrease between Coeur d'Alene Lake and Stateline.
- Total phosphorus loads also decreased.
- The orthophosphorus to total phosphorus averages about 50 percent, but varies widely from 0 to 100 percent.

4.9 Prioritization of Nonpoint Source Phosphorus Sources and Subbasins

Using the previously-summarized results of nonpoint source phosphorus loading analyses, geographic subbasins and sources were prioritized for additional assessment. This prioritization provided a solid foundation for subsequent analyses and linkage with subsequent project phases, such as selection of sites for project field data collection and reduction plan elements. In addition to loading, the prioritization also was based on qualitative measures and geographic characteristics. The following additional factors were also considered to prioritize nonpoint source phosphorus loads.

- Connections between the potential phosphorus sources and the in-stream loads observed in each subbasin.
- High phosphorus loads could be the basis for a high priority to target load reductions, but other factors should be considered, including:
  - The Hangman Creek subbasin has a high load but the loads are generally dispersed across the watershed and episodic, and are potentially related to sediment runoff due to snowmelt and thunderstorm events.
  - The apparent distribution of loads in the Spokane River within the Upper Spokane River, WA and Upper Spokane River, ID subbasins is variable, e especially from Coeur d'Alene Lake to Stateline, including positive and negative loadings due to the groundwater/surface water interaction.
  - A subbasin or source with a relatively low phosphorus load should not necessarily be excluded from nonpoint phosphorus source reductions if tangible nonpoint source phosphorus reductions are possible and practical.

The geographic prioritization was based on the following criteria: surface water and groundwater loading, proximity to Lake Spokane, feasibility of source identification, and feasibility of

nonpoint source reduction. This resulted in the Hangman Creek, Little Spokane River, St. Joe River, and Upper Spokane River WA subbasins being assigned the highest priority (GeoEngineers, September 15, 2009).

A list of nearly 20 nonpoint sources of phosphorus was developed. The criteria used to prioritize these sources were the relationship to surface water and groundwater loading, the feasibility of source identification, and the feasibility of nonpoint source reduction. Based on these criteria, septic systems, agricultural runoff, and agricultural operations were assigned the highest priority.

4.10 Nonpoint Source Phosphorus Data Gaps

Groundwater and surface water were examined both temporally and spatially for data gaps (GeoEngineers, September 17, 2009). This assessment of gaps in project data and analysis was performed to recognize those areas with limited or no historical data. The Spokane NPS Database values are not uniformly distributed throughout the watershed. Also, the data distribution is not currently sufficient to identify the origin, location, and magnitude of nonpoint sources of phosphorus in all portions of the study area.

4.10.1 Groundwater

Most groundwater total phosphorus concentration data compiled in the Spokane NPS Database are associated with the portion of the SVRP Aquifer located within Washington. Sampling locations outside of the boundaries of the SVRP Aquifer are limited in number and historically contain relatively few phosphorus analyses per well location. As a result, numerous data gaps exist with respect to phosphorus concentrations in non-SVRP aquifers in Idaho and Washington.

Sufficient baseflow and total phosphorus concentration data were available to develop preliminarily estimates of total phosphorus loads entering surface water from groundwater along gaining stream segments of the Spokane River, Little Spokane River, and Hangman Creek (GeoEngineers, August 4, 2009; October 20, 2010; and November 5, 2010). Meaningful loading analyses associated with other study area streams and lakes were not possible with the current dataset. Additional data gaps relating to groundwater include the following (GeoEngineers, September 17, 2009):

- Temporal Analysis: Monitoring locations vary significantly with respect to the timing and number of collected samples. As a result, it is currently not understood how phosphorus concentrations in groundwater might have varied with time, which could indicate whether existing management programs have been effective at mitigating phosphorus concentrations.
- Phosphorus Loading Upgradient of the SVRP Aquifer: Little information is available upgradient of the SVRP Aquifer regarding aquifer extent and geometry, aquifer material and hydraulic properties, hydraulic head conditions, baseflow quantities, and groundwater phosphorus concentrations.
- Phosphorus Loading Downgradient of Nine Mile Falls Dam: Groundwater inflow to the segment of the Spokane River between Nine Mile Falls Dam and the study area boundary (near Long Lake Dam) has not been examined in detail. Discharge of groundwater-based

phosphorus to this river segment potentially is significant and could originate from several different aquifers (Tetra Tech, 2007).

- Hangman Creek Aquifer System: Spokane County Conservation District (2005) identified a significant gaining stream segment along Hangmen Creek below the Hangman Creek Golf Course. Total phosphorus data for wells located in close proximity to this stream segment were not identified or included the Spokane NPS Database.
- Little Spokane River Subbasin Agricultural Operations: Relatively small-scale agricultural operations are abundant within the Little Spokane River subbasin. More groundwater phosphorus data and an examination of the relationship between small-scale agricultural operations and groundwater-based phosphorus loading would help identify applicable nonpoint source reduction efforts and projects.

4.10.2 Surface Water

Most surface water total phosphorus concentration data compiled in the Spokane NPS Database are associated with the portion of the watershed downstream of Coeur d'Alene Lake. Numerous data gaps exist with respect to phosphorus concentrations in the upper subbasins of the study area both in Idaho and Washington, where generally few if any samples have been collected. For the locations with data, only a few have long-term data records, while some locations have periods of concentrated sampling, and the remaining locations have been only sporadically sampled.

There is a significant volume of data that were useful for estimating phosphorus loads in the watershed. However, additional data gaps include an understanding of the total phosphorus and orthophosphorus relationship, potential phosphorus loads upstream of Coeur d'Alene Lake, potential loads from the Lower Spokane/Lake Spokane subbasin, and loading mechanisms from the Hangman Creek and Little Spokane River subbasins. Data gaps relating to surface water include the following (GeoEngineers, September 17, 2009):

- Temporal Analysis: Monitoring locations vary significantly with respect to the timing and number of collected samples. This data gap presents challenges in appropriately assessing long-term trends at a monitoring location and trends between upstream and downstream monitoring locations. The historic variability in monitoring demonstrates the need for coordinated efforts for monitoring long-term water quality improvements from reduction efforts in the watershed.
- Orthophosphorus in Surface Water: Analysis of all forms of phosphorus in collected samples would provide insight into sources of biological available phosphorus.
- Potential Phosphorus Loading Upstream of Coeur d'Alene Lake: There is a large data gap in phosphorus monitoring and understanding of processing above and in Coeur d'Alene Lake to understand the contribution to the Spokane River from this large portion of the watershed.
- Potential Phosphorus Loading from the lower watershed: Increased understanding of the timing and magnitude along with the delivery mechanisms for phosphorus nonpoint sources nearest to Lake Spokane.

4.10.3 Data and Analysis Gap Prioritization

Identified groundwater and surface water data and analysis gaps were prioritized. The prioritized list was then considered for additional funding and analyses. Between seven to fifteen gaps were identified for each of the four cases: surface water data gaps, groundwater data gaps, surface water analysis gaps, and groundwater analysis gaps.

Highest priority data gaps for groundwater included: 1) understanding the relationship between land use parameters and potential phosphorus loading to groundwater; 2) the impacts of specific and isolated areas of septic systems; and the 3) paleochannel aquifers originating on the West Plains.

For surface water, the highest priority data gaps included: 1) understanding the forms and bioavailability of phosphorus in the watershed and nonpoint sources; 2) understanding the load delivery mechanisms associated with seasonal, episodic, and other hydrologic events; and 3) the relationship between land use parameters and potential phosphorus loading to surface water.

Highest priority analysis gaps for groundwater included: 1) temporal analysis including an assessment of the attenuation or propagation of phosphorus loads; 2) correlation between land use and groundwater loads; and 3) examining orthophosphorus and phosphorus forms.

The analysis gap list for surface water was the longest. Highest priority analysis gaps for surface water included: 1) connecting the identification of sources for phosphorus reduction with the loading analysis and monitoring data; 2) investigating the mechanisms for the delivery and transport of total phosphorus loads; and 3) the correlation between land use and phosphorus concentrations.

4.11 Nonpoint Source Phosphorus Recommended Studies

A prioritized list of studies recommended to fill identified data and analysis gaps were developed (GeoEngineers, September 17, 2009). Eight potential studies were recommended for groundwater and nine for surface water. The prioritized data and analysis gaps were translated into potential study titles and a brief subject summary. The high priority studies related to: 1) timing of phosphorus loads; 2) transport and delivery of the loads; 3) phosphorous forms; 4) phosphorus to land uses and activities correlation; and 5) linkage to reduction activities.

Chapter 5

Watershed Conditions and Supplemental Data

5.1 Screening-Level Field Reconnaissance

A screening-level field reconnaissance was completed during February 2010 to assist with the selection of field data collection alternatives to be implemented as part of the NPS Study. Sampling results were used to evaluate relative phosphorus concentrations between sites. A total of sixteen sites within the Spokane River Watershed were visited to examine site characteristics such as sampling feasibility, physical access, surrounding land uses, and potential for nonpoint source load quantification. The sites selected for the reconnaissance were located in three subbasins: Hangman Creek, Little Spokane River and Lower Spokane River. The sites considered are in the following four groupings:

- Cheney Area/Marshall Creek.
- Deep Creek.
- Lower Hangman Creek.
- Lower Little Spokane River.

Three grab samples were collected at each of the sixteen sites for screening of phosphorus concentrations. Grab samples were collected using a hand-held polypropylene open dipper from a single point in the stream. None of the samples were turbid or had visible suspended particles. The results were then analyzed using a Hach DR/820 Colorimeter using Method 8048 with PhosVer3 phosphate reagent. The analytical results are approximately three times higher than the median results discovered during the field data collection (Section 5.2). It is unknown if these differences are actual or due to sensitivity differences of the methods, calibration of the instrument, the collection method, or other factors or some combination of these factors. Regardless, the reconnaissance still provided a relative comparison of various locations for potential field data collection.

The field reconnaissance did not result in the identification of a previously-undocumented or large nonpoint source. However, two areas with little or no previous data, Cheney Area and Deep Creek, appear to have significant phosphorus concentrations and warrant consideration for identification and potential reduction of nonpoint source phosphorus loads.

Field observations suggested that appearance is not a clear indicator of higher nonpoint source phosphorus loads. Of the streams observed during the field reconnaissance, there were streams that appeared to have high quality riparian zones and streams with poor quality riparian zones and eroding streambanks; yet all had similar phosphorus concentrations. Greater research into the correlations between land use, surface-groundwater interaction, streambank conditions, soil and rock properties, total suspended sediment, and ortho-total-bioavailable phosphorus relationships would support a greater understanding of nonpoint source phosphorus loading within the watershed. Results of the field reconnaissance are summarized in Table 5-1 and Figure 5-1.

Table 5-1. Results of February 2010 Field Reconnaissance

Subbasin	Location	Stream Reach	Orthophosphate as P[1] (mg/L)
Hangman Creek	Fish Lake near Cheney off Cheney-Spokane Rd	Lake	0.06
Hangman Creek	Marshall Creek off Cheney-Spokane Rd	Downstream of Cheney	0.20
Hangman Creek	Rock Creek at S Valley Chapel Rd	Near confluence with Hangman	0.14
Hangman Creek	Hangman Creek at S Valley Chapel Rd & S Latah Creek Rd	Mid-reach (below Rock Creek)	0.13
Hangman Creek	Hangman Creek at Hatch Rd	Downstream	0.13
Little Spokane River	Little Spokane River at Chattaroy	Mid-reach	0.15
Little Spokane River	Little Spokane River at E Colbert Rd	Mid-reach	0.16
Little Spokane River	Little Spokane River off W. Rutter Pkwy	Near confluence Lake Spokane	0.18
Little Spokane River	Dragoon Creek at E Chattaroy Rd	Near confluence Little Spokane River	0.05
Little Spokane River	Dragoon Creek at E Chattaroy Rd - surface white foam	Near confluence Little Spokane River	0.07
Little Spokane River	Deadman Creek at Mt Spokane Fire Station (E Mt Spokane Parkway)	Upstream	0.10
Little Spokane River	Deadman Creek at N. Bruce Rd off Mt Spokane Rd	Mid-reach	0.11
Little Spokane River	Deadman Creek at Shady Slope Rd	Near confluence Little Spokane R.	0.13
Little Spokane River	Little Deep Creek (L. Spokane subbasin) at Shady Slope Rd	Near confluence Little Spokane R.	0.09
Lower Spokane River	Riverside State Park Lavatory	Groundwater?	0.10
Lower Spokane River	Deep Creek off N. Deep Creek Road	Mid-reach	0.14
Lower Spokane River	Deep Creek off W 7 Mile Rd, S of Rd in Riverside St Park, down trail	Near confluence Lake Spokane	0.15

[1]Average of three grab samples shown as Orthophosphate as P analyzed with a Hach DR/820 Colorimeter using Method 8048. Field reconnaissance was not performed under a Quality Assurance Project Plan.

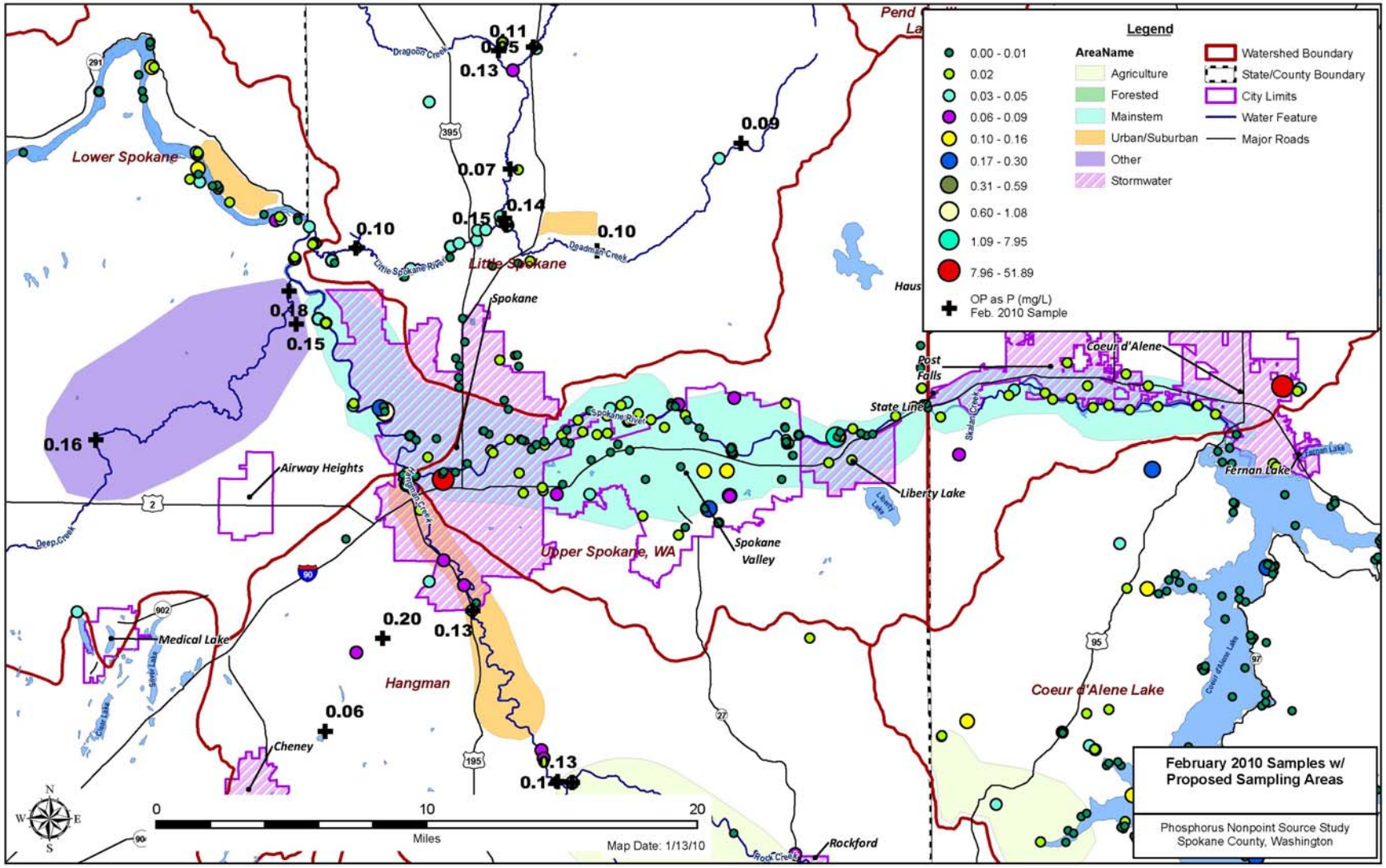

Figure 5-1. Summary of Results of February 2010 Field Reconnaissance

5.2 Field Data Collection

Based on the results of the field reconnaissance, review of the Spokane NPS Database and discussions with the NPAC, two areas were selected for detailed field data collection and development of a Quality Assurance Project Plan (QAPP). The two selected field data collection areas were:

- The Deep Creek Field Data Collection Area which focused on Deep and Coulee Creeks within the western portion of Spokane County.
- The Eaglewood Field Data Collection Area which focused on Little Deep and Deadman Creeks within the northern portion of Spokane County

The goal of field data collection was to: 1) evaluate total phosphorus and soluble reactive phosphorus (for the purposes of this investigation, assumed equal to orthophosphorus) concentrations within area surface water and shallow groundwater as a basis for filling data gaps in the existing project dataset; and 2) develop instantaneous phosphorus loading estimates, if practical. Field data collection activities were conducted in conformance with the project QAPP (GeoEngineers and HDR, 2010).

A detailed discussion of data collection methods and results is presented in the Field Data Collection technical memoranda by GeoEngineers and HDR (2011a and 2011b). Study location, rationale, objectives and conclusions are summarized in Sections 5.3 and 5.4 of the NPS Reduction Plan for the two field data collection areas.

5.2.1 Deep Creek Field Data Collection and Phosphorus Loading Summary

The Deep Creek Field Data Collection Area includes two surface water bodies: Deep Creek and Coulee Creek. Deep Creek is a tributary to the Spokane River. Coulee Creek is a tributary to Deep Creek, joining Deep Creek a short distance upstream from where Deep Creek joins the Spokane River. Surface water and groundwater sampling locations are shown in Figures 5-2 and 5-3, respectively.

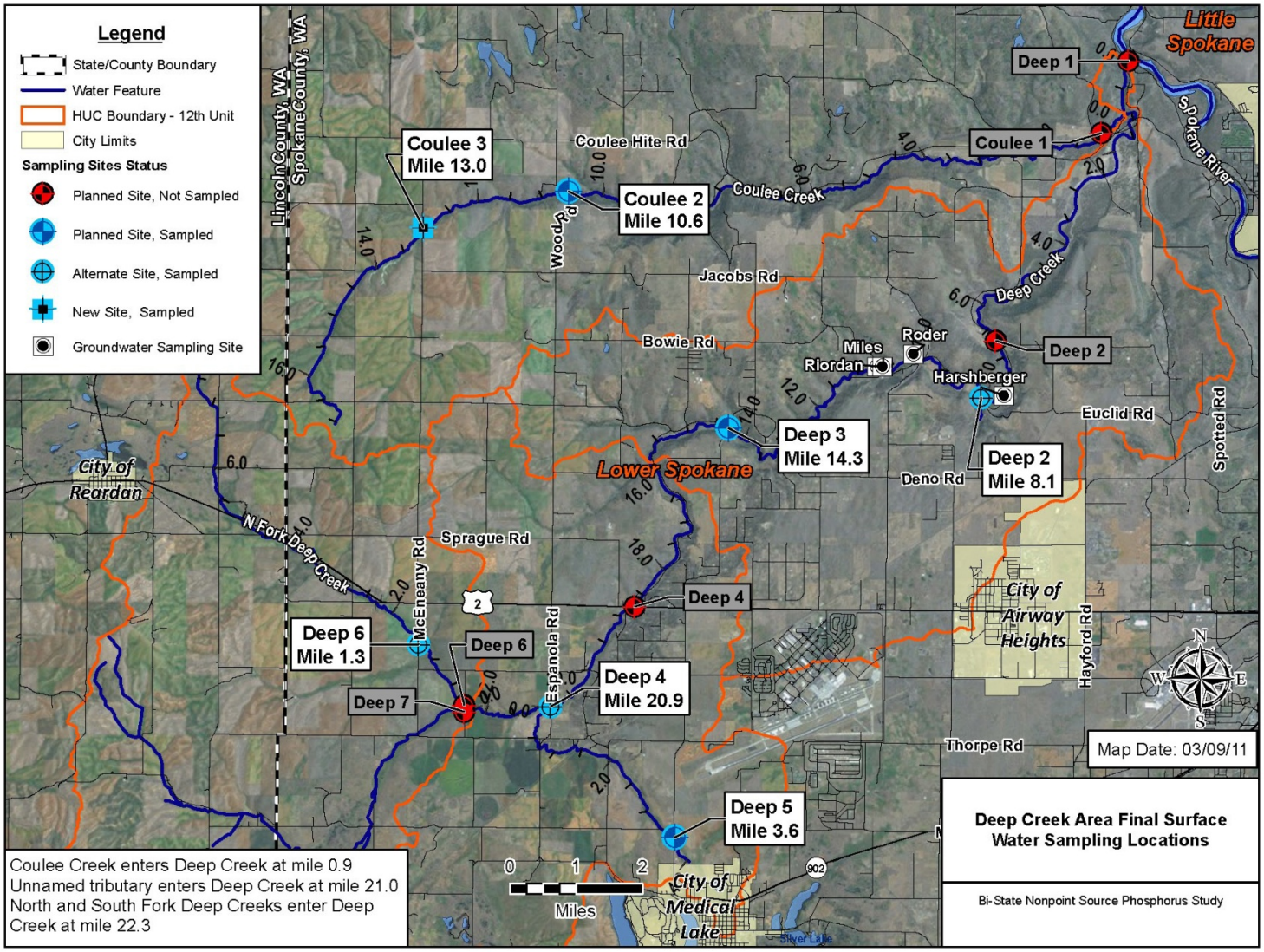

Figure 5-2. Surface Water Sampling Locations

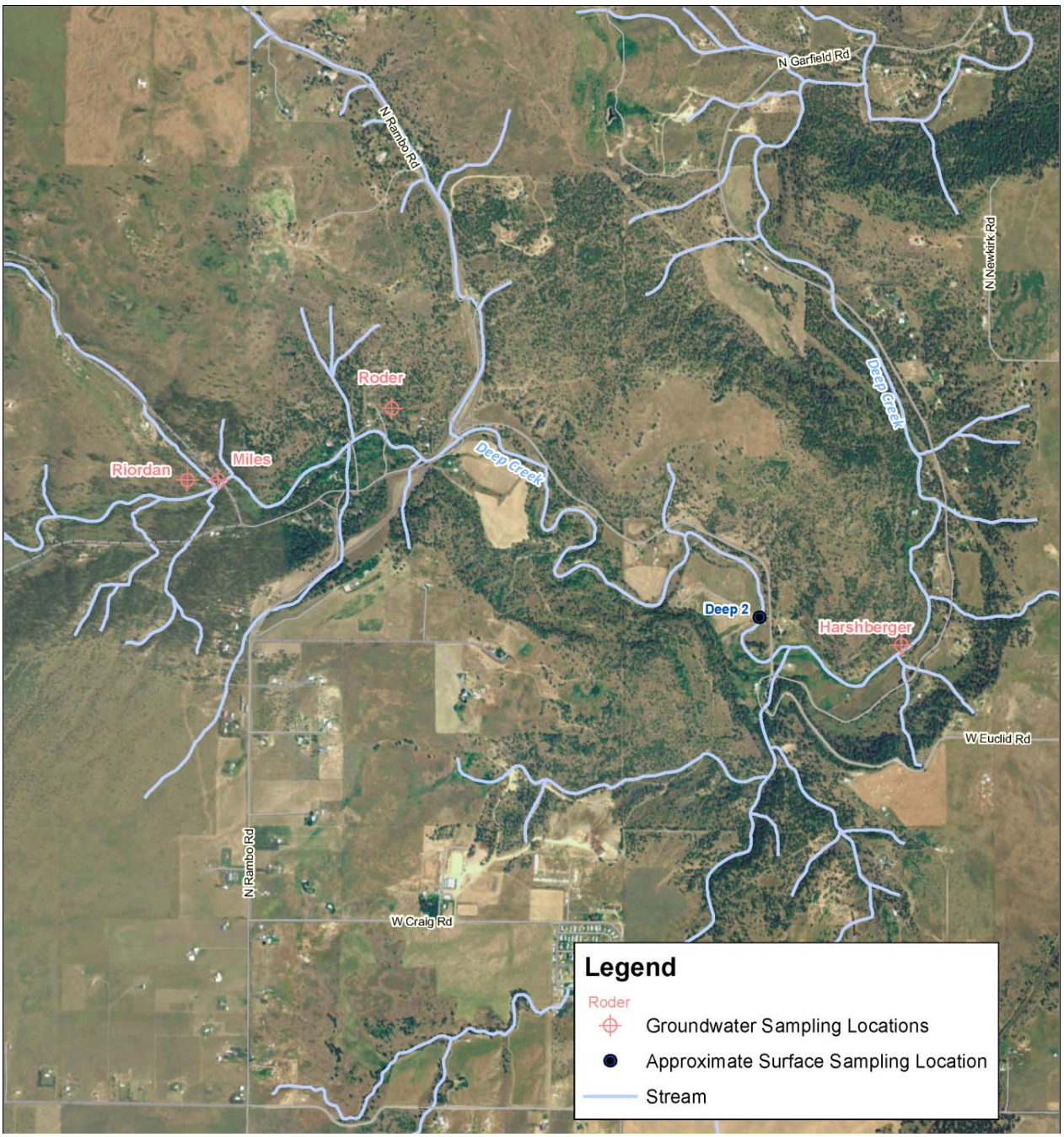

Figure 5-3. Groundwater Sampling Locations

Study results indicate that phosphorus concentrations in surface water and groundwater within the Deep Creek Field Data Collection Area appear to be impacted from point and nonpoint sources including wastewater discharge and land use activities. The magnitude of phosphorus loadings from this area may be lower than the estimated loadings from other portions of the Deep Creek Watershed where loads directly discharge to Lake Spokane and do not infiltrate into the groundwater. Opportunities for management activities throughout the Lower Spokane River subbasin exist for reducing phosphorus nonpoint source loads.

Defining loading from the Deep Creek hydrologic system (surface and groundwater) to Lake Spokane is complicated by the presence of two major drainage ways (Coulee Creek and Deep Creek), sparse existing subsurface information, and full infiltration (except at high flows) of area surface water upgradient of Lake Spokane.

Estimated surface water total phosphorus loads ranged from 0 to 3.6 pounds per day (lbs/day) for the locations sampled. These results are only representative of low flow conditions; high flow conditions may result in different nonpoint source impacts. Upstream phosphorus concentrations and loads in both Deep and Coulee Creeks provided significant proportions of the subbasin concentrations and loads. The highest phosphorus concentrations measured in the subbasin were in the tributary that has contributing areas from the Fairchild Air Force Base, the City of Medical Lake, and wastewater discharge from the City of Medical Lake.

By combining surface water and groundwater loading analyses for the monitoring period, the estimated loading to Lake Spokane from the Deep Creek system was on the order of 0.95 lbs/day for total phosphorus and 0.35 lbs/day for soluble reactive phosphorus. For perspective, these loads represent less than 5 percent of estimated phosphorus loading associated with near shore unconsolidated aquifers surrounding Lake Spokane (GeoEngineers, 2010a) and less than 1 percent of the estimated phosphorus loading to the mainstem Spokane River from the SVRP Aquifer (GeoEngineers, 2010b).

These conclusions are based on a project dataset that is associated with relatively low flow conditions and limited subsurface data. Field observations indicate that, at high flow conditions, surface water discharges directly to Lake Spokane and infiltration to groundwater is likely greater than observed conditions. Lastly, this analysis focused on the shallow aquifer interpreted to be in hydraulic connection with Deep Creek. Interaction between the shallow aquifer and deeper aquifers, as well as potential loadings from deeper aquifers, is unknown.

5.2.2 Eaglewood Field Data Collection and Phosphorus Loading Summary

The Eaglewood Field Data Collection Area includes two surface water bodies, Deadman Creek and Little Deep Creek. Deadman Creek is a tributary to the Little Spokane River. Little Deep Creek is a tributary to Deadman Creek, joining Deadman Creek a short distance upstream from where Deadman Creek joins the Little Spokane River. Surface water and groundwater sampling locations are shown in Figures 5-4 and 5-5, respectively.

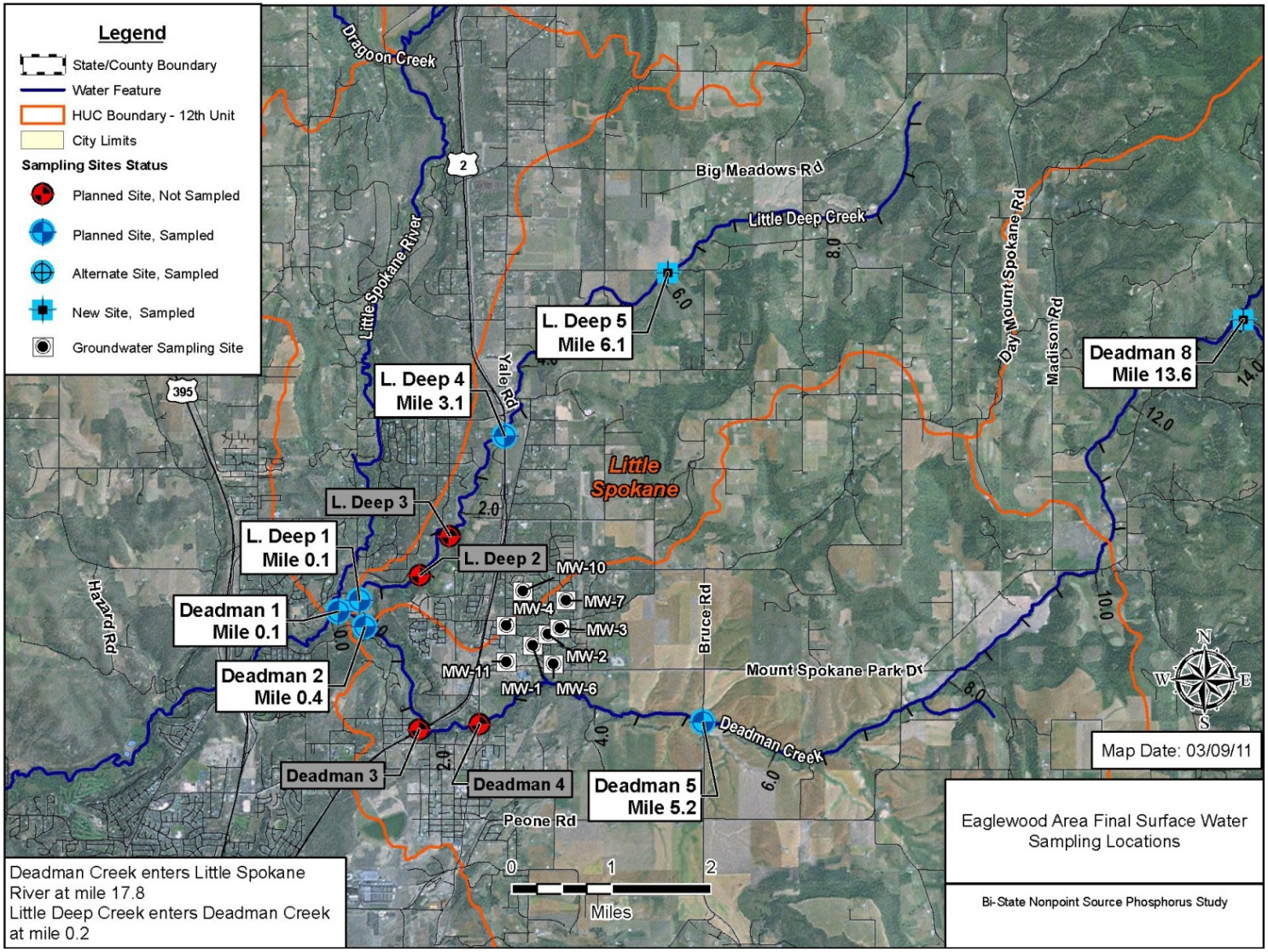

Figure 5-4. Surface Water Sample Locations

Figure 5-5. Groundwater Sampling Locations

Findings for the Eaglewood Field Data Collection Area indicate the presence of significant phosphorus loads in both surface water and groundwater, although the distribution of these loads suggests that upgradient areas, rather than the densely developed portion of the study area, are primarily responsible for loading. Phosphorus concentrations in surface water and groundwater within the Eaglewood Field Data Collection Area appear to be impacted from point and nonpoint sources including wastewater discharge and land use activities. Opportunities for management activities throughout the Little Spokane River subbasin exist to reduce the phosphorus loading.

Estimated surface water total phosphorus loads ranged from 1 to 39 lbs/day for the locations sampled. These results are only representative of low flow conditions; high flow conditions could result in different nonpoint source impacts. Upstream phosphorus concentrations and loads in both Deadman and Little Deep Creeks provided significant proportions of the subbasin concentrations and loads.

Phosphorus concentrations in groundwater within the Eaglewood Field Data Collection Area are elevated with respect to conditions that are typical for similar land use conditions (based on examination of data contained within the Spokane NPS Database). Phosphorus concentrations are highest along the upgradient margin of the densely developed area and generally decrease in the downgradient direction. These observations suggest that groundwater phosphorus concentrations in the study area: 1) may be impacted more by agricultural operations to the east and northeast than by septic systems within the densely developed area; and 2) shallow groundwater underlying the densely developed area could be perched on top of underlying fine-grained sediments and not hydraulically connected to groundwater from upgradient areas to the east (GeoEngineers, 1996).

Groundwater-based phosphorus loading to surface water fluctuates temporally within the study area. During the early portion of the monitoring period (between the May 24 and June 7, 2010 monitoring events), groundwater loading was estimated to be on the order of 0.5 to 1.0 lbs/day and was dominated by baseflow to Deadman Creek, rather than Little Deep Creek. During the latter portion of the monitoring period (between the June 20 through July 26, 2010 monitoring events), the subject streams tended to lose water and groundwater loading was negligible. The comparison of calculated surface water loads suggests that, within Little Deep Creek, phosphorus loading mechanisms other than baseflow likely contribute to observed loading increases.

Chapter 6

Spokane River Watershed – Groundwater Nonpoint Source Phosphorus Advanced Analysis

6.1 Groundwater Analytical Methods and Tools for Nonpoint Source Phosphorus Assessment

An approach was developed to identify potential analytical methods and tools for assessing groundwater phosphorus distribution and loading in the Spokane River Watershed. The purpose of this advanced analysis was to support the NPS Reduction Plan goal of identifying "where" significant nonpoint sources of phosphorus are located. Analytical methods and tools include publicly available and proprietary models that integrate water quality equations for application to specific situations. Analytical methods and tools that ranged from simple to detailed in complexity, and ranged from the local to the watershed scale, were identified based on the following requirements:

- Ability to assess nonpoint phosphorus sources.
- Applicability to the analysis of phosphorus, including total and orthophosphorus.
- Ability to address the availability, detachment/mobility, and transport of phosphorus.
- Potential to relate to the identification, quantification, and BMP effectiveness of nonpoint source phosphorus loads.

In total, 11 analytical methods and tools were identified that were specific to groundwater and sufficiently met these requirements (GeoEngineers, October 22, 2010). Summary information about each of these analytical methods or tools was included in GeoEngineers' October 22, 2010 technical memorandum.

6.2 Applicability and Feasibility of Groundwater Techniques for Spokane River Watershed

The 11 groundwater-based analytical methods and tools identified in GeoEngineers' October 22, 2010 technical memorandum are presented in Table 6-1.

Table 6-1. Analytical Methods Applicable to Groundwater-Based Nonpoint Source Phosphorus and the Spokane River Watershed

Analytical Method	Short Description
Argus ONE	A GIS-based processor that includes a suite of computer models that is capable of transient three-dimensional simulations of water and contaminants through the unsaturated and saturated zones.
FEFLOW	A transient three-dimensional finite element computer model that simulates the flow of water and contaminants through the unsaturated and saturated zones.
FEMWATER	A transient three-dimensional finite element computer model that simulates the flow of water and contaminants through the unsaturated and saturated zones.
GMS	A GIS-based processor that includes a suite of computer models that are capable of transient three-dimensional simulations of water and contaminants through the unsaturated and saturated zones.
Hydrogeochem	A transient three-dimensional finite element computer model that simulates the flow of water and contaminants through the unsaturated and saturated zones.
HydroGeoSphere	A transient three-dimensional finite element computer model that simulates the flow of water and contaminants through the unsaturated and saturated zones.
MF2K-GWT	A transient three-dimensional finite difference computer model that simulates the flow of water and contaminants through the saturated zone.
MODFLOW-SURFACT	A transient three-dimensional finite difference computer model that simulates the flow of water and contaminants through the unsaturated and saturated zones.
SutraSuite	A transient three-dimensional finite difference and finite element computer model that simulates the flow of water, contaminants and energy through the unsaturated and saturated zones.
UTCHEM	A transient three-dimensional finite difference computer model that is capable of simulating the flow of water and contaminants through the unsaturated and saturated zones.
Visual MODFLOW	A transient three-dimensional finite difference computer model that simulates the flow of water and contaminants through the saturated zone.

Project-specific screening criteria were developed for application to the groundwater tools and methods identified above. The screening criteria included:

- Applicability.
- Schedule and Cost.
- Required Data Input.
- Output/Type of Results.
- Level of Confidence in Results.
- Constructability.

- Appropriate Scale for Project Objectives.

The groundwater analytical methods and tools were evaluated against the screening criteria in a series of evaluation matrices. These matrices provided a methodology to evaluate the criteria by rating each analytical method and tool to the screening criteria and combining these rating to develop a prioritized list.

6.3 Selection of Groundwater Analysis Techniques for Application to Spokane River Watershed

Based on the results of the evaluation and screening of the analytical methods against the selection criteria listed above, with consideration of professional judgment, the recommended short-list of methods for analysis of groundwater data (within the unsaturated zone and saturated zone) include the following three methods:

- Unsaturated Zone and Saturated Zone.
  - Hydrogeochem.
  - MODFLOW-SURFACT.
- Saturated Zone.
  - VISUAL MODFLOW.

The recommended methods and tools for analysis of project groundwater data were considered in tandem with the recommended methods and tools for advanced surface water analysis presented in Chapter 7. Based on analytical needs to support the NPS Study and available funding, it was decided that advanced analysis should focus on surface water. However, limited additional groundwater analysis was conducted to supplement the advanced surface water analyses, as described in this plan section.

6.4 Application of Selected Groundwater Analysis Techniques

6.4.1 Introduction

The NPS Study model constructed for the Spokane River Watershed estimates total phosphorus loads associated with various land uses. Comparison of these estimated total phosphorus loads with total phosphorus concentrations observed at various down-gradient stream sampling stations can be used to calibrate the model. However, it is unclear whether dilution or enrichment (with respect to total phosphorus) of surface water as a function of baseflow could significantly affect the calibration.

To evaluate the potential impact of groundwater loading on model calibration, total phosphorus loading from groundwater (as a function of contributing surface area) to the Rifle Club Road monitoring station was estimated. The Rifle Club Road monitoring station is located within the northwest portion of the city of Spokane about 4.3 miles upstream of Nine Mile Dam, at approximately river kilometer 108.5. Based on the designations of surface water basins and subbasins presented by HDR (2010), contributions from three primary subbasins that contribute baseflow to the Rifle Club Road monitoring station were evaluated. These include the Upper Spokane River WA and ID, Hangman Creek and Lower Spokane River subbasins.

6.4.2 Methodology

Total phosphorus loading rates from groundwater to the Rifle Club Road monitoring station were calculated by estimating the total phosphorus exchanges (resulting from groundwater/surface water interaction) within the areas of interest and presenting the results as loading rates per unit area. Representative total phosphorus concentrations from the Spokane River and Hangman Creek were compiled and calculated to estimate the total phosphorus exchange rates.

Representative total phosphorus concentrations were estimated to provide coverage for the model domain. These concentrations are summarized in Table 6-2.

Table 6-2. Supplemental Total Phosphorus Concentrations

Study Subbasin	Reach	Sampling Location	Median Total Phosphorus Concentration (µg /L)[1]	Number of Samples Collected	Sampling Years
Upper Spokane River WA and ID	Near Lake Coeur d'Alene to near Post Falls	140	27.8	6	1984
		141	27.8	6	1984
		510	15.5	51	1973-1981, 1989, 1991-1992, 1997-2003
		2071	10.0	11	1980, 2003-2005
		2074	120.0	3	1980
		2075	50.0	3	1980
		2078	40.0	3	1980
		2079	40.0	2	1980
		2080	60.0	2	1980
	Median	--	**20.0**	--	--
	Near Post Falls to near Otis Orchards	145	20.6	5	1984
		511	8.0	2	1999
		1131	13.0	5	1999-2000
		1141	13.0	55	1971,1973,1977, 1991-2007
		2081	12.0	50	1980-1981,1989-2003, 2007
		2082	9.0	4	2003, 2008
		2083	8.0	2	1999
		3590	2.0	1	1992
	Median	--	**12.0**	--	--
	Near Otis Orchards to Greenacres	3	19.0	9	1980-1981
		1114	9.4	2	2007
		1130	20.0	5	1999-2000
		1281	4210.0	4	1999-2000

Study Subbasin	Reach	Sampling Location	Median Total Phosphorus Concentration (µg /L)[1]	Number of Samples Collected	Sampling Years
	Median	--	**20.3**	--	--
	Greenacres to Flora Road	1114	9.4	2	2007
		1130	20.0	5	1999-2000
		1262	--	--	--
	Median	--	**19.0**	--	--
	Below Greene Street to USGS (Spokane)	161	16.3	6	1984
		162	16.3	6	1984
		517	7.0	2	1999
		1066	25.0	8	1971, 1973
		1112	4.6	2	2007
	Median	--	**16.3**	--	--
Hangman Creek	River Mile 21.0 to Duncan	224	90.0	1	2004
		338	90.0	1	2004
		1583	90.0	1	2004
		3530	111.5	4	1991
	Median	--	**98.0**	--	--
	Duncan to downstream of Hangman Creek Golf Course	375	50.5	2	2004
		1590	50.5	2	2004
	Median	--	**50.5**	--	--

[1] µg /L = micrograms per liter.

Total phosphorus exchange rates were then estimated using rates of groundwater/surface water exchange and representative total phosphorus concentrations, using the same methodology presented by GeoEngineers, Inc. (2010a). The resulting total phosphorus exchange rates are presented in Table 6-3.

Table 6-3. Total Phosphorus Exchange

Study Subbasin	Reach	Streamflow Gain (+) or Loss (-) (cfs)	Representative Total Phosphorus Concentration (µg /L)	Total Phosphorus Loading[1] (lbs/day)
Upper Spokane River WA and ID	Near Lake Coeur d'Alene to near Post Falls	-291	20.0	-31.4
	Near Post Falls to near Otis Orchards	-191	12.0	-12.4
	Near Otis Orchards to Greenacres	-110	20.3	-12.0
	Greenacres to Flora Road	-14.0	19.0	-1.4
	Flora Road to Centennial Trail Bridge	360	--	85.9
	Centennial Trail Bridge to below Green Street	233	--	31.1
	Below Green Street to USGS (Spokane)	-112	16.3	-9.8
Total Gain				117.0
Total Loss				-67.1
Net Loading				**49.9**
Hangman Creek	River Mile 21.0 to Duncan	-1.0	98.0	-0.5
	Duncan to downstream of Hangman Creek Golf Course	-0.7	50.5	-0.2
	Downstream of Hangman Creek Golf Course to USGS Gage on Hangman Creek	16.5	--	6.2
Total Gain				6.2
Total Loss				-0.7
Net Loading				**5.5**
Lower Spokane River	USGS (Spokane) to T.J. Meenach Bridge	88.5	--	6.8
	T.J. Meenach Bridge to Rifle Club Road	38.0	--	5.1
Total Gain				11.9
Total Loss				0.0
Net Loading				**11.9**

[1] Total phosphorus concentrations and loading adapted from GeoEngineers, Inc. (2010).

The total phosphorus loading rates from groundwater that discharges toward the Rifle Club Road monitoring station were then calculated with respect to the areas of interest. The groundwater subbasins and basins are assumed to be the same as those defined for surface water.

6.4.3 Results

The net total phosphorus loading from groundwater that discharges up-gradient of the Rifle Club Road monitoring station from three upstream subbasins within the study area (Lower Spokane River, Upper Spokane River WA and ID and Hangman Creek) is summarized in Table 6-4.

Table 6-4. Summary of Total Phosphorus Loading from Groundwater

Study Subbasin	HUC Basin	Area[1] (ac)	Total P Loading[2]	
			(lbs/day)	(lbs/ac/yr)
Upper Spokane River WA and ID	Total	378305	49.9	**0.048**
	Chester Creek-Spokane River	75334	107.2	0.52
	Other HUC basins	302971	--	--
Hangman Creek	Total	447610	5.5	**0.0045**
	Hangman Creek	17372	--	--
	Minnie Creek	25555	--	--
	Marshal Creek	15483	--	--
	Stevens Creek-Hangman Creek	38850	--	--
	Subtotal of 4 basins above	97260	6.2	0.023
	Other HUC basins	350350	--	--
Lower Spokane River	Total	580597	11.9	0.0075
	Nine Mile Reservoir-Spokane River	29055	11.9	0.15
	HUC basins in study area	218452	11.9	**0.020**
	Subbasins total	1406512	67.3	0.017
	Subbasins in study area	1044367	67.3	**0.024**

[1] Areas from HDR (2010).

[2] Total phosphorus loading from groundwater, discharging toward the Rifle Club Road station.

Net total phosphorus loading from groundwater is estimated to be about 0.024 pounds per acre per year (lbs/ac/yr).The contributing total phosphorus loading rates from each of the three subbasins are about:

- 0.048 lbs/ac/yr from the Upper Spokane River WA subbasin.
- 0.0045 lbs/ac/yr from the Hangman Creek subbasin.
- 0.020 lbs/ac/yr from the Lower Spokane River subbasin (within the study area).

Within specific portions of the watershed, the total phosphorus exchange rates (Table 6-3) provide enough resolution for total phosphorus loading rates to be calculated for selected HUC basins (Table 6-4), yielding the following results:

- 0.52 lbs/ac/yr from the Chester Creek-Spokane River basin (within the Upper Spokane River WA subbasin).
- 0.023 lbs/ac/yr from the four lowest basins (Hangman Creek, Minnie Creek, Marshal Creek and Stevens-Hangman-Creek) within the Hangman Creek subbasin.
- 0.15 lbs/ac/yr from the Nine Mile Reservoir-Spokane River basin (within the Lower Spokane River subbasin).

The above estimates were intended for use during model calibration, to assist in evaluating the potential for groundwater/surface water interaction to negatively impact calibration accuracy.

Chapter 7

Spokane River Watershed – Surface Water Nonpoint Source Phosphorus Advanced Analysis

7.1 Surface Water Analytical Methods and Tools for Nonpoint Source Phosphorus Assessment

An approach was developed to identify potential analytical methods and tools for assessing surface water phosphorus loading in the Spokane River Watershed. The purpose of this advanced analysis was to support the NPS Reduction Plan goal of identifying "where" significant nonpoint sources of phosphorus are located. Analytical methods and tools include publicly available and proprietary models that integrate water quality equations for application to specific situations. Analytical methods and tools that ranged from simple to detailed in complexity, and ranged from the local to the watershed scale, were identified based on the following requirements:

- Ability to assess nonpoint phosphorus sources.
- Appropriate for the analysis of phosphorus, including total and orthophosphorus.
- Address the availability, detachment/mobility, and transport of phosphorus.
- Potential to relate to the identification, quantification, and BMP effectiveness of nonpoint source phosphorus loads.

In total, over thirty analytical methods and tools were identified that were specific to surface water and sufficiently met these requirements (GeoEngineers, October 22, 2010). Additionally, summary information about each analytical method or tool was compiled into fact sheets. This information was used to select an analytical method for application to the Spokane River Watershed.

7.2 Applicability and Feasibility of Surface Water Techniques for Spokane River Watershed

The surface water analytical methods and tools identified for the assessment were reduced to twelve analytical methods by applying project-specific screening criteria (GeoEngineers, October 22, 2010). The list of analytical methods and tools was evaluated against the screening criteria in a series of evaluation matrices. These matrices provided a methodology to evaluate the criteria by rating each analytical method and tool to the screening criteria and combining these rating to develop a prioritized list. The screening criteria included:

- Applicability.
- Schedule and Cost.
- Required Data Input.
- Output/Type of Results.

- Level of Confidence in Results.
- Constructability.
- Appropriate Scale for Project Objectives.

The analytical methods that met the screening criteria were advanced for additional consideration and are shown in Table 7-1. Each of these tools was determined to be applicable and a feasible technique for advanced analysis of surface water phosphorus in the Spokane River Watershed (GeoEngineers, October 22, 2010).

Table 7-1. Analytical Methods Applicable to Nonpoint Source Phosphorus and the Spokane River Watershed

Analytical Method	Short Description
GISPLM	GIS-based phosphorus loading model
GSSHA	Gridded Surface Subsurface Hydrologic Analysis (GSSHA) is a grid-based 2-D hydrologic and pollutant fate and transport model
LSPC+HSPF	EPA Loading Simulation Program in C++ (LSPC) and Hydrological Simulation Program FORTRAN (HSPF) for watersheds
PLOAD	EPA GIS-based model to calculate watershed pollutant loads
STEPL	NRCS sediment and nutrient loading estimates in stormwater runoff
STORM	USACE quasi-dynamic model for hydrology and erosion simulation
SWAT	ARS Soil and Water Assessment Tool (SWAT) is a river basin scale model developed to quantify the impact of land management practices
USGS Regression	Statistical analysis of water quality datasets
USGS Sparrow	SPAtially-Referenced Regression On Watershed attributes (SPARROW), statistical long-term averages of watershed characteristics
WAM	Spatial impact of existing and modified land use on water quality and quantity for small stream or large river basins
WARMF	Watershed Analysis Risk Management Framework (WARMF) GIS based water quality management alternatives for a river basin
WMM	Watershed Management Model (WMM) is a spreadsheet model that calculates annual per-acre pollutant loadings

7.3 Selection of Surface Water Analysis Techniques for Application to Spokane River Watershed

The analytical methods and tools were evaluated as part of an experts workshop held on May 25, 2010 in Spokane, Washington. The purposed of the workshop was to discuss and select a preferred analytical method for application to the Spokane River Watershed. At this workshop, the PLOAD model was selected for recommendation to the NPAC. A majority of the NPAC agreed with applying PLOAD to the Spokane River Watershed.

PLOAD is a simplified, GIS-based model that calculates pollutant loads for watersheds (EPA, 2001). The model was designed to be a tool for selecting watershed management projects. Data inputs to the model include watershed geographic parameters, land use, and pollutant loading rate data tables. PLOAD functions within the Better Assessment Science Integrating Point and Nonpoint Sources (BASINS) interface framework to generate annual pollutant loads using pollutant export coefficients (EPA, 2007). For example, a land use has a typical pollutant export of so many pounds of phosphorus per area per time period based on historical research and monitoring. The phosphorus export coefficient is a lumped parameter that describes the annual total phosphorus load expected from a land use in terms of pounds per acre per year. The lumped parameter integrates all the potential mechanisms and sources for phosphorus loads, such as precipitation, stormwater runoff, snowmelt, erosion, slope, and soils.

PLOAD estimates nonpoint loads of pollution on an annual average basis, for any user-specified pollutant. The user may calculate the nonpoint loads using export coefficients, which can be applied to large and small watersheds. PLOAD is designed to provide a broad approach so that it can be applied in a wide variety of application scenarios including NPDES stormwater permitting, watershed management, or reservoir protection or restoration projects.

7.4 Application of Selected Surface Water Analysis Techniques

The PLOAD model was applied to the Spokane River Watershed for the purpose of estimating phosphorus loads (HDR, August 9, 2010). The ten 8-digit HUC subbasins of the Spokane River watershed were used as the starting point for building the PLOAD model within the BASINS interface. (See Chapters 1, 3 and 4 for discussions of the subbasins.) The 12-digit HUC subset of the subbasins was used to further refine the PLOAD model to 156 basins. Use of the 12-digit HUCs provided further refined USGS delineated basins and a scale that was appropriate for the study area. The average area of the 8-digit HUCs for the subbasins is 528,370 acres (826 square miles). The average area of the 12-digit HUCs for the 156 basins is 25,740 acres (40 square miles).

The application of the PLOAD model to the Spokane River Watershed included datasets describing characteristics of the subbasins (HDR, August 9, 2010). The digital elevation model and the national hydrography dataset (NHD) available within BASINS were used as model inputs. The NLCD from 2001 was used for the land use.

The approach for calibrating the PLOAD model involves combining multiple pieces of information including the following (HDR, November 30, 2010):

- Researching appropriate phosphorus export coefficients for the various land uses.
- Using the Spokane NPS Database values to calibrate the magnitude of the phosphorus loads.

7.4.1 Land Use Based Phosphorus Export Coefficients

The major land uses in the Spokane River Watershed and brief descriptions of the land use categories are described in Chapter 3. For these land uses, literature values for phosphorus export coefficients were researched (HDR, March 21, 2010). These literature values (Table 7-2) provided a range of export coefficients. The same land use in different parts of the country has

been found to export phosphorus at different rates. The low and high values provide the limits of the expected export coefficients for the Spokane River Watershed.

The literature range of coefficients was narrowed for the Spokane River Watershed (Table 7-2) using a procedure that compared the PLOAD model predictions to sampling data compiled in the Spokane NPS Database for a range of export coefficients. By generating a range of results, a level of uncertainty and variability was represented for the estimated phosphorus loadings. Twelve separate PLOAD model scenarios were simulated with export coefficients considered to provide results within the target ranges set by the water quality data. These refined export coefficients for the Spokane River Watershed are generally on the lower end of the literature range. The results were then compiled into a range of phosphorus loadings.

The PLOAD model uses a single export coefficient for each land use and generates a single total annual phosphorus load rate for each sub-subbasin. The lack of available comparison data meant that variations in land use export coefficients by subbasin would not provide additional refinement. Additionally, the relative comparison between land use loadings and sub-subbasin loadings are expected to be similar with and without land use changes in the rapid growth areas. This is anticipated because a majority of the rapid growth occurred as in-fill in sub-subbasins with existing urban land uses.

Table 7-2. Phosphorus Export Coefficients for Spokane River Watershed Land Uses

Land Use	Total Phosphorus (lbs/ac/yr)					
	Literature			PLOAD Model		
	Low	Median	High	Low	Median	High
Urban or Built-up Land	0.06	0.40	5.56	0.06	0.17	0.40
Residential	0.01	0.49	1.97	0.01	0.49	1.97
Commercial and Service	0.09	1.81	6.78	0.09	1.81	6.78
Other Urban	0.17	0.18	0.80	0.17	0.18	0.32
Cropland and Pasture	0.02	0.50	16.6	0.02	0.03	0.06
Other Agricultural Land	0.50	0.71	0.92	0.50	0.50	0.71
Herbaceous Range Land	0.04	0.25	0.87	0.04	0.04	0.09
Shrub and Brush Land	0.05	0.18	0.87	0.05	0.05	0.09
Deciduous Forest Land	0.01	0.13	0.99	0.01	0.13	0.99
Evergreen Forest Land	0.01	0.08	0.99	0.01	0.01	0.02
Mixed Forest Land	0.01	0.18	0.99	0.01	0.16	0.99
Forested Wetland	0.02	0.17	0.66	0.02	0.16	0.66
Non-forested Wetland	0.01	0.11	0.22	0.01	0.11	0.22

7.4.2 Comparing Spokane NPS Database to Model Predictions

Phosphorus data collected from monitoring in the watershed were compiled in the Spokane NPS Database. However, the phosphorus concentrations in the database are from discrete grab

samples from the water body, whereas the PLOAD model predicts an annual phosphorus load. Thus, the two are not directly comparable because they represent different time scales. A statistical translation method was developed to compare the watershed data to the predictions generated by the PLOAD model (HDR, March 21, 2010). The method was only applied for Spokane NPS Database entries that had:

- Data collected after January 1, 1990.
- Both total phosphorus concentration and flow data that were collected on the same date.
- Locations with sufficient samples to provide a statistically representative distribution of the annual load.

This resulted in 98 locations from the Spokane NPS Database with adequate data to estimate annual loads. The summary of the annual loads per acre provided a range for comparison to the PLOAD model of the Spokane River Watershed (Table 7-3). Export coefficients selected for the PLOAD provided results that are within the ranges estimated from the Spokane NPS Database indicating that these export coefficients represent watershed conditions as measured by the monitoring data.

This analysis shows that the PLOAD model application is within the target watershed comparison data using export coefficients within literature ranges. As a result, the model provides a valuable tool for the comparison of nonpoint sources across the Spokane River Watershed. The results of the comparison provide a guide for future prioritization of areas for additional monitoring, studies, and prioritization of BMPs (See Chapter 8).

Table 7-3. Phosphorus Export for Spokane River Subbasins

Subbasin	Number of Stations	Total Phosphorus (lbs/ac/yr)					
		Spokane NPS Database			PLOAD Models		
		Low	Median	High	Low	Median	High
Lower Spokane River	1	0.000	0.029	0.075	0.010	0.018	0.033
Upper Spokane River ID and WA	3	0.012	0.034	0.043	0.007	0.010	0.015
Little Spokane River	64	0.001	0.028	1.066	0.015	0.028	0.070
Hangman Creek	5	0.003	0.055	2.845	0.027	0.033	0.061
Coeur d'Alene Lake	6	0.000	0.032	0.704	0.004	0.021	0.040
South Fork and Upper Coeur d'Alene River	9	0.003	0.091	0.885	0.012	0.027	0.062
St. Joe River	10	0.003	0.027	0.836	0.017	0.021	0.041

7.4.3 Model Results

The results of the PLOAD modeling are presented spatially in Figure 7-1. The model results indicate that the highest phosphorus loads per area are located along the Spokane River corridor. This is similar to previous results that suggested phosphorus loads nearest the river may have a higher priority for reduction opportunities. The next highest phosphorus loads from the model results are located in areas around the Spokane River corridor and especially in the Little Spokane River subbasin. These areas generally have a greater mix of land uses, which results in the higher loading because there are more urban land uses covering larger areas, which have greater phosphorus export coefficients than forestry and rangeland. The mid-range loads occur mostly in areas with mixes of agricultural, rangeland and small suburban areas. The majority of this area is the middle of Hangman Creek subbasin through the agricultural areas around the lower portion of Coeur d'Alene Lake and into the Silver Valley along the South Fork Coeur d'Alene River. The lowest loadings were the rural mostly forested areas around the northern and eastern portion of the watershed.

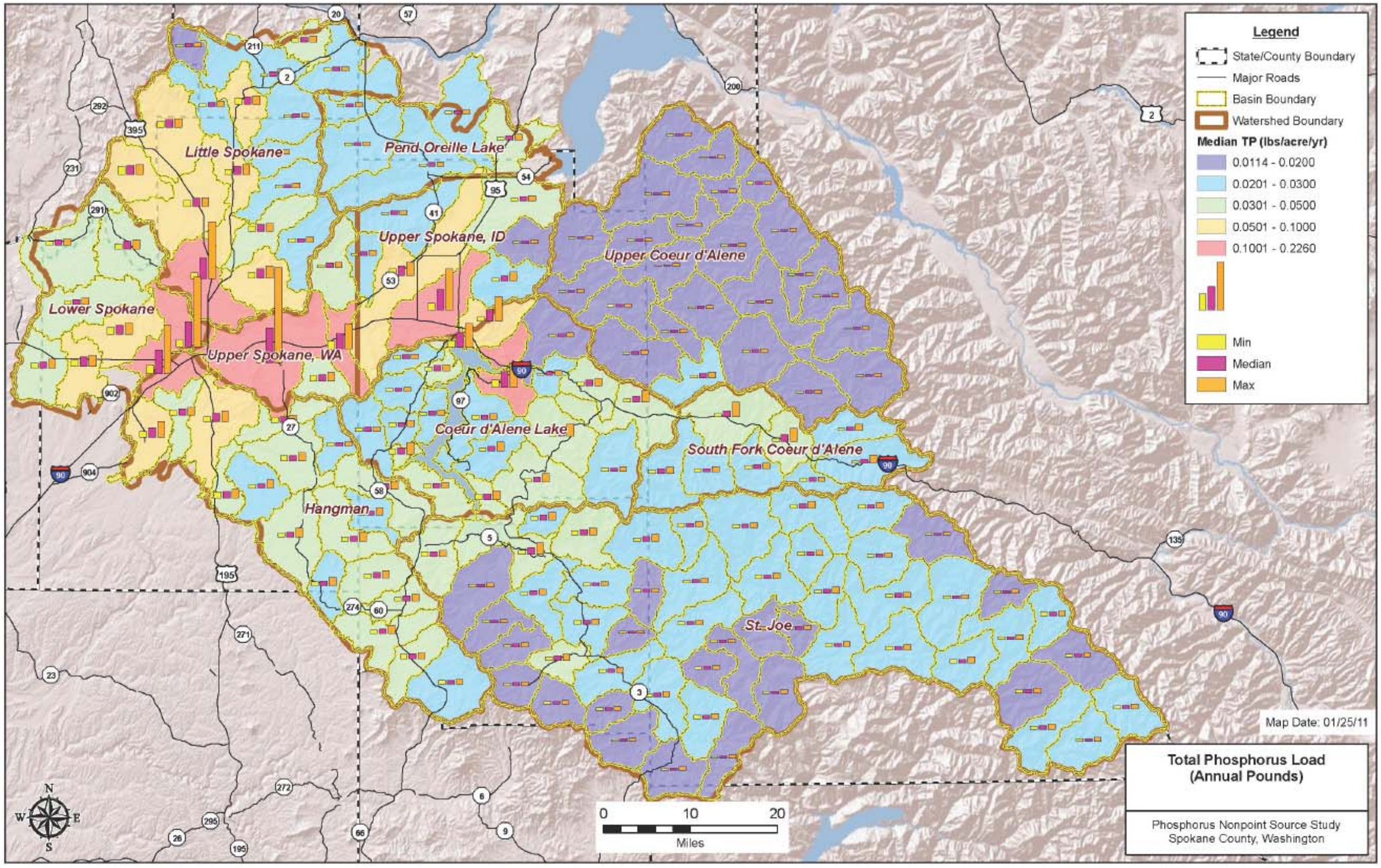

Figure 7-1. Spatial Results of PLOAD Model with Minimum, Median, and Maximum Results Shown

Chapter 8

Nonpoint Source Phosphorus Control Measures

8.1 Best Management Practices for Nonpoint Source Phosphorus

The management and implementation of control measures for nonpoint source phosphorus is a broad topic because nonpoint source phosphorus loads originate from diffuse sources located throughout the watershed resulting from a variety of activities. These control measures are commonly referred to as Best Management Practices (BMPs). BMPs include both non-structural efforts and structural facilities. Examples of non-structural efforts include education, street sweeping, and phosphate detergent bans. Examples of structural facilities include stormwater swales and ponds, stream buffer strips, and riparian fencing. Ecology defines BMPs as "Physical, structural, and/or operational practices that, when used singularly or in combination, prevent or reduce pollutant discharges" (Ecology, 2010).

As part of the NPS Study, BMPs were identified and evaluated to determine their applicability for nonpoint source phosphorus management in the Spokane River Watershed. The results of this BMP evaluation were presented in a technical memorandum titled Identification and Evaluation of Best Management Practices (GeoEngineers, HDR and HGC, 2011). The process for identifying and evaluating potential BMPs included:

- Compiling information on BMPs from previous studies: watershed planning documents; TMDLs; BMPs that have been implemented, constructed and/or used in the watershed; and BMPs identified by both watershed and national experts.
- Descriptions of the categories or types of activities and typical locations where the BMPs may be suitable.
- A list of BMPs both non-structural and structural based on local and global information.
- Quantitative estimates of the pollution reduction effects and costs of the BMPs.
- Consideration of other factors which should be taken into account in adapting BMPs to specific sites or locations, including the results of BMP survey of local watershed and national experts.

8.2 Types of BMPs

A simple list of BMPs does not provide information about the source the BMP is designed to reduce. Three common ways of describing BMPs are by activity, relationship to land use, and shape. Activity is typically categorized as structural or non-structural. Structural BMPs are typically physical features that treat or reduce phosphorus. Non-structural BMPs are typically practices or activities that reduce the source and/or transport of phosphorus. Relationship to land use is typically categorized by some combination of land use, infrastructure, and/or activities to provide a direct connection between the BMP type and location. Shape is typically categorized by morphology – point, linear, or area. Point BMPs are those with a small footprint, such as protecting stream crossings. Linear BMPs include items such as riparian buffers along

waterways. Area BMPs are those over large areas such as conservation tillage and residue management.

8.3 Sources of BMP Information

BMP information was compiled from a wide range of sources as part of the NPS Study (GeoEngineers, HDR and HGC, 2011). The sources included:

- The literature researched for phosphorus data to create the Spokane NPS Database for the NPS Study was examined as a source of BMPs as suggested by these previous investigators.
- Nonpoint source phosphorus BMPs that have been identified in the TMDL Water Quality Improvement Reports (WQIRs) for the Spokane River and subbasins, along with BMP information in the Coeur d'Alene Lake Management Plan (DEQ, 2009) and *Water Quality Trading Suitability Analysis: Spokane River Watershed* (Ross and Associates, 2005) were compiled.
- Numerous sources of BMP information from EPA, state agencies, and private organizations were reviewed and referenced including EPA National Menu of BMPs; International Stormwater BMP Database; SERA-17: Organization to Minimize Phosphorus Losses from Agriculture; Washington State Department of Ecology's Washington's Water Quality Management Plan to Control Nonpoint Sources of Pollution (Published in 2005 under Publication No. 05-10-027); and Lake Champlain Basin Program.
- Consultation and input from experts. Members of the NPAC (stakeholders throughout the watershed including EPA, Ecology, DEQ, Avista, Lands Council, utilities, tribes and SCCD) and other local and national experts were surveyed for an "on the ground" perspective of BMPs, including those successfully and unsuccessfully implemented in the watershed. Results of the local and national BMP surveys were summarized (HGC, 2011a; HGC, 2011b) and considered during the evaluation and prioritization of BMPs for the Spokane River Watershed.

8.4 Evaluation of BMPs

The evaluation of BMPs included compiling key information about each BMP. As part of the NPS Study, the following types of information about BMPs were compiled and considered as part of the BMP evaluation, selection and prioritization:

- BMP performance – total phosphorus removal efficiency.
- Typical phosphorus removal costs – dollars per pound of phosphorus removal.
- Regulatory agency acceptance and approval.
- Advantages, limitations and Spokane River Watershed applications.

The review conducted identified many sources that provide lists of BMPs, but few that provide data on phosphorus reduction performance and costs. Additionally, no direct information on performance and cost data was discovered for BMPs implemented in the watershed from the review of literature and responses to the BMP survey.

BMP performance effectiveness and costs were found to vary widely depending upon the watershed and site-specific conditions, and are summarized by land use in Tables 8-1 through 8-3. This results in a high degree of variability in performance in reducing phosphorus loads and a great variety of nonpoint source costs. This variability is influenced by the many different combinations of BMPs which can be applied, and by the location, design, materials used, climate and other factors which influence individual BMPs.

Results of this BMP evaluation and associated BMP information are provided in the Identification and Evaluation of Best Management Practices technical memorandum (GeoEngineers, HDR and HGC, 2011). Phosphorus removal efficiency, phosphorus removal cost, estimated longevity and estimated implementation effectiveness of BMPs identified for implementation in the Spokane River Watershed are presented in the sections below.

Table 8-1. Nonpoint Source BMPs for Agricultural Land Uses

BMP	Average Range of Phosphorus Removal Efficiency (%)	Typical Range of Phosphorus Removal Costs ($/lb)
Alternative Water Supply	-10 to 97	unknown
Animal Waste Systems	25 to 90	unknown
Barnyard Runoff Control/Management	30 to 70	2 to 6
Barnyard Runoff Treatment	unknown	250 to 275
Conservation Tillage	5 to 97	1 to 150
Contour Cropping, Plowing and Terracing	30 to 75	1 to 2
Contour Strip Crop	70 to 85	unknown
Conversion to Perennial Crops	75 to 95	unknown
Cover Crops	0 to 67	unknown
Crop Rotation	53 to 67	unknown
Crop Rotations and Diverse Cropping Systems	25 to 88	unknown
Detention Ponds/Impoundments	70 to 80	unknown
Erosion Control	unknown	400 to 450
Feed Management (dairy)	20 to 30	unknown
Feed Management (non-ruminant animals)	5 to 60	unknown
Feed Management (ruminant animals)	5 to 30	unknown
Grazing Management	unknown	85 to 100
Livestock Exclusion from Streams	20 to 76%	unknown
Managed Livestock Grazing	0 to 78%	unknown

BMP	Average Range of Phosphorus Removal Efficiency (%)	Typical Range of Phosphorus Removal Costs ($/lb)
Manure Management	unknown	2 to 4
Milkhouse Waste Treatment	unknown	5 to 450
Mortality Composting (dead animals)	5 to 15%	unknown
No-Till Practices	35 to 90%	unknown
Nutrient Management Plan	0 to 91%	525 to 550
Nutrient Management Plan with P Soil Testing	61 to 71%	unknown
Off-Stream Livestock Watering (with fence)	25 to 35%	120 to 650
Off-Stream Livestock Watering (without fence)	17 to 27%	unknown
Phosphorus Management (balanced to crop use)	15 to 47%	unknown
Subsurface Phosphorus Application	8 to 92%	unknown
Terraces	unknown	2 to 4
Various Conservation Tillage Practices	45 to 55%	unknown
Vegetative Buffer Areas	unknown	1 to 2
Waste Storage Facility	unknown	120 to 890
Waste Utilization	unknown	1,100 to 1,200

[1] Costs compiled from numerous sources, as referenced by GeoEngineers, HDR, and HGC (2011). Costs are presented in dollars per pound, unless otherwise noted, and in some cases were converted with respect to the units used in the original document.

[2] A 25-year life expectancy was assumed for infiltration structures and sand filters by Corrozi (2009). Costs represent dollars per pound of total phosphorus removed for life of BMP.

[3] Provided in dollars per year per pound of total phosphorus load reduction.

8.5 Prioritization of BMPs for Spokane River Watershed

Prioritization was completed to identify what BMPs would provide the greatest net nonpoint source phosphorus load reduction in each subbasin. The following considerations were evaluated during the detailed prioritization process:

- Land use.
- Phosphorus delivery potential.
- Key BMP attributes.

The analysis and prioritization considered 108 candidate BMPs and resulted in the identification of 22 primary BMPs for the 11 major land uses for each subbasin in the Spokane River Watershed. The BMPs identified can provide significant opportunities for the highest net

potential reduction in nonpoint source phosphorus in each subbasin. The following sections describe the prioritization process and results.

8.5.1 Land Use Considerations

Land use was used in the prioritization process because it correlates with subbasins, BMPs, and nonpoint source phosphorus loads. Achieving a net nonpoint source reduction of phosphorus from an entire subbasin will require the implementation of several BMPs over a large area. In general, the largest land uses in a subbasin provides the greatest opportunities for applying BMPs. However, since various land uses generate different phosphorus loads, identifying the combination of BMPs applicable to land uses that generate large phosphorus loads provides the greatest potential for a net source reduction of phosphorus at the subbasin scale.

For example, a subbasin that is mostly forested land will likely require primarily forestry BMPs to achieve a phosphorus reduction. The percentage of each land use over the total subbasin area was calculated based on land use areas presented in Chapter 3. Land use percentages were sorted to identify the major land uses in each subbasin. The greatest land uses in each subbasin were summed until the total was 80 percent or greater (Table 8-2). At the 80 percent threshold, the subbasins are comprised of two to five dominate land uses. The remaining subbasin area is a mix of the other 10 to 13 land uses.

As is shown in Table 8-2, forestry (evergreen forest) is the largest land use in almost every subbasin. The Lower Spokane River subbasin is characterized by a nearly equal split of shrub and brush range, forested land, and cropland. The Hangman Creek subbasin is largely cropland and pasture land. The remaining subbasins are dominated by forested land.

Table 8-2. Land Uses Totaling More than 80 percent of the Subbasin

Subbasin	Major Land Uses[1]	Percent of Total Area (%)
Lower Spokane River	Shrub and Brush Range	28
	Evergreen Forest	25
	Cropland and Pasture	23
	Herbaceous Range	12
Upper Spokane River WA	Evergreen Forest	35
	Urban or Built-up Land	17
	Shrub and Brush Range	16
	Herbaceous Range	8
	Other Urban or Built-up	7
Upper Spokane River ID	Evergreen Forest	61
	Shrub and Brush Range	13
	Herbaceous Range	6
Little Spokane River	Evergreen Forest	57
	Shrub and Brush Range	14
	Herbaceous Range	11
Hangman Creek	Cropland and Pasture	48
	Evergreen Forest	30
	Shrub and Brush Range	9
Pend Oreille Lake (SW portion)	Evergreen Forest	83
	Shrub and Brush Range	8
Coeur d'Alene Lake	Evergreen Forest	62
	Shrub and Brush Range	17
Upper Coeur d'Alene River	Evergreen Forest	94
	Shrub and Brush Range	5
South Fork Coeur d'Alene River	Evergreen Forest	74
	Shrub and Brush Range	20
St. Joe River	Evergreen Forest	73
	Shrub and Brush Range	24

[1]Combined land uses totaling more than 80 percent of the entire subbasin area.

8.5.2 Phosphorus Delivery Potential Considerations

Land use area alone is not an absolute indicator of loading potential because various land uses generate different phosphorus loads per unit area. For example, forested land can be a small nonpoint source of phosphorus since in an undisturbed condition these areas tend to generate little nonpoint source phosphorus. Vegetation slows stormwater runoff, holds the organic matter and soils together, and provides a more stable hydrologic regime. As a result, BMPs for forested land are unlikely to have a significant load reduction impact for most of the subbasins.

On the other hand, smaller land uses such as urban/suburban areas can be larger nonpoint sources of phosphorus and deliver greater phosphorus loads to the Spokane River and its tributaries. Urban/suburban areas can generate more nonpoint source phosphorus due to rapid high-volume

and high-flow rates of stormwater runoff that occurs from developed hard surface areas such as buildings and pavement. This runoff can carry a variety of phosphorus pollutants including pet waste, fertilizers, and soils. BMPs for the uses that generate these larger loads can provide a greater impact in load reduction efforts.

Export coefficients are used to account for the differences in the intensity of nonpoint source phosphorus from the various land uses. Export coefficients were used as part of the PLOAD modeling analysis of the Spokane River Watershed. These export coefficients were developed by applying the PLOAD model to the Spokane River Watershed and comparing the results to the monitoring data as compiled in the Spokane NPS Database. The results are shown in Table 8-3.

Table 8-3. Spokane River Watershed Land Use Phosphorus Export Coefficients

Land Use	Total Phosphorus (lbs/ac/yr)
Cropland and Pasture	0.31
Other Agricultural Land	0.50
Deciduous Forest Land	0.01
Evergreen Forest Land	0.08
Mixed Forest Land	0.01
Commercial and Service	0.20
Other Urban	0.17
Residential	0.01
Urban or Built-up Land	0.06
Herbaceous Range Land	0.04
Shrub and Brush Land	0.05
Forested Wetland	0.02
Non-forested Wetland	0.01

Phosphorus loads were calculated by multiplying the land use areas by the export coefficients for each land use. The phosphorus load for each land use was also calculated as a percentage of the total subbasin load. The land use load percentages were sorted to identify the land uses that tend to generate the greatest phosphorus loads. These land uses are shown in Table 8-4.

Dominant land use areas usually resulted in the greatest phosphorus loads, since the percentage of evergreen forest land dominants most subbasins. However, cropland and pasture does have a higher load percentage than the largest land use of shrub and brush land in the Lower Spokane River subbasin. Cropland and pasture was also the second highest load percentages compared to the second largest land use of shrub and brush land in the Coeur d'Alene Lake, Little Spokane River, and Upper Spokane River ID subbasins. Cropland and pasture was also the second highest load percentage compared to the second largest land use of urban or built-up land in the Upper Spokane River WA subbasin.

Controlling nonpoint sources of phosphorus on both the largest land uses and the most phosphorus intensive land uses in each subbasin will be important for making the greatest phosphorus load reductions in the overall watershed.

Table 8-4. Major Spokane River Subbasin Land Uses with High Phosphorus Delivery Potential

Subbasin	Major Land Uses	Percent of Total Load (%)
Lower Spokane River	Cropland and Pasture	59
	Evergreen Forest Land	17
	Shrub and Brush Land	12
Upper Spokane River WA	Evergreen Forest Land	34
	Cropland and Pasture	14
	Other Urban	14
	Urban or Built-up Land	13
Upper Spokane River ID	Evergreen Forest Land	55
	Cropland and Pasture	21
Little Spokane River	Evergreen Forest Land	48
	Cropland and Pasture	29
Hangman (Latah) Creek	Cropland and Pasture	81
	Evergreen Forest Land	11
Pend Oreille Lake (SW portion)	Evergreen Forest Land	87
Coeur d'Alene Lake	Evergreen Forest Land	65
	Cropland and Pasture	17
	Shrub and Brush Land	11
Upper Coeur d'Alene River	Evergreen Forest Land	96
South Fork Coeur d'Alene River	Evergreen Forest Land	78
	Shrub and Brush Land	14
St. Joe River	Evergreen Forest Land	80
	Shrub and Brush Land	16

8.5.3 BMP Attribute Considerations

The volume of published BMP information for phosphorus reduction is extensive. To create a manageable subset of BMPs for the prioritization in the Spokane River Watershed, key attributes were used to select high potential BMPs. Key attributes for this project include the four highest ranked BMP attributes determined by the Spokane River Watershed Local BMP Survey (Local Survey) (HGC, 2011a). The four key attributes used to evaluate the list of BMPs for the prioritization include:

- Phosphorus percent reduction efficiency (Table 8-1).
- Costs (Table 8-1).

- Estimated longevity.
- Implementation effectiveness. (Degree to which stakeholders consider the BMP to be effective, i.e., level/likelihood of required citizen/landowner cooperation.) (Local Survey).

A composite score for ranking BMPs was determined by equally weighting each of these four attributes. In researching BMPs, the percent reduction in phosphorus was the most complete dataset of the four attributes (i.e., data were found for nearly all the BMPs). Higher percent reductions received higher scores. Costs were not available for all of the BMPs for which phosphorus reduction information was available. As a result, costs were estimated for those BMPs that had data associated with similar practices. Lower costs received higher scores, so the costs data had an inverse relationship in scoring. The least information was available for BMP longevity and consequently, estimates were made based on similar BMPs. Greater longevity received higher scores. The Local Survey responses provided data on implementation effectiveness. For those BMPs that were not included in the survey, the implementation effectiveness was estimated based on similar BMPs. Greater implementation effectiveness received higher scores.

Based on the scoring of these attributes, the initial list of 108 candidate BMPs was reduced to 22 primary BMPs most appropriate for the Spokane River Watershed. The 22 BMPs are listed with a brief description in Table 8-5 with additional details provided in the technical memorandum titled Identification and Evaluation of Best Management Practices (GeoEngineers, HDR and HGC, 2011). The 22 BMPs are shown in Table 8-6 along with the classification of the key attributes. The classification of each attribute ranges from very low to very high with the ranges used shown in the footnote. The types of BMPs shown in Table 8-6 are those necessary to achieve a substantial net nonpoint source reduction of phosphorus with the Spokane River Watershed subbasins.

An example of a BMP that scored very high was the vegetated buffer strip. Research indicated an average phosphorus load reduction of about 49 percent (Table 8-1) and a low cost of about $15/pound (Table 8-1) for a vegetated buffer strip. Moreover, buffers are generally accepted by the public aesthetically and once established with native vegetation, can provide long-term benefits and a high effectiveness (as identified in the Local Survey responses). In contrast, dry detention ponds/basins scored very low. The research indicated an average phosphorus reduction of only about 10 percent (Table 8-1), a high cost in the hundreds to thousands of dollars per pound (Table 8-1), lower longevity and a moderate effectiveness.

Table 8-5. Primary BMPs and Brief Descriptions

BMP	Brief Description
Conservation Tillage / No-Till / Direct Drill Seeding	Various terms for leaving the soil undisturbed from harvest to planting and using a 'drill' for seeding
Contour Plowing and Terracing	A method of plowing furrows that follow the curves of the land with ridges slowing runoff and erosion
Contour Strip Crop	Alternating bands of crops with higher erosion potential with those of lower erosion potential
Conversion to Perennial Crops	Planting crops that are not reseeded every year
Detention Ponds/Impoundments	A basin that stores runoff for a limited period
Dry Swale	A swale with a soil filter system that temporarily stores and then filters the runoff
Erosion Control	Techniques for preventing or controlling erosion such as from agriculture and construction sites
Filter Strips	A vegetated band of land between a runoff area and receiving waterbody
Grassed Bio-Infiltration Swales	Vegetative cover in a swale provides pretreatment of runoff before infiltration to the subsurface
Inspection and Pumping of Septic Systems	Removing the contents of a septic tank and properly disposing it at a wastewater treatment facility
Manure Management	Practices for handling and using manure to enhance solid waste management and protect water resources
Nutrient Management Plan with Phosphorus Soil Testing	Managing the amount, source, placement, form and timing of nutrients and soil amendments
Off-Stream Livestock Watering	Methods for providing livestock water other than direct access to the water body
Phosphate Lawn Fertilizer Ban	Limits the availability of phosphate lawn fertilizer through restrictions
Riparian Fencing	Fencing along the stream corridor to protect the native vegetation and stream bank
Riparian Zones and Buffer Strips	Vegetated areas next to waterbodies that filter runoff, stabilize the bank, shade the water, and provide aquatic and wildlife habitat
Septic Tank Elimination (Sewering)	Removal of septic systems by connecting to sewer systems
Stream Bank Stabilization	A combination of erosion and sediment control practices to protect streams, banks, and habitat
Stream Crossings	Designed to minimize impacts to streams where vehicles must travel through the water
Streamside Management Zones	Managed areas of undisturbed riparian vegetation along a waterway
Timber Harvest Planning	Process of organizing, scheduling, and planning harvests to minimize nonpoint sources of pollution
Vegetated Buffer Strips	Runoff directed via sheet flow to a band of vegetation

Table 8-6. Primary BMPs Based on Key Attributes

BMP	Phosphorus Removal Efficiency[1]	Phosphorus Removal Costs ($/lb)[1]	Estimated Longevity[1]	Estimated Implementation Effectiveness[1]
Conservation Tillage / No-Till / Direct Drill Seeding	Moderate	Very Low	Moderate	Moderate
Contour Plowing and Terracing	Moderate	Very Low	Moderate	Moderate
Contour Strip Crop	High	Moderate	Moderate	Moderate
Conversion to Perennial Crops	High	Moderate	Moderate	Moderate
Detention Ponds/Impoundments	High	Moderate	High	Moderate
Dry Swale	High	Moderate	High	Moderate
Erosion Control	Moderate	Moderate	Moderate	High
Filter Strips	Moderate	Low	High	High
Grassed Bio-Infiltration Swales	Moderate	Moderate	Moderate	High
Inspection and Pumping of Septic Systems	Moderate	Low	Low	Moderate
Manure Management	High	Low	Low	Moderate
Nutrient Management Plan with Phosphorus Soil Testing	High	Moderate	Low	High
Off-Stream Livestock Watering	Low	Moderate	Moderate	Very High
Phosphate Lawn Fertilizer Ban	Low	Low	Moderate	High
Riparian Fencing	Low	Moderate	Moderate	Very High
Riparian Zones and Buffer Strips	Moderate	Moderate	High	Very High
Septic Tank Elimination (Sewering)	High	High	High	Moderate
Stream Bank Stabilization	Moderate	Low	High	High
Stream Crossings	Moderate	Moderate	Moderate	High
Streamside Management Zones	High	Low	Moderate	Very High
Timber Harvest Planning	High	Low	Moderate	High
Vegetated Buffer Strips	Moderate	Low	High	Very High

[1]The classifications of the four attributes from very low to very high were based on the following ranges

Very low	<10%	<100	Estimated based on amount of public acceptance and amount of care required	<20
Low	10 to 35%	100 to 300		20 to 40
Moderate	35 to 65%	300 to 1000		40 to 60
High	65 to 90%	1000 to 3000		60 to 80
Very High	>90%	>3000		>80

8.5.4 Linking High Scoring BMPs to Land Uses

Many of the high scoring BMPs are suited to particular land uses. The 22 major BMPs and their relation to the land uses are shown in Table 8-7. The relevance and appropriateness ranges from 1 (little or no relevance) to 5 (very relevant for the land use) as shown in the footnote. Higher scores correlate to greater compatibility for addressing nonpoint source phosphorus issues on the particular land use and lower scores indicate less compatibility.

Table 8-7. Relevance and Appropriateness of BMP for Land Use

BMP/Land Use[1]	Cropland and Pasture	Other Agricultural Land	Deciduous Forest	Evergreen Forest	Mixed Forest	Commercial and Service	Other Urban and Built-up Land	Residential	Urban or Built-up Land	Herbaceous Range	Shrub and Brush Range
Conservation Tillage / No-Till / Direct Drill Seeding	5	3	1	1	1	1	1	1	1	1	1
Contour Plowing and Terracing	5	5	1	1	1	1	1	1	1	1	1
Contour Strip Crop	5	5	1	1	1	1	1	1	1	1	1
Conversion to Perennial Crops	5	5	1	1	1	1	1	1	1	1	1
Detention Ponds/Impoundments	3	3	2	2	2	5	5	5	5	3	3
Dry Swale	4	4	2	2	2	5	5	5	5	2	2
Erosion Control	5	5	5	5	5	3	3	3	3	5	5
Filter Strips	5	5	5	5	5	1	3	1	1	5	5
Grassed Bio-Infiltration Swales	4	4	2	2	2	5	5	5	5	2	2
Inspection and Pumping of Septic Systems	1	1	1	1	1	5	3	5	5	1	1
Manure Management	5	5	1	1	1	1	1	1	1	1	1
Nutrient Management Plan with Phosphorus Soil Testing	5	5	1	1	1	1	1	1	1	1	1
Off-Stream Livestock Watering	5	5	1	1	1	1	1	1	1	3	3
Phosphate Lawn Fertilizer Ban	1	1	1	1	1	3	3	5	3	1	1
Riparian Fencing	5	5	5	5	5	1	3	1	1	5	5

BMP/Land Use[1]	Cropland and Pasture	Other Agricultural Land	Deciduous Forest	Evergreen Forest	Mixed Forest	Commercial and Service	Other Urban and Built-up Land	Residential	Urban or Built-up Land	Herbaceous Range	Shrub and Brush Range
Riparian Zones and Buffer Strips	5	5	5	5	5	1	3	1	1	5	5
Septic Tank Elimination (Sewering)	1	1	1	1	1	5	3	5	5	1	1
Stream Bank Stabilization	5	5	5	5	5	3	3	3	3	5	5
Stream Crossings	5	5	5	5	5	2	2	2	2	4	4
Streamside Management Zones	3	3	5	5	5	1	1	1	1	3	3
Timber Harvest Planning	1	1	5	5	5	1	1	1	1	1	1
Vegetated Buffer Strips	5	5	3	3	3	5	5	5	5	2	2

[1]Values represent relevance and appropriateness: 1= low, 3= moderate, 5 = high.

8.5.5 Highest Prioritized BMPs for Spokane River Watershed Subbasins

The best BMPs by land use based on relevance and appropriateness, the BMP scores and the land uses with high phosphorus delivery potential were identified by subbasin (Table 8-8). The identification was completed using a matrix for each subbasin with the 22 primary BMPs on one axis and the 11 primary land uses on the other axis. The 22 primary BMPs are shown in the first columns of Tables 8-8. The 11 primary lands uses are shown in the first column of Table 8-3. The factors as described above and include: land use, reduction efficiency, cost, longevity, implementation effectiveness, and relevance where used to develop a combined score for each combination of BMPs and land use. This combined score integrated the factors and completed the core of the matrix. The combined score provided a relative comparison between the BMPs and land uses. For each subbasin, the combined scores were then sorted to identify the highest priority BMPs. This resulted in a prioritization for each subbasin by the 11 major land uses and the 22 primary BMPs. Table 8-8 provides a summary of the three highest prioritized BMPs by subbasin.

Additional information revealed from the matrix includes the critical land uses and secondary BMPs (Table 8-8). The critical land uses are those with the highest combined scores. The secondary BMPs are those with the next best combined score, independent of land use. There is repetition in the BMPs because of the dominant land uses and high applicability rating of similar BMPs. These secondary BMPs will likely be important in local areas.

Based on this prioritization process, BMPs are identified that can provide significant opportunities for the highest net potential reduction in nonpoint source phosphorus in each subbasin. From a planning perspective, multiple opportunities exist in each subbasin to implement a combination of these BMPs. Other BMPs and land uses may be present in each subbasin that can provide phosphorus reduction opportunities, especially at the local scale. These opportunities can still be valuable in working towards achieving nonpoint source phosphorus reductions.

This prioritization is intended to inform and guide decision makers about the types of BMP opportunities in each subbasin that can help to reduce phosphorus loads to meet water quality objectives in the Spokane River. These high priority BMPs were considered as potential approaches as part of the more specific nonpoint source phosphorus management strategies and actions that were developed for each subbasin, as described in Chapters 10 through 19 of this NPS Reduction Plan.

Table 8-8. Highest Prioritized Spokane River Watershed Nonpoint Source BMPs

Subbasin	Primary BMPs	Percent of Land Use Applicable (%)	Critical Land Use	Secondary BMPs
Lower Spokane River	Vegetated Buffer/Filter Strips Riparian Zones and Buffer Strips Stream Bank Stabilization	80 80 82	Cropland and Pasture Evergreen Forest	Streamside Management Zones
Upper Spokane River WA	Streamside Management Zones Riparian Zones and Buffer Strips Stream Bank Stabilization	40 58 64	Evergreen Forest Other Urban Cropland and Pasture	Vegetated Buffer/Filter Strips
Upper Spokane River ID	Streamside Management Zones Riparian Zones and Buffer Strips Stream Bank Stabilization	62 78 81	Evergreen Forest Cropland and Pasture	Vegetated Buffer/Filter Strips
Little Spokane River	Streamside Management Zones Riparian Zones and Buffer Strips Stream Bank Stabilization	62 83	Evergreen Forest Cropland and Pasture	Vegetated Buffer/Filter Strips
Hangman Creek	Vegetated Buffer/Filter Strips Riparian Zones and Buffer Strips Stream Bank Stabilization	85 85 86	Cropland and Pasture Evergreen Forest	Streamside Management Zones
Pend Oreille Lake (SW portion)	Streamside Management Zones Riparian Zones and Buffer Strips Stream Bank Stabilization	79 86 87	Evergreen Forest Shrub and Brush	Vegetated Buffer/Filter Strips
Coeur d'Alene Lake	Streamside Management Zones Riparian Zones and Buffer Strips Stream Bank Stabilization	64 78 79	Evergreen Forest Cropland and Pasture	Vegetated Buffer/Filter Strips
Upper Coeur d'Alene River	Streamside Management Zones Riparian Zones and Buffer Strips Stream Bank Stabilization	86 89 89	Evergreen Forest Shrub and Brush	Vegetated Buffer/Filter Strips
South Fork Coeur d'Alene River	Streamside Management Zones Riparian Zones and Buffer Strips Stream Bank Stabilization	73 87 87	Evergreen Forest Shrub and Brush	Vegetated Buffer/Filter Strips
St. Joe River	Streamside Management Zones Riparian Zones and Buffer Strips Stream Bank Stabilization	73 89 89	Evergreen Forest Shrub and Brush	Vegetated Buffer/Filter Strips

Chapter 9

Spokane River Watershed – Nonpoint Source Phosphorus Management Strategy and Actions

9.1 Introduction

The NPS Reduction Plan introduces subbasin scale nonpoint source control strategies and actions that would contribute to long-term reductions of phosphorus loading across the entire Spokane River Watershed. Chapter 9 describes regional management actions and supporting activities applicable to the entire watershed. Chapters 10 through 19 describe actions for each individual subbasin. Therefore, Chapter 9 recommendations should be considered in tandem with subbasin-specific recommended actions. Achieving reductions in nonpoint source phosphorus loads will require the implementation of a variety of actions in every subbasin by multiple entities. Thus, the identified source control reduction strategies and actions will need to be adapted and applied at the local scale.

A goal of the NPS Reduction Plan is to provide justification to local, state, and federal decision-makers about the requirements, studies, and actions that are needed to reduce nonpoint sources of phosphorus. It encourages organizations within the Spokane River Watershed to undertake and support the reduction of nonpoint source phosphorus in an effort to improve watershed conditions and water quality. Since regulatory requirements for nonpoint sources are not as stringent as those for point sources, this NPS Reduction Plan does not dictate the reduction of nonpoint source phosphorus pollution, require the actions to be taken, or BMPs to be implemented.

Within the watershed there are multiple land-uses, ownership, and government agencies with jurisdiction. A significant number of actions implemented by multiple organizations, requiring multiple and extensive funding, may be needed to achieve the targeted level of improvements to water quality. Funding sources may need to be pooled, combined and/or applied independently. Chapter 20 includes information on funding opportunities. Activities to reduce nonpoint sources of phosphorus include:

- Reducing pollutant loading from nonpoint sources by implementing Best Management Practices (BMPs).
- Maintaining and increasing a watershed's ability to keep water healthy by protecting existing ecological functions such as riparian zones, wetlands and floodplains.

The benefits include both measurable economic benefits and less tangible cultural benefits, such as aesthetics, increased quality of recreational opportunities and quality of life. Some specific benefits of nonpoint source reductions include:

- Enhanced water quality for drinking water, fisheries, recreation and other water uses.
- Improved watershed conditions for habitat, aesthetics, and recreation.
- Soil conservation and reduced flooding potential.

- Reduced net environmental impacts due to decreased chemical use, energy use and release of greenhouse gases that may be associated with advanced phosphorus removal treatment of wastewater.
- Lower costs than advanced phosphorus removal treatment from wastewater, stormwater and water from industrial use.
- Lower costs than potential modifications to hydropower facilities and/or operations.

Due to the complexity and distribution of nonpoint sources within the subbasins of the Spokane River Watershed, it is anticipated that reduction will be a long-term process and could take decades for BMPs to be successfully established. Moreover, the high costs and technical expertise of mitigation will require contributions from many organizations, extensive local government participation, public education, financial assistance, and regulatory enforcement to successfully implement strategies to restore and protect water quality. The NPS Reduction Plan provides a structured starting point to implement management strategies and actions at the local level to lead toward the successful reduction of nonpoint source phosphorus.

9.2 Priorities Based on Phosphorus Data Analysis

Each organization should evaluate potential activities and prioritize implementation opportunities based on a variety of factors including: objectives, availability of resources, funding, schedule, and reduction benefits. The NPS Reduction Plan provides guidance on prioritizing "what" actions and "where" to implement them. As part of the NPS Study, nonpoint phosphorus sources and associated geographic subbasins were preliminarily prioritized as part of the initial phosphorus data analyses (see GeoEngineers, September 15, 2009). This preliminary prioritization identified the type and location of actions necessary to reduce the overall phosphorus load within the watershed. The findings were:

- Actions should be implemented in all subbasins.
- Aggressive actions should be taken in the areas nearest Lake Spokane including the Lower Spokane River, Upper Spokane River WA, Upper Spokane River ID, Hangman Creek and Little Spokane River subbasins.
- Connections should be established between specific sources and stakeholders that have the ability to take action.
- Agencies and responsible parties should be connected and engaged to maintain and enhance the communication and exchange of information.
- The Spokane NPS Database and NPS Study documents should be made available to assist groups with making decisions and dedicating available resources to reductions.
- Results should be integrated with the additional examination of economics, feasibility, determining quantifiable loads and impacts, and project monitoring.
- Multiple smaller projects should be considered if the results are greater than one larger project.

Additional information is presented in the following subbasin-specific chapters (Chapters 10 through 19), including distribution of land uses, distribution of land ownership, and regulatory

and supporting agencies. This information should also prove valuable as decisions are made to pursue management strategies and actions in each subbasin.

9.3 Regulatory Authorities in Washington and Idaho

Organizations may use the information provided in the NPS Reduction Plan to select nonpoint source management strategies and take action (i.e., “what to do” and “where to do it”). Land owners implementing BMPs may seek the assistance of a variety of stakeholders. Stakeholders include regulatory agencies, commissions, and enforcement regulators. Stakeholders may also include agencies and groups that provide technical assistance, financial aid and environmental education and conservation programs.

Depending on the location, various jurisdictions (including federal and state agencies, tribes, counties, and cities) have regulatory authority for land use planning, management, and development. Each of these entities may enact regulations stricter than the federal standards that may directly or indirectly affect nonpoint sources. Stormwater regulations are an important tool used by local jurisdictions (usually cities and counties) to identify allowable pre- and post-development timing, quantity, and quality of runoff flows. Development usually increases the amount of impervious area within a given area which in turn increases the speed and amount of stormwater runoff and provides a mechanism for the transport of nonpoint source phosphorus.

The EPA, DEQ and Ecology enforce CWA requirements. These agencies are responsible for setting and assuring that state water quality standards are met. The U.S. Fish and Wildlife Service, Idaho Fish and Game and Washington Department of Fish and Wildlife may also have regulatory authority since these agencies are responsible for the preservation, protection, and management of fish, wildlife, and habitats which can be impacted by water quality.

Agencies responsible for land management have the ability to implement policies that encourage meeting water quality requirements. For example, forest practice regulations will be relied upon to reduce nonpoint sources on federal, state, and private forestlands. Improvement to water quality depends on land managers complying with state water quality standards and policies.

Accomplishing nonpoint source reductions will require action from local, state, and federal agencies and land managers. Organizations that have regulatory authority in the subbasins are shown in Table 9-1; a ‘Y’ indicates they have authority in the corresponding subbasin chapter. These organizations are encouraged to work together in an effort to balance their diverse levels of authority and responsibility, secure funding and select nonpoint source phosphorus control actions to pursue.

Table 9-1. Organizations and Nonpoint Source Phosphorus

Chapter[1]										Organization	Related Responsibilities
10	11	12	13	14	15	16	17	18	19		
[1]Chapters – X indicates organization has responsibilities within the subbasin. Chapter 10 Lower Spokane River subbasin, Chapter 11 Upper Spokane River WA subbasin, Chapter 12 Little Spokane River subbasin, Chapter 13 Hangman Creek subbasin, Chapter 14 Upper Spokane River ID subbasin, Chapter 15 Coeur d'Alene Lake subbasin, Chapter 16 Upper Coeur d'Alene Lake subbasin, Chapter 17 South Fork Coeur d'Alene River subbasin, Chapter 18 St. Joe River subbasin, Chapter 19 Pend Oreille Lake subbasin											
										Local Governments	
										Counties	
			X		X		X	X		Benewah County, ID	Issues building permits and maintains county roads.
		X							X	Bonner County, ID	
								X		Clearwater County, ID	
				X	X	X	X	X	X	Kootenai County, ID	
								X		Latah County, ID	
X										Lincoln County, WA	
		X							X	Pend Oreille County, WA	
				X	X	X	X	X		Shoshone County, WA	
X	X	X	X		X				X	Spokane County, WA	
X		X								Stevens County, WA	
			X							Whitman County, WA	
										Conservation Districts	
			X		X		X	X		Benewah County Soil and Water Conservation District	Partners with other government agencies, private landowners and users, and the public to promote voluntary, non-regulatory, locally-led conservation and stewardship of the natural resources including water resource protection and alternatives for agricultural production.
		X							X	Bonner County Soil and Water Conservation District	
				X	X	X	X	X	X	Kootenai-Shoshone Soil and Water Conservation District	
								X		Latah Soil and Water Conservation District	
X										Lincoln County Conservation District	
		X							X	Pend Oreille County Conservation District	
X	X	X	X		X				X	Spokane County Conservation District	
X		X								Stevens County Conservation District	
			X							Whitman Conservation District	
										Health Districts	
		X	X	X	X	X	X	X		Idaho Panhandle Health District 1	Mission includes: protecting the health and quality of the environment, work with environmental agencies on pollution sources, and advise local entities, including businesses, schools and government agencies about pollution prevention.
X	X	X	X		X					Spokane Regional Health District	
										Municipalities	
X										Airway Heights, WA	Local jurisdictions for construction, roads, stormwater and wastewater.
				X					X	Athol, ID	
			X							Cheney, WA	
				X	X					Coeur d'Alene, ID	
				X						Dalton Gardens, ID	
		X								Deer Park, WA	
			X							Fairfield, WA	
					X					Fernan Lake, ID	
					X					Harrison, ID	
				X						Hauser, ID	
				X						Hayden, ID	
				X						Hayden Lake, ID	

Chapter[1]										Organization	Related Responsibilities
10	11	12	13	14	15	16	17	18	19		
[1]Chapters – X indicates organization has responsibilities within the subbasin. Chapter 10 Lower Spokane River subbasin, Chapter 11 Upper Spokane River WA subbasin, Chapter 12 Little Spokane River subbasin, Chapter 13 Hangman Creek subbasin, Chapter 14 Upper Spokane River ID subbasin, Chapter 15 Coeur d'Alene Lake subbasin, Chapter 16 Upper Coeur d'Alene Lake subbasin, Chapter 17 South Fork Coeur d'Alene River subbasin, Chapter 18 St. Joe River subbasin, Chapter 19 Pend Oreille Lake subbasin											
				X						Huetter, ID	
							X			Kellogg, ID	
			X							Latah, WA	Local jurisdictions for construction, roads, stormwater and wastewater.
	X									Liberty Lake, WA	
X										Medical Lake, WA	
	X									Millwood, WA	
							X			Mullan. ID	
		X								Newport, WA	
							X			Osburn, ID	
							X			Pinehurst, ID	
								X		Plummer, ID	
				X						Post Falls, ID	
				X						Rathdrum, ID	
			X							Rockford, WA	
							X			Smelterville, ID	
			X							Spangle, WA	
X	X	X	X							Spokane, WA	
									X	Spirit Lake, ID	
	X									Spokane Valley, WA	
				X						Stateline, ID	
								X		St. Maries, ID	
			X							Tekoa, WA	
			X							Tensed, ID	
							X			Wallace, ID	
							X			Wardner, ID	
			X							Waverly, WA	
			X							Worley, ID	
										Tribal Governments	
			X		X			X		Coeur d'Alene Tribe	Local government for protection of the environment.
										State Agencies	
										Idaho	
		X	X	X	X	X	X	X	X	Idaho Department of Environmental Quality	Responsible for assuring that state water quality standards are met and coordinates with agencies regarding Spokane River DO TMDL.
		X	X	X	X	X	X	X	X	Idaho Department of Lands	Responsible for water quality and BMPs on state lands.
		X	X	X	X	X	X	X	X	Idaho Department of Parks and Recreation	Responsible for management and upkeep of existing parks, improve and enhance outdoor recreation, and public education.
		X	X	X	X	X	X	X	X	Idaho Department Fish and Game	Responsible for the preservation, protection, and management of all wildlife in the State of Idaho.
		X	X	X	X	X	X	X	X	Idaho Forest Products Commission	Goals include helping achieve and maintain a healthy forest products industry through responsible forest stewardship. Recognizes importance of healthy forests, watershed health, and protection of water quality.
		X	X	X	X	X	X	X	X	Idaho Rangeland Resource Commission	To provide, coordinate, and disseminate factual information about economic and ecological aspects of rangeland management practices.
		X	X	X	X	X	X	X	X	Idaho Soil and Water Conservation Commission	Manage the Water Quality Program for Agriculture and provides cost sharing to agricultural land owners and operators to make improvements that protect water quality. Agricultural non-point source control is included in TMDL agriculture

Chapter[1]										Organization	Related Responsibilities
10	11	12	13	14	15	16	17	18	19		
[1]Chapters – X indicates organization has responsibilities within the subbasin. Chapter 10 Lower Spokane River subbasin, Chapter 11 Upper Spokane River WA subbasin, Chapter 12 Little Spokane River subbasin, Chapter 13 Hangman Creek subbasin, Chapter 14 Upper Spokane River ID subbasin, Chapter 15 Coeur d'Alene Lake subbasin, Chapter 16 Upper Coeur d'Alene Lake subbasin, Chapter 17 South Fork Coeur d'Alene River subbasin, Chapter 18 St. Joe River subbasin, Chapter 19 Pend Oreille Lake subbasin											
											implementation plans.
		X	X	X	X	X	X	X	**X**	Idaho Soil Conservation Commission	The Commission and local conservation districts are the primary public entities in the State of Idaho that provide private landowners and users with natural resource conservation assistance.
		X	**X**	**X**	**X**	**X**	**X**	**X**	**X**	Idaho State Department of Agriculture	The Agricultural Water Quality Program implements agricultural monitoring and protection programs with public and private partners to protect ground and surface water quality.
		X	**X**	**X**	**X**	**X**	**X**	**X**	**X**	Idaho Transportation Department	Responsible for transportation system stormwater management.
										Washington	
X	**X**	**X**	**X**		**X**				**X**	Washington Department of Fish and Wildlife	Responsible for protecting and enhancing fish and wildlife and their habitats and providing fish and wildlife related recreational and commercial opportunities.
X	**X**	**X**	**X**		**X**				**X**	Washington Forest Practices Board	Sets standards for forest practices (timber harvests, pre-commercial thinning, forest chemical applications, and road construction) that protect water quality and fish habitat while maintaining the timber industry.
X	**X**	**X**	**X**		**X**				**X**	Washington Land Use Study Commission	Review effectiveness of land use and environmental laws and integrates land use and environmental laws into single statues.
X	**X**	**X**	**X**		**X**				**X**	Washington State Conservation Commission	The Commission and local conservation districts are the primary public entities in the State of Washington to provide private landowner and land users with assistance for natural resource conservation.
X	**X**	**X**	**X**		**X**				**X**	Washington State Department of Agriculture	The WSDA partners with Washington Department of Ecology and the USGS to monitor and assess the effects of pesticides on surface and groundwater.
X	**X**	**X**	**X**		**X**				**X**	Washington State Department of Ecology	Responsible for coordination of Spokane River DO TMDL.
X	**X**	**X**	**X**		**X**				**X**	Washington State Department of Natural Resources	Manage aquatic, agricultural, commercial, forest and range lands.
X	**X**	**X**	**X**		**X**				**X**	Washington State Department of Transportation	Responsible for stormwater management from state transportation systems.
X	**X**	**X**	**X**		**X**				**X**	Washington State Parks and Recreation Commission	Responsible for acquiring, operating, enhancing, and protecting recreational, cultural, historical and natural sites while encouraging statewide outdoor education.
										Federal Agencies	
X										U.S. Air Force	Operation and maintenance of the land at Fairchild Air Force Base.
			X		**X**			**X**		U.S. Bureau of Indian Affairs	Provides services to federally recognized tribes, including the Coeur d'Alene Tribe, specifically related to Indian self-governance and self-determination. BIA administers programs related to natural resource management, land and water claims, and irrigation systems.
X	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**	U.S. Bureau of Land Management	Manages Bureau of Land Management public lands.
X	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	U.S. Department of Agriculture – Natural Resource Conservation Service	Works with landowners through conservation planning and assistance to benefit the soil, water, air, plants, and animals for productive lands and healthy ecosystems.
X	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	U.S. Environmental Protection Agency	Approves and oversees TMDLs.
X	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	U.S. Fish and Wildlife Service	To conserve, protect and enhance fish, wildlife and plants and their habitats.
X	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	U.S. Forest Service	Manages public lands in national forests and grasslands. Responsible for managing the Clearwater, Coeur d'Alene, Kaniksu, and St. Joe National Forests. Participate in the restoration of watersheds to meet water quality and fish habitat commitments.

9.4 Nonpoint Source Phosphorus Reduction Strategy

Identifying strategies for reducing nonpoint source phosphorus in the Spokane River Watershed is an important step to protect and restore water quality in the Spokane River and its tributaries. Success will also ultimately support improvement of dissolved oxygen concentrations in Lake Spokane. The extent of improvement will also depend on fate and transport processes which were not addressed in the NPS Study. Nonpoint source phosphorus reductions will benefit the subbasin and overall watershed.

9.4.1 Strategy and Actions

The reduction of nonpoint source phosphorus will require actions throughout the watershed, including addressing obvious problems and undertaking efforts that can be readily completed. The strategy emphasizes reducing nonpoint source phosphorus from land uses that generate large phosphorus loads and cover large areas of the subbasins. The actions may involve implementing one or more BMPs.

Actions are the measures or steps from planning through achievement of nonpoint source phosphorus reduction. Actions include sufficient description and specificity for a responsible party to decide to take the action. The actions also help the responsible party determine where, what, when, and how to achieve the potential suggested outcome.

BMPs are the core of the action; whereas, actions encompass the entire process from the identification of the area, selection and implementation of the BMP through post monitoring.

BMPs for addressing nonpoint sources of phosphorus include structural (i.e., physical) and non-structural (i.e., educational) measures.

9.4.2 Schedule

The schedule for nonpoint source actions used to write this plan is based on meeting the schedule in the Spokane River DO TMDL (Ecology, 2010). The schedule targets expeditious management actions to reduce nonpoint source phosphorus over the next two decades. After the Spokane River DO TMDL approval (May 2010), the Spokane River DO TMDL has progress evaluated every five years, with extensive assessments every 10 years. The results from the first 10 years will be used to guide actions during the second 10-year period. Actions initiated in the first 10 years and determined to be beneficial should be continued, including successful nonpoint source control.

9.5 Summary of Actions and Schedule

Chapters 10 through 19 provide specific recommendations for each of the subbasins within the Spokane River Watershed. The following information about nonpoint source phosphorus was considered when developing the recommendations:

- Linkages to the Spokane River DO TMDL - Chapter 2.
- Assessment of nonpoint source phosphorus - Chapters 4, 6, and 7.
- Linkages to subbasin sources and land uses – Chapters 3 and 7.

- Identification of phosphorus control measures and BMPs - Chapter 8.
- Monitoring of phosphorus, funding opportunities, measuring progress and adaptive management - Chapters 5 and 20.

The NPS Reduction Plan is meant to provide guidance on where to take action. The NPS Study was conducted at the watershed and subbasin scale and is limited in its guidance to actions at those scales. It is important to recognize that most nonpoint source actions are voluntary and do not fall under the same regulatory and legal restrictions as point sources, which have mandatory requirements. Since an organizations action is limited to its jurisdiction and authority, they will need to examine local conditions to determine specifically how and where they choose to pursue actions.

Opportunities for organizations to undertake nonpoint source phosphorus reductions are available throughout each subbasin. The actions to reduce nonpoint source phosphorus are primarily related to the source and land use. Land uses that occur in each subbasin were considered in the prioritization of the BMPs recommended for implementation. A trading program may be established in the future that provides the opportunity to sell phosphorus credits based on quantifiable nonpoint source reductions. However, such a trading program is beyond the scope of the NPS Study and it is uncertain as to when or if it may be established.

The subbasin recommendations outline strategies and actions for nonpoint source reductions that include:

- The identification of entities and stakeholders in the subbasin and associated acres of land ownership.
- The relationships of entities and stakeholders in each subbasin.
- An overview of reduction strategies, actions, and schedule for meeting reduction in each subbasin.
- An overview of the nonpoint source reduction opportunities including guidance on “what” actions to undertake and “where” these actions should be taken.
- Any specific actions to be undertaken, including those identified by specific entities and stakeholders.

Each recommended action includes a general description of the activity. Additional considerations include the potential phosphorus load reduction, range of costs, potential timeline and potential organization responsible for leading the action. These considerations were left as to be determined (TBD) unless research or an organization provided specific information during the course of the NPS Study.

It will be important as actions are implemented for organizations to coordinate on selecting the “what” and “where” items identified in the NPS Reduction Plan. The lead organization will need to assist local entities in developing: 1) detailed plans for local implementation of activities; 2) a schedule; and 3) a plan for monitoring progress. When the information is available, the actions should also include a description of the roles of the organization with responsibility to improve water quality and the means through which the organization will address water quality issues.

9.5.1 Identification of Actions

Actions to take across the watershed are described below. Actions specifically tailored to the characteristics of a subbasin are described in the relevant subbasin chapters (Chapters 10 through 19). This removes the duplication of repeating watershed actions in each of the subbasin chapters. The actions described in Chapters 9 through 19 are identified by a code (subbasin-category-number) and categorized as presented in Table 9-2 and 9-3:

Table 9-2. Subbasin Codes

Subbasin	Subbasin Chapter	Subbasin Code
Spokane River Watershed	9	SRW
Lower Spokane River subbasin	10	LWS
Upper Spokane River WA subbasin	11	USW
Little Spokane River subbasin	12	LSR
Hangman Creek subbasin	13	HLC
Upper Spokane River ID subbasin	14	USI
Coeur d'Alene Lake subbasin	15	CDA
Upper Coeur d'Alene River subbasin	16	UCR
South Fork Coeur d'Alene River subbasin	17	SFC
St. Joe River subbasin	18	SJR
Pend Oreille Lake subbasin	19	PDO

Table 9-3. Management Actions Category Codes and Relevant Chapters

Management Action	Code	Chapters
Highest Prioritized BMPs		9 through 19
Regional Phosphorus Management	RM	9
Supporting Phosphorus Reduction Activities	SA	9
Additional Activities	AA	9 through 19
Agriculture Related Activities	AR	10 through 19
Forestry Related Activities	FR	10 through 19
Range Related Activities	RR	10 through 19
Urban/Suburban Related Activities	UR	10 through 19
Support Existing and Planned Activities	EP	10 through 19

9.5.2 Highest Prioritized BMPs

While this section primarily focuses on actions, at the core of most actions is the implementation of a BMP. The highest prioritized BMPs are highlighted here to emphasize the connectivity between actions and BMPs recommended for implementation as a part of the action. Chapter 8 provides a description of the prioritization of 108 BMPs to 22, including the four highest prioritized BMPs. Additional information about BMPs is provided by GeoEngineers, HDR and HGC (2011). Any of these BMPs may be selected as part of an action but the following are most likely to provide the greatest reduction efficiency, at the lowest cost, and greatest estimated longevity and implementation effectiveness. These highest prioritized BMPs are frequently referenced in the actions in Chapters 10 through 19 where they may be implemented.

9.5.2.1 Vegetated Buffer/Filter Strips

Stormwater runoff is directed via sheet flow to a vegetated buffer strip. Vegetative cover within the buffer strip provides pretreatment of stormwater before infiltration to the subsurface, and/or evaporation. Vegetated buffer strips are used to intercept overland sheet flow runoff. They slow runoff velocities, filter out sediment and other pollutants, and provide infiltration into underlying soils.

This BMP may be used in variety of situations and is commonly used for stormwater runoff from adjacent impervious areas such as situated adjacent to a rural roadway or parking lot. As described in Chapter 8, vegetated filter strips have moderate to phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999). Grass filter strips have phosphorus removal costs of $190 to $250 per pound (Sera-17, 2010).

When buffer strips are used for infiltration, the area underlying the buffer strip should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone.

9.5.2.2 Riparian Zones and Buffer Strips

Riparian zones, buffers, or buffer strips are vegetated areas next to waterbodies that filter runoff, stabilize the bank, shade the water, and provide aquatic and wildlife habitat. The vegetation should include a variety of native grasses, shrubs, and trees. The vegetation is generally associated with three zones. The streamside and middle zones should include the three vegetation types. The outer zone should be dominated by grasses and smaller shrubs.

As described in Chapter 8, the buffer must spread the runoff to allow for interception and infiltration (NCSU, 2002). The width of the buffer varies depending upon the location with typical widths around 50 feet, although "research has shown that the width of a buffer zone needs to be 65 to 100 feet to maintain the biotic integrity of a riparian area" (Clermont County, 2010). Riparian buffers have phosphorus removal efficiencies ranging from 30 to 45 percent

(EPA, 2010c) to 40 to 93 percent (Dinnes, 2004; Gitau et al., 2005; Smith et al. 1992). Riparian buffers have phosphorus removal costs of $11 to $18 per pound (for grass buffers [Sweeney, 2004]).

9.5.2.3 Stream Bank Stabilization

Streambank stabilization involves a combination of erosion and sediment control practices to protect streams, banks, and in-stream habitat from accelerated erosion. As described in Chapter 8, BMPs associated with streambank stabilization may include protection of existing vegetation, check dams/grade control, temporary and permanent seeding, outlet protection, rolled erosion control products, temporary diversions, dewatering operations and bioengineering practices such as brush layering, live staking and fascines.

9.5.2.4 Streamside Management Zones

Streamside management zones (SMZs) are managed areas of undisturbed riparian vegetation along a waterway. Riparian vegetation is an important factor to maintaining water quality by reducing runoff, trapping sediments, and reducing nutrient (phosphorus and nitrogen) loads in runoff. As described in Chapter 8, generally SMZs are suggested to be 35 to 50 feet wide. As slope steepness increases, greater widths are required to maintain an effective BMP. Forestry BMPs in general have phosphorus removal efficiencies of 44 to 86 percent (Edwards, 2007).

Practices to reduce nonpoint source pollution include not operating skidders or other heavy machinery in the SMZ, constructing landings, portable sawmills, and roads outside the SMZ, and establishing harvesting restriction in the SMZ. Practices also include limiting pesticide and fertilizer usage in the SMZ with established buffers for applications along flowing streams. Directionally felling trees away from streams helps to prevent excessive quantities of logging slash and organic debris from entering the waterbody. Remove slash and debris unless consultation with a fisheries biologist indicates that it should be left in the stream for large woody debris.

9.5.3 Regional Phosphorus Management

A number of regional phosphorus control strategies should be considered at both a watershed-scale and subbasin-specific level. Regional or watershed-scale phosphorus management actions to facilitate load reductions and/or establish the technical foundation for further phosphorus control activities are described below. Collaboration between various stakeholders and agencies is encouraged to enhance implementation of these activities.

SRW-RM-1 Public Education and Outreach Programs

There are several potential phosphorus reduction opportunities in the watershed that can occur through voluntary actions. For voluntary phosphorus reduction actions to be successful, a comprehensive public education and outreach program is critical. Public education and outreach helps regional nonpoint source reduction by informing the local constituents of practices that are harmful to the local water bodies and by providing information on ways to change these practices. By increasing awareness through public education and outreach programs, entities can focus on the most effective phosphorus reduction opportunities. Public education and outreach programs may be led by regional organizations, coordinating agencies and/or each organization or entity in the subbasin specific to the users and land uses they support.

Activity: Develop outreach programs to educate, promote, and adopt practices to reduce loading of phosphorus to the river.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SRW-RM-2 Spokane River Watershed Phosphorus Trading

Participate in a phosphorus trading program that would allow phosphorus reductions to be exchanged throughout the watershed. The objective of the exchange is to provide a flexible way to achieve Spokane River water quality goals in the most cost effective manner. Wastewater dischargers may choose to achieve compliance with their permit limits or wasteload allocation by implementing treatment technology, exchanging a phosphorus load reduction with another point source discharger, exchanging a phosphorus load reduction from a nonpoint source, or a combination of these methods. A trading framework and equivalency between loadings is being developed by Ecology, DEQ and EPA. Exchanges will require on-going monitoring and tracking by the regulatory agencies.

Activity: Participate in a phosphorus trading program to facilitate load reductions in a flexible and cost effective manner.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SRW-RM-3 Develop Bi-State Subbasin Coordination Group

Entities from both states (including local, regional and state agencies) will all play a role in implementing BMPs and improving water quality. Since the watershed includes areas in both Washington and Idaho, it is important that entities from the two states work together. This collaboration can allow for the best use of resources and the ability to accomplish a greater amount of improvement.

Activity: Establish a subbasin coordination group with representatives from both states; setup regular meetings and structure how resources will be utilized between the agencies.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SRW-RM-4 Evaluate Long-term Load Trends

Evaluation of the annual variation in phosphorus loads to the Spokane River should be completed as suggested in various plans such as the Hangman Creek Water Resources Management Plan (2005). This could be established as an annual meeting with the Bi-State Subbasin Coordination Group.

Activity: Evaluate annual variation in phosphorus loads to the Spokane River. Assign responsibility to the Bi-State Subbasin Coordination Group (see SRW-RM-3).
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

9.5.4 Supporting Phosphorus Reduction Activities

Supporting phosphorus reduction activities are in addition to those projects and BMPs designed to provide direct phosphorus reduction. These supporting activities, while not having a specific phosphorus reduction value, are tangible activities that provide valuable information for long-term success. They may include water quality monitoring and data collection, data assessment, water quality modeling, and adaptive management. These activities provide an understanding of how the system responds as activities are implemented throughout the watershed. They help inform future decision making and are critical to measuring progress and success of the entire program.

SRW-SA-1 Ongoing Monitoring

This action includes tracking water quality through ambient monitoring and targeted pollution source identification. Monitoring surface waters is needed to identify polluted areas, contributing sources, and to verify that corrective actions are protecting local waters. Two types of water quality monitoring are needed:

- Pollution source detection monitoring.
- Effectiveness monitoring.

Source detection monitoring is used to pinpoint the location and relative severity of suspected pollution sources. It allows local governments and private groups to implement resources where they are needed most. Source detection monitoring is used when pollution sources are not obvious and additional data is needed to track unknown or suspected causes. When high phosphorus levels are observed, additional sampling can help track the source to a discrete geographic area. Events that typically trigger the need for source detection monitoring include:

- When ambient water quality monitoring has identified high phosphorus levels on either a consistent or sporadic basis.
- Where potential sources of phosphorus are identified and need to be verified (examples of potential problem areas include areas where soil erosion is occurring, poorly managed animal confinement/recreation areas, failing onsite septic systems, or illicit discharges).

Spokane River DO TMDL effectiveness monitoring indicates whether phosphorus concentrations are decreasing. This can be accomplished in two ways:

- Directly measuring the reduction of phosphorus suspected of causing the water quality impairment from individual phosphorus sources.
- Indirectly measuring success by monitoring dissolved oxygen in Lake Spokane.

New water quality data gathered in the course of the adaptive management program will provide the necessary information for prioritizing and selecting the activities to implement. Coordination between monitoring efforts, including locations and times for monitoring, will provide a stronger dataset and efficient use of funds for field collection and laboratory analysis. Monitoring should be designed and conducted to identify the source of phosphorus from a variety of sources including surface water and groundwater, and perennial, intermittent, and ephemeral sources.

Monitoring locations should be added to identify: 1) nonpoint sources of phosphorus; and 2) where activities are implemented to evaluate the success and reduction in total phosphorus from that activity. New locations for monitoring should be based on field observations, previous data, and effectiveness monitoring. Selection of monitoring locations should be coordinated and associated with the adaptive management plan.

As data are collected, they should be maintained in a database or similar other format for long-term recovery and use. One potential option is to add the data to the Spokane NPS Database. The new data should be assessed annually (at a minimum) to evaluate progress and make adaptive management decisions associated with implemented activities.

Organizations should coordinate via an annual meeting or other method to present their data from the previous year. The purpose of this coordination is to review data and determine trends so organizations can decide what actions (if any) are needed to meet the reduction target. These meetings also ensure that the same sites are not monitored by multiple entities, all data collected is comparable, and the community is aware of other monitoring efforts.

A QAPP will be prepared with any monitoring plans to demonstrate that the data collected meets quality standards for use in review, validation, and implementation of the adaptive management approach.

Activity: Develop an agreement to annually review the water quality monitoring plan. Develop an agreement for each stakeholder to contribute to a fund for additional monitoring. Negotiate and develop an agreement for the long-term storage and retrieval of water quality monitoring data. Develop an annual report format with minimum standard text, tables and figures to assess new water quality data each year.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

Activity: Continue and improve the ambient monitoring program. Coordinate and schedule an annual meeting to review data, progress, and upcoming implementation activities.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SRW-SA-2 Adaptive Management and Adjustments

Adaptive management is used to adjust or change strategies if the current approach is not being effectively implemented, or water quality goals are not being met. During the course of implementation, true adaptive management requires flexibility and adjustment as new information is gathered and the understanding of system responses improves (i.e., cause and effect relationships).

Natural systems are complex and dynamic. The way a system responds to human management activities is often unknown and can only be described as assumptions, probabilities, or possibilities. Adaptive management involves testing, monitoring, evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings. Adaptive management is used to assess whether the actions identified as necessary to solve the identified pollution problems are the correct ones and whether they are working. As actions are taken, the system will respond and change. Additionally, if some unforeseen event affects the landscape, such as a wildfire, the management strategy may need modification to adapt to the new conditions. Adaptive management allows for actions to be fine-tuned to make them more effective, and to try new strategies if there is evidence that a new approach could help achieve reduction goals.

If implementation activities are not producing expected or required results, stakeholders may choose to conduct additional studies to identify other sources or causes. If the causes can be determined, implementation of additional BMPs and/or educational efforts should be considered.

Selection of implementation activities is partially dependent on knowledge of the effectiveness of the activity. Effectiveness monitoring and tracking BMP performance, as described in activity SRW-SA-1 and Chapter 20, will support the adaptive management process.

Activity: Develop framework for updating NPS Reduction Plan based on results from future data collection and assessment. Determine how, when and what criteria will be necessary.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

9.5.5 Additional Activities

Additional activities include indirect actions that either lead to overall improvements in ecological functions and water quality or provide additional insights into the overall health and conditions of the watershed.

SRW-AA-1 Evaluating and Restoring Stream Functions and Streambank Conditions

Streams exist throughout many subbasins and land use types. Therefore, it is critical to have an understanding of the streambank conditions and the areas that can be improved. An inventory of the stream miles to understand the total length of streambank in the subbasin as well as the condition of the streambanks should be completed. Other subbasin studies have identified stream restoration as an important action. The highest prioritized BMPs may be implemented to support

this action. For example, streambank stabilization can include the protection of existing vegetation, check dams, streambank seeding, and protection of outlets, among other activities.

Projects should be identified for re-connecting streams with the floodplain, creating meanders to reduce stream energy and erosion, and restoring beaver habitat where appropriate. In forested areas, and where the stream is small to medium, restoring beaver habitat could benefit water quality and increase water storage late in the summer. Beaver dams trap sediment, and therefore phosphorus. Beaver habitat changes flow patterns that typically result in reduced nonpoint source phosphorus loading.

Activity: Inventory total length of streambank and current condition; identify areas where streambank stabilization could be implemented; identify potential restoration projects.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SRW-AA-2 Determining Baseline Conditions

Work on establishing a baseline condition of how the subbasin originally functioned before human disturbance. Understanding the original state of equilibrium and baseline condition will: 1) provide insight into how the watershed may have been altered by forestry and land management practices; 2) assist in understanding and selecting appropriate reduction measures; and 3) help understand how BMPs should be adjusted to improve performance.

Activity: Determine baseline and current conditions to understand achievable nonpoint source reduction potential.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

9.5.5.3 SRW-AA-3 Review Forest Management Actions

Review what forest management regulations and actions are being followed that minimize nonpoint source phosphorus pollution. BMPs that should be used in the subbasin include: roadside vegetation, silt traps, re-vegetation post-harvest, and temporary cover during harvest operations (i.e. erosion control blankets, wattles, and silt fences). Also check for the proper construction and maintenance of roads such as the use of rolling swales and prevention of direct discharge of runoff into streams, to reduce nonpoint source pollution. Based on the results of this review, update the recommended forestry subbasin-specific actions to address deficiencies.

Activity: Review forest management regulations and nonpoint source phosphorus actions and applicable BMPs that are being implemented. Update the recommended forestry subbasin-specific actions to address deficiencies.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

9.6 Estimation of Reduction Potential

The potential reduction in nonpoint source phosphorus loads can be estimated to various degrees. These estimations are based on various assumptions and illustrate the potential reduction that could be achieved for these circumstances. Items that may be used in estimating the reduction potential include BMP type and reduction efficiency (Chapter 8), participation, and land use (Chapter 3). The examples also demonstrate the level of effort necessary to achieve significant reductions. The examples are based on the land use areas (Chapter 3) and phosphorus export coefficients (Chapter 7) which indicates a total load of 387,000 lbs/yr.

If an equal percent reduction in nonpoint source phosphorus loads were achieved from BMPs, participants, land uses and land owners, then that percent reduction would be achieved for the watershed. Simply, if the BMPs have 50 percent reduction efficiency, then an overall reduction of 50 percent or approximately 200,000 lbs/yr of phosphorus would be eliminated as a nonpoint source (Table 9-4).

Table 9-4. Overall Reduction Example

Reduction Efforts (%)	Results	
	Overall Percent Reduction (%)	**Load Reduction (lbs/yr)**
50	50	194,000

However, the various BMPs that may be implemented range in their phosphorus reduction efficiency (see Chapter 8). BMPs implemented in different areas may attain lower or higher reductions. For example, if four BMPs with reductions ranging from 10 to 50 percent are equally distributed across the watershed, then an overall reduction of 30 percent or approximately 116,000 lbs/yr of phosphorus would be achieved (Table 9-5).

Table 9-5. BMP Reduction Example

Reduction Efforts		Results	
BMP Reduction (%)	**Area (%)**	**Overall Percent Reduction (%)**	**Load Reduction (lbs/yr)**
BMP-A 10	25	30	116,000
BMP-B 25	25		
BMP-C 35	25		
BMP-D 50	25		

Another variable is the percentage of participation of implementing BMPs across the watershed. Less than 100 percent participation further reduces the potential reduction. For example, if four BMPs with reductions ranging from 10 to 50 percent are equally distributed across the watershed and implemented at various participation rates, then an overall reduction of 5 percent or approximately 19,000 lbs/yr of phosphorus would be achieved (Table 9-6).

Table 9-6. BMP Reduction and Participation Example

Reduction Efforts			Results	
BMP Reduction (%)	**Area (%)**	**Participation (%)**	**Overall Percent Reduction (%)**	**Load Reduction (lbs/yr)**
BMP-A 10	25	15	5	19,000
BMP-B 25	25	30		
BMP-C 35	25	15		
BMP-D 50	25	10		

BMPs may be selected based on the land use. Rather than use a percentage of the land area, the land use and associated BMP reduction along with participation may be used. For example if various BMP reduction and participation rates are selected for each land use, then an overall reduction of 13 percent or approximately 52,000 lbs/yr of phosphorus would be achieved (Table 9-7).

Table 9-7. BMP Reduction and Land Use Example

Reductions Efforts			Results	
BMP Reduction (%)	**Land Uses with Watershed or Subbasin Evaluated**	**Participation (%)**	**Overall Percent Reduction (%)**	**Load Reduction (lbs/yr)**
20	Barren Land	10	13	52,000
40	Commercial and Service	40		
50	Cropland and Pasture	30		
60	Deciduous Forest Land	25		
60	Evergreen Forest Land	25		
30	Forested Wetland	5		
15	Herbaceous Range Land	15		
60	Mixed Forest Land	25		
30	Nonforested Wetland	5		
50	Other Agricultural Land	30		
40	Other Urban	40		
40	Residential	20		
15	Shrub and Brush Range Land	15		
40	Urban or Built-up Land	40		

The selections of other BMP reduction efficiencies and participation rates, and including combinations of factors, such as by land owners and subbasin, would change the example reduction results presented. Table 9-7 is the most descriptive of the examples; however, it only

pairs one BMP with each land use at the entire watershed or subbasin scale. This provides a general estimate of conditions. Additional analysis and an expanded format to estimate reduction potential may be necessary for management decisions at the subbasin or sub-subbasin level.

Chapter 10

Lower Spokane River Subbasin - Nonpoint Source Phosphorus Management Strategy and Actions

10.1 Introduction

An objective of this NPS Reduction Plan is to formulate nonpoint source control strategies that contribute to long-term reductions of phosphorus loads. It provides guidance on selecting 'what' strategies and actions to take and 'where' to apply them. Chapter 9 provides an introduction to the subbasin actions and strategies, background of the NPS Study objectives, how the subbasin chapters support the overall NPS Reduction Plan, and regional phosphorus control strategies that should be considered in all subbasins in the Spokane River Watershed.

This chapter identifies specific actions for entities located in the Lower Spokane River subbasin and stakeholders supporting these entities to reduce nonpoint source phosphorus. Strategies and actions and areas to target within the subbasin are identified. The guidance identifies potential organization leads and potential timelines for initial and long-term reductions of nonpoint source phosphorus pollution.

The following sections of this chapter describe:

- The identification and relationship of entities and stakeholders in the watershed and associated acres of land ownership.
- An overview of reduction strategies, actions, and schedule for the subbasin.
- An overview of the nonpoint source reduction opportunities and guidance on 'what' BMPs to implement and 'where' to take these actions.
- The specific actions by category identified to be undertaken, including those identified by specific entities and stakeholders.

Estimates of the potential BMP phosphorus reductions and cost per pound are provided in Chapter 8. The overall phosphorus reduction potential is discussed in Chapter 9.

10.2 Entities and Stakeholders

As discussed in Chapter 9, accomplishing nonpoint source reductions will require engaging local, state, and federal agencies and land managers, as well as private land owners. The principal organizations involved with securing funding, identifying priority locations, selecting BMPs, and taking actions in the Lower Spokane River subbasin include those shown in Table 10-1. These organizations are subdivided into entities and stakeholders as shown in Table 10-2, along with the area of land owned and miles of streams in the Lower Spokane River subbasin. Land ownership for the subbasin is shown in Figure 10-1.

Table 10-1. Organizations and Nonpoint Source Phosphorus

Organization
Local Governments
Lincoln, Spokane, and Stevens Counties
Lincoln, Spokane, and Stevens County Conservation Districts
Lincoln County Health Department and Spokane Regional and Northeast Tri-County Health Districts
Municipalities
Airway Heights
Medical Lake
Spokane
Utilities
Avista Utilities
Stevens Public Utility District
Tribal Governments
None identified
State Agencies
Washington Department of Fish and Wildlife
Washington Forest Practices Board
Washington Land Use Study Commission
Washington State Conservation Commission
Washington State Department of Agriculture
Washington State Department of Ecology
Washington State Department of Natural Resources
Washington State Department of Transportation
Washington State Parks and Recreation Commission
Federal Agencies
U.S. Air Force
U.S. Bureau of Land Management
U.S. Department of Agriculture – Natural Resource Conservation Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service

Table 10-2. Organizations and Land Area

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Private				
In Airway Heights	3,320	Airway Heights	Spokane County Conservation District	n/a
In Medical Lake	1,487	Medical Lake		
In Spokane	9,886	Spokane		
In Spokane County	159,348	Spokane County		372.3
In Lincoln County	17,611	Lincoln County	Lincoln County Conservation District	73.0
In Stevens County	29,620	Stevens County	Stevens County Conservation District	163.0
Incorporated Municipalities[2]				
Airway Heights	*3,326*	Washington Department of Ecology, U.S. Environmental Protection Agency	Washington State Department of Agriculture, Washington State Conservation Commission	0
Medical Lake	*1.487*			0
Spokane	*10,559*			21.5
Local Governments[2]				
Lincoln County	*17,817*	Washington Department of Ecology, U.S. Environmental Protection Agency, Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service	Washington State Department of Agriculture, Washington State Conservation Commission	73.0
Spokane County	*170,551*			410.8
Stevens County	*38,812*			186.4
State Agencies				
Washington Department of Fish and Wildlife	8	Washington Department of Ecology, Forest Practices Board, Washington Department of Fish and Wildlife	Washington State Department of Agriculture, Washington State Conservation Commission, Washington Land Use Study Commission	0
Washington State Department of Natural Resources	6,158			22.1
Washington State Department of Transportation	407			n/a
Washington State Parks and Recreation Commission	7,883			18.1

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Federal Agencies				
U.S. Air Force	5,268	U.S. Environmental Protection Agency	USDA – NRCS	2.5
Additional Land Areas				
Roads	1,183 miles		797 stream crossings	

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation, road miles include primary, secondary, local and forest service roads

[2] Incorporated municipalities and local governments is total land area within boundaries, not land ownership

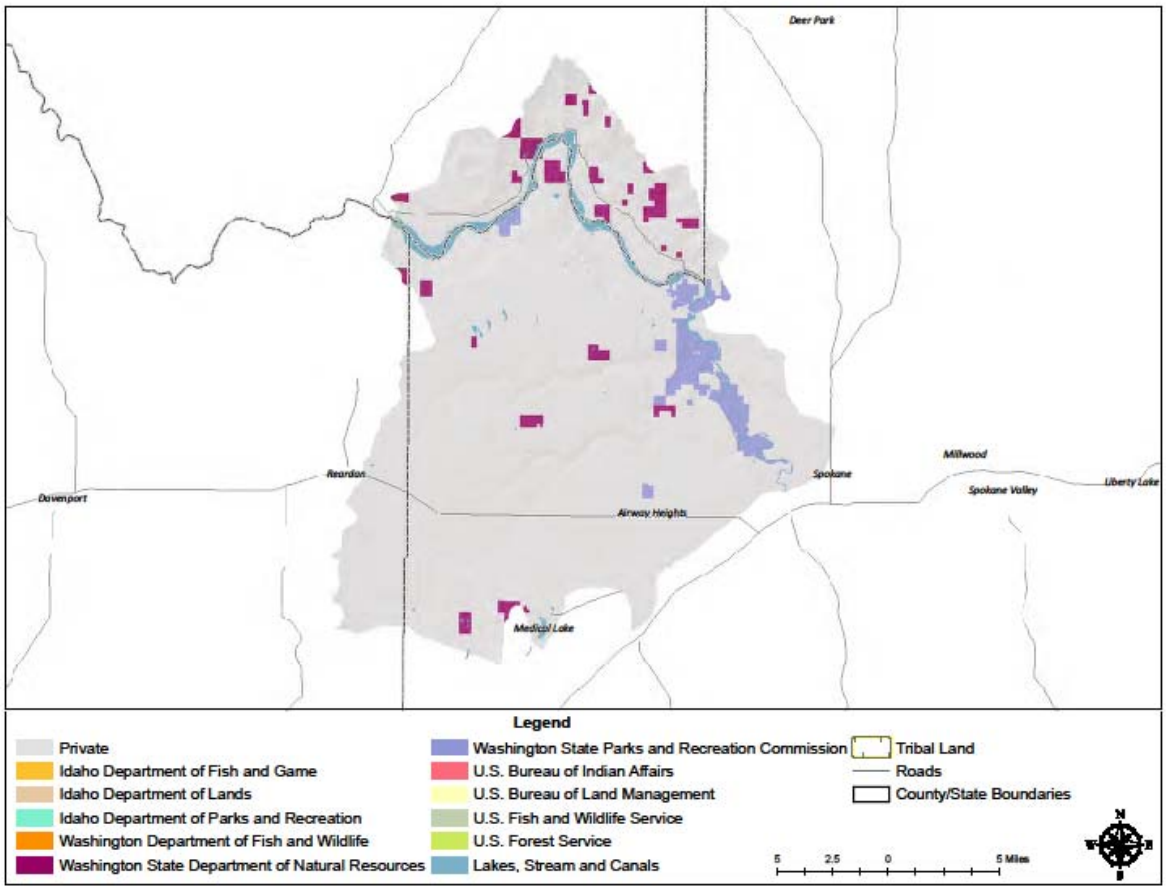

Figure 10-1. Lower Spokane River Subbasin and Land Owners

10.3 Overview of Reduction Strategy, Actions, and Schedule

Identifying strategies for reducing nonpoint source phosphorus in the Lower Spokane River subbasin is an important step to protect and restore water quality in the Spokane River. A successful strategy will also ultimately support improving dissolved oxygen concentrations in Lake Spokane. The extent of water quality improvements will depend on fate and transport processes which were not addressed in the NPS Study. Nonpoint source phosphorus reductions will have both local and watershed benefits.

10.3.1 Strategy

The strategy for addressing nonpoint sources of phosphorus includes taking actions throughout the subbasin. Nonpoint source reduction actions include addressing obvious problems and undertaking actions that can be readily completed. The strategy emphasizes reducing nonpoint source phosphorus from land uses that generate large phosphorus loads and cover large areas of the subbasin. A subbasin scale assessment of these land uses revealed that shrub and brush rangeland and evergreen forest are dominant throughout the subbasin (Chapter 3).

10.3.2 Actions

Actions are the measures or steps from planning through achievement of nonpoint source phosphorus reduction. Actions include sufficient description and specificity for a responsible party to decide to take the action. The actions also help the responsible party determine where, what, when, and how to achieve the potential suggested outcome.

BMPs are the core of the action; whereas, actions encompass the entire process from the identification of the area, selection and implementation of the BMP through post monitoring. BMPs for addressing nonpoint sources of phosphorus include structural (i.e., physical) and non-structural (i.e., educational) measures.

BMPs referenced in the actions in Section 10.5 were identified based on the dominant land uses and the associated loading potential of the land uses. BMP phosphorus percent reduction efficiency, costs, estimated longevity and implementation effectiveness were also key indicators for identifying high priority BMPs for the subbasin. See Chapter 8 Nonpoint Source Phosphorus Control Measures for information about BMPs and the prioritization process.

10.3.3 Schedule

The schedule for nonpoint source actions for this plan is based on meeting the schedule in the Spokane River DO TMDL (Ecology, 2010). The schedule targets expeditious management actions to reduce nonpoint source phosphorus over the next two decades. From the Spokane River DO TMDL approval in May 2010, progress will be evaluated every 5 years, with extensive assessments after 10 and 20 years. The results from the first 10 years will be used to guide actions during the second 10-year period. Actions initiated in the first 10 years and determined to be beneficial should be continued, including successful nonpoint source control.

10.3.4 Summary of Approach

A load allocation for Coulee Creek and the Lake Spokane Watershed was assigned in the Spokane River DO TMDL. A target reduction of 20 percent from March through May, 40 percent in June and 50 percent from July through October was determined as necessary to meet downstream targets (Ecology, 2010). Using an average efficiency of 54 percent for the priority BMPs (Chapter 8), approximately 92 percent of the major land uses (rangeland and evergreen forest) would need BMPs applied to achieve the target. Based on the average cost for the priority BMPs of about $320/pound (Chapter 8), the total cost for the target reduction would be approximately $2,060,000. Achieving the target reduction over a 20-year period will require that approximately $103,000 is spent annually on BMPs in the subbasin.

10.4 Overview of Opportunities

Nonpoint source reduction opportunities are present throughout the Lower Spokane River subbasin due to the variety of land uses. This overview includes a description of what BMPs are the most relevant and where the BMPs should be implemented. Where the BMPs should be implemented is specific to land uses.

10.4.1 Control Measures and BMPs

BMPs specific to land use type and source are described in detail in Chapter 8. The background included in Chapter 8 narrowed the list of BMPs from 108 to 22 based on phosphorus percent reduction efficiency, cost, estimated longevity, and implementation effectiveness. This list of BMPs, if implemented for the appropriate land uses, could result in substantial net nonpoint source reduction of phosphorus.

There are several organizations throughout the Lower Spokane River subbasin that can mitigate nonpoint source loads by incorporating BMPs. The agencies and organizations are encouraged to review the land and nonpoint phosphorus sources in their jurisdiction to further identify BMPs that are specific to their situation.

A review of stormwater management practices may further refine opportunities where BMPs could be implemented since stormwater is a primary transport mechanism for nonpoint source phosphorus. Organizations identified in Tables 10-1 and 10-2 include private, municipal, state and federal entities. Associated opportunities for nonpoint source phosphorus reduction include:

- Private land owners may protect and restore riparian corridors; minimize stormwater runoff; and consider education, land evaluation, and/or aide available from the conservation organizations.
- Municipalities may install BMPs to treat and/or reduce stormwater discharge to water bodies; evaluate where stormwater is being discharged; and/or evaluate the pollutant loading by collecting samples for analysis.
- State and federal agencies should review activities occurring on the land, identify potential impacts, and implement applicable BMPs.
- Organizations should consider actions recommended in other plans that could be implemented in conjunction with NPS Reduction Plan actions and strategies: such as the:
    - Water Resource Inventory Areas (WRIA) 54 – Lower Spokane River Watershed Detailed Implementation Plan (Tetra Tech, 2010).
    - Avista Utilities Water Quality Attainment Plan (WQAP) which should be completed in 2012.
    - Spokane, Stevens and Lincoln Counties Shoreline Master Plans.
    - The Stormwater Management Manual for Eastern Washington (Ecology, 2004b).
    - The Spokane Regional Stormwater Manual (Spokane County et. al. 2008).
    - Other plans and requirements associated with reducing phosphorus and sediment loads to the Lower Spokane River subbasin.

10.4.2 Land Uses and Source Potential

The NPS Reduction Plan is intended to serve as a guiding document for where reduction actions should take place to have the most impact. Guidance is limited to the watershed and subbasin scale, similar to what was completed for the NPS Study. Actions by organizations are limited by their jurisdictions and authority. It is the responsibility of the organizations to review the existing conditions and determine the details of installations.

The NPS Reduction Plan analyses (Chapters 6 and 7) evaluated the dominant land uses and the phosphorus load potential for each subbasin. In some cases, the largest land use did not match the largest phosphorus load reduction potential. The following land uses have the highest priority for the Lower Spokane River subbasin with respect to nonpoint source phosphorus loading:

- Shrub and Brush Land.
- Residential.

The analytical evaluation results indicated that the western portion of the subbasin has the highest nonpoint source phosphorus loading rates in the Lower Spokane River subbasin (see Chapter 7). These two sub-subbasins are North Fork Deep Creek (0.245 lbs/ac/yr) and Coulee Creek (0.184 lbs/ac/yr). These subareas should be considered as priority areas for action.

Shrub and brush land represents the greatest land use type in the Lower Spokane River subbasin (28 percent) as well as the greatest phosphorus removal potential. Residential land use represents a smaller percentage of the subbasin; however, based on the analysis, reduction of nonpoint source phosphorus from residential land use can have a substantial impact on the subbasin phosphorus load. Organizations are encouraged to take action in these high priority land use areas. It is also important that organizations are aware of other obvious areas for nonpoint source reduction opportunities.

10.4.3 Summary of Reduction Opportunities

BMPs have been prioritized first by their ability to remove nonpoint source phosphorus loads and then by land use type. The acres of land use by organization were computed and are tabulated in Table 10-3. The acres in Table 10-3 demonstrate how the land uses are distributed among the land owners and where the greatest opportunities for reductions may exist.

The export coefficients summarized in Chapter 7, along with the land uses and areas, can be used to estimate potential nonpoint source phosphorus loads by organization. There is an associated range of reduction opportunities based on the potential to reduce phosphorus loads. These opportunities are presented in Table 10-4 by assigning a load reduction potential that ranges from low to high. The range is based on total phosphorus load; therefore, higher potential may be due to a greater export coefficient, the total land area, or a combination of both. Table 10-4 is intended to provide further guidance for considering and selecting BMPs for implementation.

Figure 10-2 shows land ownership with stream segments highlighted in areas of high potential for nonpoint source phosphorus reduction based on the land use and export coefficients. Stream segments are shown since the highest priority BMPs in this subbasin generally relate to stream or riparian corridors.

Table 10-3. Organizations Land Area by Land Use

Land Owners	Agriculture[1] (acres)	Forested[1] (acres)	Rangeland[1] (acres)	Urban / Suburban[1] (acres)	Other[1] (acres)
Private					
Private	50,670	43,512	89,124	23,235	5,383
Incorporated Municipalities[2]					
Airway Heights	0	2	1,896	823	601
Medical Lake	82	192	399	516	295
Spokane	0	862	1,235	4,299	3,495
Local Governments[2]					
Lincoln County	14,261	832	1,770	605	331
Spokane County	36,398	33,698	75,668	15,558	9,317
Stevens County	449	17,959	15,726	1,993	2,697
State Agencies					
Washington Department of Fish and Wildlife	0.2	0	7	0	0.2
Washington State Department of Natural Resources	438	3,714	1,756	102	147
Washington State Parks and Recreation Commission	0.2	5,189	2,261	251	186
Federal Agencies					
U.S. Air Force	149	21	2,465	1,935	700

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation.

[2] Incorporated municipalities and local governments is the total land area within boundaries.

Table 10-4. Organizations and Potential for Nonpoint Source Phosphorus Reduction

Land Owners	Agriculture[1]	Forested[1]	Rangeland[1]	Urban / Suburban[1]	Other[1]
Private					
Private	High	High	High	High	Low-Mod.
Incorporated Municipalities					
Airway Heights	n/a	Low	Moderate	Moderate	Low
Medical Lake	Low-Mod.	Low-Mod.	Low-Mod.	Moderate	Low
Spokane	n/a	Moderate	Moderate	High-Mod.	Low
Local Governments					
Lincoln County	High	Moderate	Moderate	High-Mod.	Low-Mod.
Spokane County	High	High	High	High	Low-Mod.
Stevens County	High-Mod.	High	High-Mod.	High-Mod.	Low-Mod.
State Agencies					
Washington Department of Fish and Wildlife	Low	n/a	Low	n/a	n/a
Washington State Department of Natural Resources	Hig11-2h-Mod.	High-Mod.	Moderate	Low-Mod.	Low
Washington State Parks and Recreation Commission	Low	High-Mod.	High-Mod.	Low-Mod.	Low
Federal Agencies					
U.S. Air Force	Moderate	Low-Mod.	Moderate	High-Mod.	Low

[1] NPS load potential based on area and export classified into five categories, low, low-moderate, moderate, high-moderate, and high.

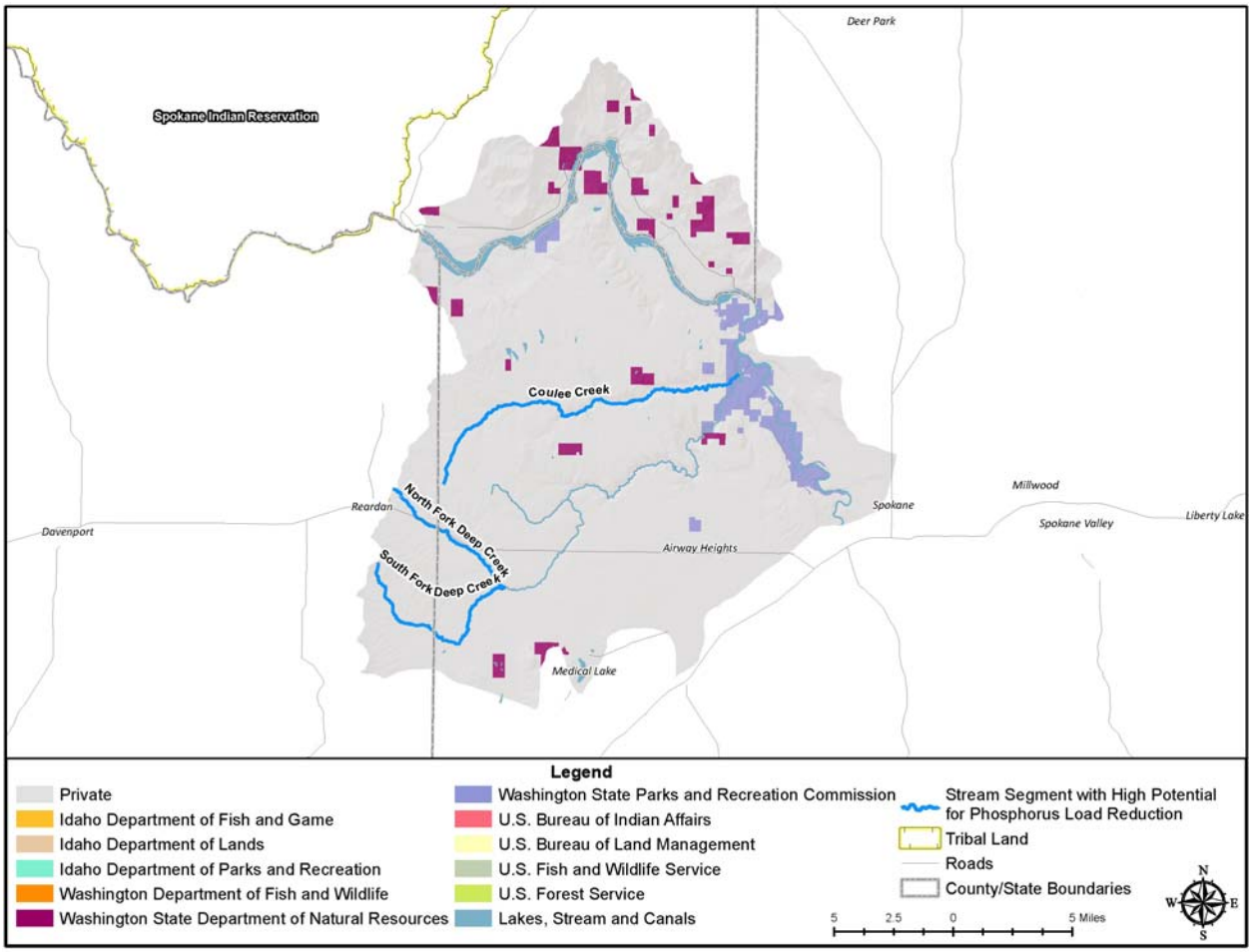

Figure 10-2. Lower Spokane River Subbasin High Potential Reduction Opportunities

10.5 Specific Actions by Category

This section includes a list of specific actions to reduce nonpoint source phosphorus loads and ultimately contribute to meeting water quality standards. A general description of each action, an activity summary, potential phosphorus load reduction, a range of costs, potential timelines, and the potential lead entity are provided for each action. Although it was not a primary objective of the NPS Study to specify "who" implements phosphorus control measures, potential lead organizations are identified for some actions to help provide linkage to the "what" and "where" objectives of the NPS Study. The lead organization will need to assist local entities in developing detailed plans for the activities, as well as a schedule and plan for monitoring progress. When the information was available, the action also includes a description of the roles of the organization with responsibility to improve water quality, and the means through which the organization will address the water quality issues.

10.5.1 High Priority BMPs

The analysis provided in Chapter 8 described the following BMPs as having the highest priority for the Lower Spokane River subbasin:

- Vegetated Buffer / Filter Strips.

- Riparian Zones and Buffer Strips.
- Stream Bank Stabilization.
- Streamside Management Zones.

Specific details regarding implementation of these high priority BMPs are provided in Chapter 9. These BMPs are appropriate for implementation for various land uses in the subbasin. The following sections summarize actions appropriate for the specific land uses within the Lower Spokane River subbasin.

10.5.2 Regional Phosphorus Management

Regional phosphorus control strategies are not specific to any one land use type or organization, and may contribute to the reduction of nonpoint source phosphorus loadings in the subbasin. Descriptions of the regional or watershed-scale phosphorus management actions intended to facilitate load reductions and/or establish the technical foundation for further phosphorus control activities are described in Chapter 9.

10.5.3 Agriculture Related Activities

BMPs related to agricultural practices can have substantial impacts on nonpoint source phosphorus loading since agricultural land uses tend to be phosphorus intensive. BMPs under this category are typically associated with crop land uses, crop till management, and livestock grazing practices.

LWS-AR-1 Fertilizer Application Location and Timing

Managing the location and timing of fertilizer application can minimize the loss of phosphorus from the field and maximize plant uptake. Assistance may be obtained from the Lincoln-Adams, Spokane or Stevens County extension offices or Lincoln, Spokane or Stevens county conservation districts. These agencies could also provide free seminars and literature about implementing such BMPs, including conservation tillage/no-till/direct drill seeding.

Optimizing fertilizer application and timing can be achieved through the following actions:

- Incorporate or inject fertilizers with phosphorus below the soil surface to reduce the total and soluble phosphorus losses (Fawecett, unknown). “Subsurface injection of fertilizer, as compared to surface application, reduced losses by 39 percent for no-till and by 35 percent for conventional tillage” (Mostaghimi, et al., 1988).
- Establish fertilizer management areas and apply at agronomic rates for those areas with phosphorus deficits under the action ‘Fertilizer Application Rates’ (see LWS-AR-2) (Waskom and Bauder, unknown). “Maintain a buffer strip (where fertilizer and manure is not applied) a safe distance from surface water and drainage channels” (Waskom and Bauder, unknown). BMPs that buffer riparian zones were rated as high priority (Chapters 7 and 8).
- Avoid fertilizer and manure application to frozen and wet soils (Fawecett, unknown). For example, the earliest and latest spring freeze dates are April 26 and July 29 in Davenport and March 28 and May 21 in Spokane, respectively (WRCC, 2011).

Activity: Provide support to growers with information on fertilizer management.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-AR-2 Fertilizer Application Rates

Sample the tillage layer of soil in each field on a regular basis and have soil analyzed to determine available soil phosphorus levels prior to applying fertilizers with phosphorus. Use crop and soil guides to determine agronomic application rates such as the University of Idaho Northern Idaho Fertilizer Guide or Washington State University Fertilizer Guides and Summary. With this information develop a nutrient management plan with phosphorus soil testing. The most common crops in this subbasin are spring wheat, winter wheat, pasture/grass, barley and alfalfa. Wheat and barley have a relatively low demand for phosphorus. Alfalfa may need phosphorus fertilizer incorporated into the soil for seedlings. Grass pasture and established alfalfa may need phosphorus fertilizer every 2 to 3years and should be done in the fall, as fertilization is less effective in the spring and winter when it is more susceptible to runoff.

Activity: Provide support to growers about soil phosphorus testing and fertilizer application rates.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-AR-3 Runoff Management and Treatment

Manage runoff, from stormwater and irrigation if irrigating, to minimize runoff and treat runoff before entering waterbodies. Employ contouring or other techniques to reduce runoff potential. Maintain grass filter strips on the downhill perimeter of erosive crop fields to catch and filter phosphorus in runoff. These types of BMPs were rated as high priority (Chapters 7 and 8). Manage irrigation water to minimize runoff and erosion with irrigation BMPs or NRCS irrigation water management practices.

Slope is one factor that affects runoff. In this subbasin, the percentage of agricultural land use by slope classes are generally 29 percent has 0 to 5 percent slope; 13 percent 5 to 10 percent slope; 14 percent 10 to 15 percent slope; 42 percent 15 to 20 percent slope; and 2 percent greater than 20 percent slope. These slopes in combination with the soil types and other factors result in 67 percent of agricultural land use in the subbasin having a capability description of “very severe limitations that restrict the choice of plants, require very careful management, or both”. This matches with implementing the recommended BMPs for managing and treating runoff, such as contour plowing and terracing and contour strip crop. About 94 percent of the agricultural land use in the subbasin is rated as “good” relative to herbaceous habitat for wildlife such as in buffer zones.

Activity: Provide support to growers about runoff management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.

Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-AR-4 Crop Management

Crop management is related to many agricultural BMPs, including tillage type (conservation tillage/no-till/direct drill seeding), contouring (contour plowing and terracing and contour strip crop), crop rotation and erosion management (see Chapter 8). Crop management is related to the typical crops grown in the subbasin. Crops grown in the subbasin include: alfalfa, barley, canola, corn, dry beans, lentils, mustard, oats, pasture grass, pasture hay, peas, potatoes, grass seed, triticale, and spring and winter wheat. Conversion to perennial crops in some locations may also be a beneficial BMP to implement. Economic crop management practices that also provide environmental benefits are supported in this action. This may require transformation in agency policies, new legislation, or other adjustments from historical practices that result in economic disincentives for implementing actions.

Activity: Provide support to growers about crop management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-AR-5 Animal Management

Animal management is related to many agricultural BMPs, including water supply, riparian zone exclusion, and feed, grazing and waste management (see Chapter 8). For example riparian fencing of stream corridors limits livestock access to streams and ultimately protects water quality. Off-stream livestock watering in another BMP that helps protect the stream and riparian while providing production benefits. Animal management is related to the head of animals raised in the subbasin. However, operations with large numbers of animals including cattle, dairy cows, turkeys, broilers and laying hens may fall under confined animal feeding operation requirements instead. Smaller operations can also result in intense pressure on the land such as disturbance to drainages and stream banks, soil erosion, and animal wastes. Regardless all animal operations should follow a manure management BMP. Recommended priority BMPs such as buffers, riparian zones and stream bank stabilization are beneficial to reducing or eliminating these pressures.

Activity: Provide support to producers about animal management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

10.5.4 Forestry Related Activities

BMPs related to forestry practices can reduce nonpoint source phosphorus. While phosphorus export from forestry in general is low, local areas of intensive use can have higher phosphorus export rates. Since a large percentage of the Spokane River Watershed is forested, reductions in

nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing erosion, reducing sediment transport, and protecting and maintaining riparian corridors and streamside management zones.

LWS-FR-1 Evaluate Forestry Practices

Washington's forest practices regulations include the Forest Practices Act as administered by the Department of Natural Resources. These regulations will be used as the basis for nonpoint source phosphorus load reduction from private and state forestlands. Ongoing practices should be reviewed by or as directed by the lead organization for compliance. If compliance with the existing regulations is not resulting in sufficient reduction, then more effective methods need to be promoted. Poorly performing practices need to be researched for the causes and potentially modified to improve the outcomes. Timber harvest planning should be done such that organizing, scheduling, and planning harvests to minimize nonpoint sources of pollution is achieved. The protection of stream crossings is another important BMP.

With large quantities of adjacent forested land, tributary water quality is likely affected by forest management practices. Logging and road building practices that have been common throughout the intermountain region from the late nineteenth century through most of the twentieth century have likely contributed to the degradation of water quality. In more recent times, implementation of more environmentally sound forest management practices has occurred.

The agencies have data on forest health, ecology, harvest areas, vegetation types, soil conditions and more. This information can be useful for identifying areas of greater nonpoint source phosphorus loading. However, much of this data is not readily available or in a format that can be interpreted by water quality managers. Coordination between forest and water quality managers is necessary to understand the data and select management activities.

Activity: Enforce existing regulations, evaluate existing practices, discourage poorly performing practices, and encourage best performing practices and improve coordination of sharing information.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-FR-2 Quantify Sediment-Phosphorus Relationship in Forested Areas

Quantifying phosphorus loading associated with forest management practices may provide additional information that support selection of successful BMPs. The construction and use of roadways represent a major source of sediment from timber harvest activities (DEQ, 2000). A study to quantify the relationship between sediment associated with phosphorus in runoff from these roads can help determine whether additional measures should be undertaken.

Activity: Quantify relationship between sediment and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-FR-3 Subbasin Scale Road Planning and Rehabilitation

A subbasin-scale management survey should be completed to document ownership and identify and prioritize the total miles of erodible roads and road banks. The development of specific BMPs can be completed based on survey results to reduce miles of erodible roads associated with road construction, road conversions, and maintenance. The inventoried roads should be included in a database that tracks BMP implementation. This database and tracking is essential for determining BMP implementation success and accountability. Reduction plans should identify opportunities to abandon non-essential roads or restore roads on non-industrial forest lands and other county roads that contribute obvious erosion problems.

Activity: Quantify relationship between roads and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-FR-4 Commercial Forest Management

Commercial timber land in the State of Washington must implement a minimum level of BMPs under the Forest Practices Act (RCW Chapter 76.09) which is administered by the Washington State Department of Natural Resources. There are road maintenance and abandonment plans required in the current rules that should reduce phosphorus loads in forested areas. Timber harvest planning and protection of stream crossings are beneficial in reducing nonpoint source phosphorus.

Activity: Enforce BMP requirements in timber lands.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-FR-5 Washington Road Surface Erosion Model

The Cooperative Monitoring, Evaluation, and Research Committee of the Washington Forest Practices Board, has developed a tool that can be used by entities to calculate the average annual road surface erosion and sediment delivery to channels (DNR, 2011). This tool can be used for a single road up to all roads in a watershed. The model can be used for screening, planning-level assessment, a detailed assessment and scenario playing, or site/segment level monitoring.

Activity: Support assessment of phosphorus loads from timber lands.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-FR-6 Fire Rehabilitation Areas

Wild fires can significantly impact the landscape. Research has shown increased concentrations of suspended sediments, phosphorus, and potassium in streams below burned areas (Stednick, et

al., 1982). Stream monitoring indicated an immediate flush of phosphorus in the runoff, followed by a slower release. Rehabilitation of burn areas, especially the riparian corridors to protect streams, will be important to reducing nonpoint source phosphorus in forested areas. The fire history from 2001 through 2010 suggests approximately 200 acres in the subbasin to have been burned and should be evaluated.

Activity: Identify and assist with rehabilitation of burned areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

10.5.5 Range Related Activities

BMPs related to rangeland practices can reduce nonpoint source phosphorus. Since range, shrub and brush land is the largest percentage of land uses in the Lower Spokane River subbasin, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing disturbance of range land, protecting and maintaining riparian zones and maintaining or stabilizing stream banks.

LWR-RR-1 Evaluate Rangeland Practices

The state's regulations will be relied upon to reduce nonpoint source phosphorus loads from rangelands. Evaluate past and present impacts and review ongoing practices for compliance. The goal of evaluating past and present activities is to manage rangeland to maintain optimum soil and water quality. If compliance with the existing regulations is not resulting in sufficient nonpoint source phosphorus reduction, then more effective methods should be identified and promoted.

Activity: Evaluate existing practices, enforce existing regulations, and encourage BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

10.5.6 Urban/Suburban Related Activities

Urban/suburban areas can have the most variable impacts on nonpoint source phosphorus loading due to the diversity of development, uses, and control of stormwater runoff. BMPs under this category are typically associated with minimization of pollution sources and the management of stormwater.

LWS-UR-1 Business Practices to Prevent Stormwater Pollution

The Urban Waters Initiative managed by Ecology and Spokane Regional Health District has developed several practices to be implemented by local businesses to prevent stormwater pollution (Ecology, 2009c). These practices include eliminating wash water from storm drains, disposing of wastes properly, and regularly maintaining grease traps, oil-water separators, and catch basins. Because these activities are performed throughout a city, each municipality may locally lead this effort.

Activity: Review existing practices, encourage BMP implementation, provide adequate resources and information to businesses.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-UR-2 Evaluate and Analyze Impervious Surfaces and Implement Stormwater BMPs

Impervious surfaces throughout the Lower Spokane River subbasin are sources of substantial stormwater runoff. In the Lower Spokane River subbasin stormwater runoff enters both to surface water and groundwater via infiltration. An understanding of the area and location of impervious surfaces in the subbasin will guide the need and responsibility for actions to reduce runoff and sources of phosphorus.

Activity: Evaluate and quantify existing impervious surfaces, identify areas where vegetated buffer/filter strips or other applicable stormwater BMPs (see Chapter 8) could be installed and encourage installation.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-UR-3 Evaluate and Revise Stormwater Policies

Approximately 7 percent of the subbasin is within municipal boundaries. Review stormwater regulations of municipalities for water quality requirements. Municipalities have unique policies; however, working towards incorporating at least some minimum water quality requirements that address nonpoint source pollution, including phosphorus, across the watershed will provide some reduction in loads. Resources to consider include the Spokane Regional Stormwater Manual (Spokane County et. al, 2008), the Washington Department of Ecology Stormwater Management Manual for Eastern Washington (Ecology, 2004b), and the WSDOT Highway Runoff Manual (WSDOT, 2010).

Consider holding a subbasin or watershed summit to evaluate and identify policies, and evaluate and determine areas throughout the Lower Spokane River subbasin for implementation and enforcement of the requirements. Developed areas outside municipal jurisdictions should also be considered.

Activity: Coordinate on minimum water quality stormwater treatment policies and requirements.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-UR-4 Strengthen Requirements for Stormwater Treatment BMPs in Key Areas

Stormwater treatment BMPs, such as bio-infiltration swales, bio-infiltration channels, vegetated buffer strips and infiltration basins are particularly important within the Lower Spokane River

subbasin because: 1) near-shore development frequently occurs above coarse-grained soils with limited treatment capacity and in close proximity to Lake Spokane; and 2) a portion of the subbasin directly overlies the sole-source SVRP Aquifer and is defined as both an Aquifer Sensitive Area (ASA) and Critical Aquifer Recharge Area (CARA).

Under ASA regulations, any project within the City of Spokane is required to provide treatment for all stormwater runoff from pollution generating impervious surfaces and bio-infiltration swales are the expected BMP for providing basic treatment (Spokane County et. al. 2008). Per CARA regulations, Spokane County requires that special consideration be given to stormwater runoff associated with commercial and industrial development such as outdoor loading docks, fueling stations, and those activities involving toxic and hazardous materials handling.

This action would strengthen requirements regarding implementation of the stormwater treatment BMPs listed in this section. These requirements could include developed and redeveloped commercial and residential properties within the following key areas:

- Overlying the SVRP Aquifer.
- Within aquifer zones defined as highly- or moderately-susceptible by Spokane County's CARA regulation.
- Within 1,000 feet of the Spokane River or Lake Spokane.

The Spokane Regional Stormwater Manual (Spokane County et. al. 2008) presents bio-infiltration swales, bio-infiltration channels, and vegetated buffer strips as stormwater treatment design alternatives. The regulatory threshold for requiring varies by jurisdiction. In Spokane County, the threshold is defined as "the addition or replacement of 5,000 square feet or more of impervious surfaces or the disturbance of 1acre or more." In the City of Spokane, the threshold is defined as "the addition or replacement of any impervious surfaces." Various exemptions, such as an exemption for redeveloped sites, are listed in the manual. The Stevens County Comprehensive Plan refers to the Washington Department of Ecology Stormwater Management Manual for Eastern Washington (Ecology, 2004b) for guidance regarding implementation of stormwater BMPs. This manual lists infiltration ponds, infiltration trenches, infiltration swales, bio-infiltration swales, and vegetated filter strips as stormwater treatment BMP options. These BMPs are also described below in the subactivities 'Install BMP' (see LWS-UR-4a through 4d).

Activity: Implement rigorous stormwater BMP requirements in key portions of subbasin.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Spokane County, Stevens County, and/or City of Spokane.

LWS-UR-4a Install Grassed Bio-Infiltration Swales

The Spokane Regional Stormwater Manual (Spokane County et. al. 2008) specifies an achievement goal of 50 percent total phosphorus removal for a range of influent concentrations from 0.1 to 0.5 μg/l of total phosphorus. Bio-infiltration swales (also locally termed grassed

percolation areas or “208” swales) are the only BMP presented in the manual that are assumed to meet this removal goal for phosphorus.

To implement this BMP, stormwater runoff is directed to a dry swale where vegetative cover provides pretreatment of stormwater before infiltration to the subsurface. Infiltration occurs either through the swale or within drywells that receive stormwater once the swale is filled to a design overflow elevation. The area surrounding the drywell and underlying the swale should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site’s unsaturated zone. Specific details regarding bio-infiltration channel design and construction within the Lower Spokane River subbasin are provided by Spokane County et al. (2008).

Potential Phosphorus Load Reduction: Grassed swales have a wide range of potential phosphorus removal efficiencies from 20 to 61 percent (Miller, 1987) to 29 to 99 percent (Yu et al., 2001).
Range of Cost: No specific quantitative information regarding the cost of grassed bio-infiltration swales was found during the project review. However, based on BMP characteristics, costs are expected to be moderate to high with respect to the other BMPs described in this plan.

LWS-UR-4b Install Bio-Infiltration Channels

To implement this stormwater treatment BMP, stormwater runoff is directed to a bio-infiltration channel underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). A bio-infiltration channel is a sloped, vegetated channel or ditch that both conveys and treats stormwater runoff. It does not provide flow control but can convey runoff to facilities designed for that purpose (Spokane County et. al. 2008). A bio-infiltration channel provides treatment as stormwater flows through vegetative cover and/or infiltrates. Channel flow can be directed to detention ponds/impoundments or other facilities. Infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. Specific details regarding bio-infiltration channel and construction within the Lower Spokane River subbasin are provided by Spokane County et al. (2008).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of bio-infiltration channels was found during planning. However, infiltration trenches and basins have a wide range of potential phosphorus removal efficiencies of 10 to 80 percent (EPA, 1999).
Range of Cost: No specific quantitative information regarding the cost of bio-infiltration channels was found during planning.

LWS-UR-4c Install Vegetated Buffer Strips

Stormwater runoff is directed via sheet flow to a vegetated buffer strip situated adjacent to a rural roadway or parking lot. Vegetative cover within the buffer strip provides pretreatment of stormwater before infiltration to the subsurface, and/or evaporation. Vegetated buffer strips are used to intercept overland sheet flow runoff from adjacent impervious areas. They slow runoff velocities, filter out sediment and other pollutants, and provide infiltration into underlying soils.

When buffer strips are used for infiltration, the area underlying the buffer strip should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone. Specific details regarding vegetated buffer strip design and construction within the Lower Spokane River subbasin are provided by Spokane County et al. (2008).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness or cost of vegetated buffer strips was found during the project review. However, vegetated filter strips have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Grass filter strips have low phosphorus removal costs of $190 to $250 per pound (Sera-17, 2010).

LWS-UR-4d Install Infiltration Areas

Stormwater runoff is directed to an infiltration area underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). The infiltration area can be equipped with a drainfield constructed of perforated pipe to facilitate infiltration. A suitable site requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Spokane County and the City of Spokane have recently constructed/enhanced a number of regional stormwater infiltration facilities for the purpose of managing stormwater runoff in areas with difficult infiltration conditions on a site-specific level. When these facilities are located over relatively thick glaciofluvial sand and gravel sequences, benefit of water quality treatment may be limited. Examples include: Hazel's Creek Drainage and Conservation Facility (City of Spokane), Browne's Mountain Regional Stormwater Facility (Spokane County), and Price and Wall Regional Stormwater Facility (Spokane County).

Potential Phosphorus Load Reduction: Infiltration basins have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).

Range of Cost: infiltration structures generally have high phosphorus removal costs of $2,500 to $3,000 per pound (Corrozi, 2009).

LWS-UR-5 Evaluate Phosphorus Load from Septic Tanks within Suncrest and Other Densely Developed Areas

While there is historical literature that suggests septic systems and subsequent treatment in the unsaturated zone provides phosphorus removal from effluent, recent and emerging evidence indicates the contrary in many locations. Both the current science and measured groundwater concentrations of phosphorus clearly indicate that septic systems release significant phosphorus loads into underlying groundwater and that phosphorus loading can increase with time as a result of the loading of sorption sites in the unsaturated zone. Moreover, the shallow hydrostratigraphy of many areas with the Lower Spokane River subbasin consists of bedrock and/or coarse sediments, which have relatively little phosphorus removal capacity.

Removing septic systems and replacing with sewers involves considerable cost. Therefore, the reduction in phosphorus loading associated with septic tank removal within key densely developed areas should be conducted as a basis for future management decisions. Areas that should be considered include but are not limited to the following:

- Suncrest.
- The residential area surrounding the intersection of State Route 291 and 7 Mile Road.
- Densely developed portions of the West Plains.

Activity: Evaluate Phosphorus Load from Septic Tanks within Suncrest and Other Densely Developed Areas as a basis for future management decisions.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Spokane County and/or Stevens County.

LWS-UR-6 Septic Tank Elimination within Suncrest and Other Areas

Removal of septic systems by connecting to sewer systems eliminates a source of pollution to surface and groundwater. Wastes are treated more thoroughly and phosphorus removal is more complete at a wastewater treatment facility designed for phosphorus removal than is possible with a septic system. For these reasons, septic tank elimination is an important long-term management approach to controlling nonpoint source phosphorus loading.

Numerous examples of septic tank elimination programs exist across the country including: the City of Coeur d'Alene, Idaho, the City of Indianapolis, Indiana; Vancouver, Washington; Pierce County, Washington, and Spokane Valley, Washington. Health district, county, and city ordinances and programs can include requirements for septic system elimination.

Septic tank elimination programs should be based on results of the action to 'Evaluate Phosphorus Load from Septic Tanks' (see LWS-UR-5), which will assist in identification of specific areas where infrastructure investment will lead to relatively large phosphorus loading reductions.

Activity: Remove septic systems and replace with sanitary sewer in key areas of the Lower Spokane River subbasin.
Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of septic tank elimination was found during planning. However, based on the phosphorus removal characteristics of area wastewater facilities and that septic tank discharges are completely eliminated during removal, the expected effectiveness is very high.
Range of Cost: TBD by Potential Lead. No specific quantitative information regarding the cost of septic tank elimination was found during planning. Potential costs may range from low to high with respect to the other BMPs described in this plan.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Spokane County and/or Stevens County.

LWS-UR-7 Inspection and Pumping of Septic Systems within Key Areas

Regular inspection and pumping of septic systems prolongs the life of the system, reduces maintenance costs and contamination around the drain field, and slows the breakthrough of phosphorus to groundwater. The priority systems to target are older systems and systems near streams and areas with a high groundwater table. The septic tank should be pumped by a licensed septage waste-hauler on a regular basis and septage properly disposed of in an approved site or wastewater treatment facility.

Septic system inspection and pumping can be performed throughout the subbasin to achieve nonpoint source loading reduction to area surface water. However, it will have greatest positive impact within nearshore areas and with septic system overlying coarse soil and/or bedrock with minimal phosphorus treatment capacity. Areas to consider include:

- Overlying the SVRP Aquifer.
- Within aquifer zones defined as highly- or moderately-susceptible by Spokane County's CARA regulation.
- Within 1,000 feet of the Spokane River and/or Lake Spokane.

Activity: Require regular inspection and pumping of septic systems on a standard interval. The interval should vary as a function of septic tank size and persons per household to achieve acceptable retention times. Standard matrices are available for these requirements.
Potential Phosphorus Load Reduction: Inspection and pumping of septic systems has low to moderate phosphorus removal efficiencies of 40 to 55 percent (DDNR, 2010).
Range of Cost: Inspection and pumping of septic systems has very low phosphorus removal costs of $7 to $25 per pound (DDNR, 2010).
Potential Timeline: TBD by Potential Lead.
Potential Lead: Spokane County and/or Stevens County.

10.5.7 Supporting Phosphorus Reduction Activities

Supporting activities to be undertaken as part of this NPS Reduction Plan will provide valuable information for long-term success, in addition to the subbasin-specific actions and BMPs designed to provide direct phosphorus reduction. These activities are described in Chapter 9.

10.5.8 Additional Activities

Additional activities include indirect actions that either lead to overall improvements in ecological functions and thus water quality or provide additional insights into the overall health and conditions of the watershed. Activities are described in Chapter 9. Additional activities in the Lower Spokane River subbasin include the coordination of activities on Lake Spokane, nearshore, and upstream activities.

LWS-AA-1 Coordination of Avista Activities and Upstream Activities

Avista is undertaking actions to improve water quality in the Spokane River. The low velocity waters especially downstream of the confluence with Hangman Creek of Nine Mile Reservoir and Lake Spokane exhibit water quality issues due to the nonpoint source pollutants delivered from upstream. These slack water environments trap sediments and cycle nutrients (Ecology, 2009a). Avista's coordination and support of upstream activities to reduce nonpoint source phosphorus, such as in the Hangman Creek subbasin (see Chapter 13), will benefit the water quality conditions in the Lower Spokane River subbasin. This additional activity is not in Avista's WQAP but may support such activities (see Section 10.5.9).

Activity: Coordinate Avista environmental and water quality activities with upstream activities.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-AA-2 Evaluate, Protect and Enhance Nearshore Lake Spokane Areas

Nearshore Lake Spokane land management and activities have the potential to impact phosphorus loads to the lake. Nearshore sources may transport phosphorus loads via surface water, stormwater runoff, interflow, and groundwater. Unlike activities and BMPs implemented upstream, there is no attenuation of phosphorus loads associated with nearshore sources. Soltero, et.al (1992), recommended a nearshore assessment of loads including evaluating surface water and groundwater sources. They stated that nearshore "property owners must be as responsible as possible to minimize their negative impact on water quality." Therefore, reduction of loads from nearshore areas is important and should be considered as part of the overall nonpoint source phosphorus load reduction strategy. Nearshore areas should be inventoried to identify areas where BMPs should be implemented. BMPs that should be considered for nearshore areas include, but are not limited to:

- Erosion control and bank stabilization.
- Filter strips.
- Septic tank elimination.
- Inspection and pumping of septic systems.
- Phosphate lawn fertilizer ban.
- Riparian fencing, riparian zones and buffer strips.
- Education and outreach to nearshore property owners.

Activity: Evaluate nearshore Lake Spokane areas and implement activities and BMPs to reduce nonpoint source phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

10.5.9 Support Existing and Planned Activities

The NPS Reduction Plan supports existing water resources and water quality studies and planning. Protection of these resources also supports the reduction of nonpoint source phosphorus. Planned activities specific to the NPS Reduction Plan are identified below.

LWS-EP-1 Implement or Complement WRIA 54 Detailed Implementation Plan Recommendations to Reduce Nonpoint Source Phosphorus

The WRIA 54 Lower Spokane Watershed Detailed Implementation Plan (Tetra Tech, 2010) recognized that nonpoint source pollution contributes to the low oxygen condition of the Spokane River and Lake Spokane. The linkage between land use, development and sources of nonpoint source pollution was also identified. Contributing factors include increases of impervious surfaces and stormwater runoff; septic systems; runoff from fertilizer-treated lawns; and improper timber stand management (Tetra Tech, 2010). Adopting phosphate lawn fertilizer ban may be one BMP to implement by communities in the subbasin.

The need for technical investigations, monitoring, public education, water conservation, and development requirements were identified. Data needs include monitoring of streams and groundwater in principal water-bearing zones and hydrogeologic characterization. Specific recommendations in the Detailed Implementation Plan that relate to or could complement efforts to reduce nonpoint source phosphorus loading should be reviewed and considered.

Activity: Implement or complement actions in the WRIA 54 Detailed Implementation Plan to achieve nonpoint source phosphorus reductions.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-EP-2 Support and Supplement Avista Utilities WQAP Implementation

Avista Utilities is developing a WQAP to identify how they will mitigate for impacts to dissolved oxygen in Lake Spokane caused by the Long Lake Dam (Ecology, 2010). The WQAP should be completed in 2012. Avista's efforts to implement the plan elements should be supported. In addition, other organizations in the Lower Spokane River subbasin should look for ways to collaborate with and complement Avista's efforts to advance and expand success in reducing nonpoint source phosphorus loads.

Activity: Support and supplement Avista Utilities WQAP implementation to achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.

Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-EP-3 Support and Enforce Spokane, Stevens and Lincoln Counties, and City of Spokane Shoreline Master Plans

Washington's Shoreline Management Act governs the use and development of Washington's shorelines and creates a unique partnership between local and state government. The Act strives to achieve responsible shoreline use and development, environmental protection, and public access. Local governments develop programs based on the Act and state guidance, and the state reviews local programs to consider statewide public interests, (Ecology, 2011b). Spokane, Stevens and Lincoln Counties, and the City of Spokane, all have shoreline master plans that establish policies and regulations for shoreline use and modification activities. Each plan is unique and involves distinct requirements for different types of development, uses, activities, and distinct requirements for different water bodies; however, each plan has similar requirements relating to nonpoint source phosphorus reduction including:

- Setback requirements for structures and uses (ranging from 10 feet to 150 feet).
- Requirements for retaining and enhancing natural vegetation buffers and restoring shoreline functions.

Some of the plans include requirements that foster phosphorus load reduction, including specific requirements for on-site wastewater treatment systems, aquaculture operations, dredging, etc.

Activity: Support and Enforce Spokane, Stevens and Lincoln Counties, and City of Spokane, Shoreline Master Plans to achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LWS-EP-4 Support, Compliment and Enforce Permits, Ordinances, Plans and Activities Relating to Nonpoint Source Phosphorus Reduction

There are a variety of permits, ordinances, plans and activities within the Lower Spokane Watershed that relate to nonpoint source phosphorus reduction, including:

- City of Spokane, Spokane County, and WSDOT NPDES Phase II Stormwater Permit Requirements.
- City and county critical area ordinances.
- Spokane, Stevens and Lincoln County Conservation Districts Natural Resource Conservation Plans.
- Spokane River Forum education efforts.

When taking actions and implementing BMPs to reduce nonpoint source phosphorus, consider these and other related plans, goals, requirements and efforts to optimize reduction potential.

Review that erosion control BMPs are followed at land development projects and construction sites.

Activity: Support, compliment and enforce permits, ordinances, plans and activities to achieve nonpoint source phosphorus reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

Chapter 11

Upper Spokane River WA Subbasin – Nonpoint Source Phosphorus Management Strategy and Actions

11.1 Introduction

An objective of this NPS Reduction Plan is to formulate nonpoint source control strategies that contribute to long-term reductions of phosphorus loads. It provides guidance on selecting 'what' strategies and actions to take and 'where' to apply them. Chapter 9 provides an introduction to the subbasin actions and strategies, background of the NPS Study objectives, how the subbasin chapters support the overall NPS Reduction Plan, and regional phosphorus control strategies that should be considered in all subbasins in the Spokane River Watershed.

This chapter includes specific actions for entities located in the Upper Spokane River WA subbasin and stakeholders supporting these entities to reduce nonpoint source phosphorus. Strategies, actions, and areas to target within the subbasin are included in this chapter. The guidance identifies potential organization leads and potential timelines for initial and long-term reductions of nonpoint source phosphorus pollution.

The following sections of this chapter describe:

- The identification and relationship of entities and stakeholders in the watershed and associated acres of land ownership.
- An overview of reduction strategies, actions, and schedule for the subbasin.
- An overview of the nonpoint source reduction opportunities and guidance on 'what' BMPs to implement and 'where' to take these actions.
- The specific actions by category identified to be undertaken, including those identified by specific entities and stakeholders.

Estimates of the potential BMP phosphorus reductions and cost per pound are provided in Chapter 8. The overall phosphorus reduction potential is discussed in Chapter 9.

11.2 Entities and Stakeholders

As discussed in Chapter 9, accomplishing nonpoint source reductions will require engaging local, state, and federal agencies and land managers, as well as private land owners. The principal organizations involved with securing funding, identifying priority locations, selecting BMPs, and taking actions in the Upper Spokane River WA subbasin include those shown in Table 11-1. These organizations are subdivided into entities and stakeholders as shown in Table 11-2, along with the area of land owned and miles of streams in the Upper Spokane River WA subbasin. Land ownership for the subbasin is shown in Figure 11-1.

Table 11-1. Organizations and Nonpoint Source Phosphorus

Organization
Local Governments
Spokane County
Spokane County Conservation District
Spokane Regional Health District
Municipalities
Liberty Lake
Millwood
Spokane
Spokane Valley
Utilities
Avista Utilities
Liberty Lake Water and Sewer District
Spokane County Utilities Division
Approximately 20 municipal water service providers
State Agencies
Washington Department of Fish and Wildlife
Washington Forest Practices Board
Washington Land Use Study Commission
Washington State Conservation Commission
Washington State Department of Agriculture
Washington State Department of Ecology
Washington State Department of Natural Resources
Washington State Department of Transportation
Washington State Parks and Recreation Commission
Federal Agencies
U.S. Bureau of Land Management
U.S. Department of Agriculture – Natural Resource Conservation Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service

Table 11-2. Organizations and Land Area

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Private				
In Liberty Lake	3,615	Liberty Lake	Spokane County Conservation District	n/a
In Millwood	494	Millwood		
In Spokane	14,632	Spokane		
In Spokane Valley	24,120	Spokane Valley		
In Spokane County	126,026	Spokane County		664.9
Incorporated Municipalities[2]				
Liberty Lake	*3,937*	Washington Department of Ecology, U.S. Environmental Protection Agency	Washington State Department of Agriculture, Washington State Conservation Commission	4.5
Millwood	*494*			0
Spokane	*14,420*			16.4
Spokane Valley	*24,271*			39.1
Local Governments[2]				
Spokane County	*134,322*	Washington Department of Ecology, U.S. Environmental Protection Agency, Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service	Washington State Department of Agriculture, Washington State Conservation Commission	711
State Agencies				
Washington Department of Fish and Wildlife	6	Washington Department of Ecology, Forest Practices Board, Washington Department of Fish and Wildlife	Washington State Department of Agriculture, Washington State Conservation Commission, Washington Land Use Study Commission	0
Washington State Department of Natural Resources	1,337			9.3
Washington State Department of Transportation	433			n/a
Washington State Parks and Recreation Commission	5,747			30.6
Additional Land Areas				
Roads	1,512 miles		1,187 stream crossings	

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation, road miles include primary, secondary, local and forest service roads.

[2] Incorporated municipalities and local governments is total land area within boundaries, not land ownership.

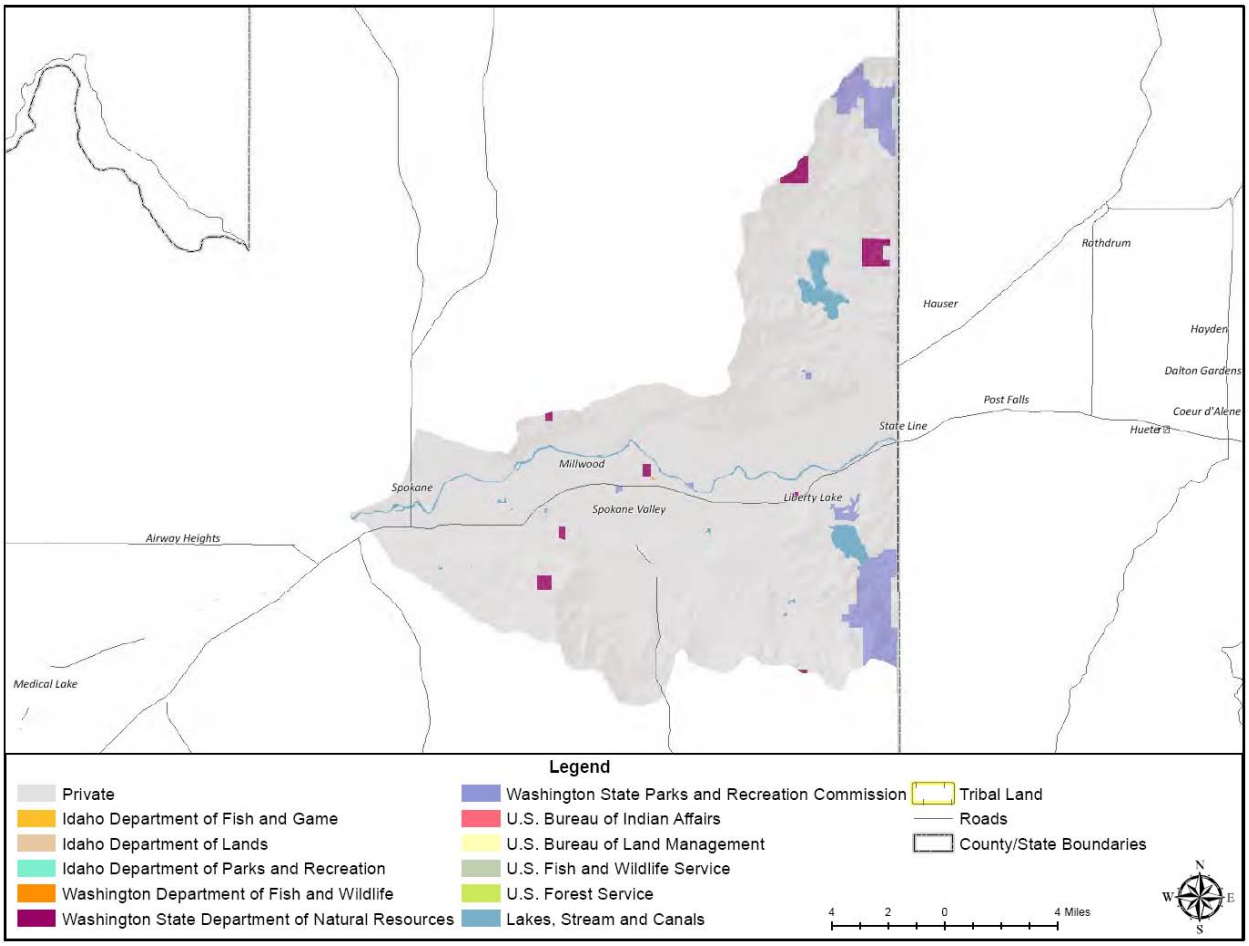

Figure 11-1. Upper Spokane River WA Subbasin and Land Owners

11.3 Overview of Reduction Strategy, Actions, and Schedule

Identifying strategies for reducing nonpoint source phosphorus in the Upper Spokane River WA subbasin is an important step to protect and restore water quality in the Spokane River. A successful strategy will also ultimately support improving dissolved oxygen concentrations in Lake Spokane. The extent of water quality improvements will depend on fate and transport processes which were not addressed in the NPS Study. Nonpoint source phosphorus reductions will have both local and watershed benefits.

11.3.1 Strategy

The strategy for addressing nonpoint sources of phosphorus includes taking actions throughout the subbasin. Nonpoint source reduction actions include addressing obvious problems and undertaking actions that can be readily completed. The strategy emphasizes reducing nonpoint source phosphorus from land uses that generate large phosphorus loads and cover large areas of the subbasin. A subbasin scale assessment of these land uses revealed that evergreen forest and urban are dominant throughout the subbasin (Chapter 3).

11.3.2 Actions

Actions are the measures or steps from planning through achievement of nonpoint source phosphorus reduction. Actions include sufficient description and specificity for a responsible party to decide to take the action. The actions also help the responsible party determine where, what, when, and how to achieve the potential suggested outcome.

BMPs are the core of the action; whereas, actions encompass the entire process from the identification of the area, selection and implementation of the BMP through post monitoring. BMPs for addressing nonpoint sources of phosphorus include structural (i.e., physical) and non-structural (i.e., educational) measures.

BMPs referenced in the actions in Section 11.5 were identified based on the dominant land uses and the associated loading potential of the land uses. BMP phosphorus percent reduction efficiency, costs, estimated longevity and implementation effectiveness were also key indicators for identifying high priority BMPs for the subbasin. See Chapter 8 Nonpoint Source Phosphorus Control Measures for information about BMPs and the prioritization process.

11.3.3 Schedule

The schedule for nonpoint source actions for this plan is based on meeting the schedule in the Spokane River DO TMDL (Ecology, 2010). The schedule targets expeditious management actions to reduce nonpoint source phosphorus over the next 2 decades. From the Spokane River DO TMDL approval (May 2010), progress will be evaluated every 5 years, with extensive assessments after 10 and 20 years. The results from the first 10 years will be used to guide actions during the second 10-year period. Actions initiated in the first 10 years and determined to be beneficial should be continued, including successful nonpoint source control.

11.3.4 Summary of Approach

There is not a load allocation for the Upper Spokane River WA at state line in the Spokane River DO TMDL (Ecology, 2010). However, based on the load allocations for the lower subbasins, a target reduction of approximately 25 percent is necessary to meet downstream targets. Using an average efficiency of 54 percent for the priority BMPs (Chapter 8), 100 percent of the major land uses (evergreen forest and urban) would need BMPs applied along with BMPs on additional land uses to achieve the target. Based on the average cost for the priority BMPs of about $320/pound (Chapter 8), the total cost for the target reduction would be approximately $858,000. Achieving the target reduction over a 20-year period will require that approximately $43,000 is spent annually on BMPs in the subbasin.

Section 11.4 Overview of Opportunities

The Upper Spokane River WA subbasin consists of a wide variety of land uses which provide several nonpoint source reduction opportunities throughout the subbasin. BMPs were prioritized by land use type and phosphorus load removal potential in previous chapters. This section includes a description of what BMPs are the most relevant and where the BMPs should be implemented in the Upper Spokane River WA subbasin.

11.4.1 Control Measures and BMPs

BMPs specific to land use type and source are described in detail in Chapter 8. The background included in Chapter 8 narrowed the list of BMPs from 108 to 22 based on phosphorus percent reduction efficiency, cost, estimated longevity, and implementation effectiveness. This list of BMPs, if implemented for the appropriate land uses, could result in substantial net nonpoint source reduction of phosphorus.

There are several organizations throughout the Upper Spokane River WA subbasin that can mitigate nonpoint source loads by incorporating BMPs. The agencies and organizations are encouraged to review the land and nonpoint phosphorus sources in their jurisdiction to further identify BMPs that are specific to their situation.

A review of stormwater management practices may further refine opportunities where BMPs could be implemented since stormwater is a primary transport mechanism for nonpoint source phosphorus. Organizations identified in Tables 11-1 and 11-2 include private, municipal, state and federal entities. Associated opportunities for nonpoint source phosphorus reduction include:

- Private land owners may protect and restore riparian corridors; minimize stormwater runoff; and consider education, land evaluation, and/or aide available from the conservation organizations.
- Municipalities may install BMPs to treat and/or reduce stormwater discharge to water bodies; evaluate where stormwater is being discharged; and/or evaluate the pollutant loading by collecting samples for analysis.
- State and federal agencies should review activities occurring on the land, identify potential impacts, and implement applicable BMPs.
- Organizations should consider actions recommended in other plans that could be implemented in conjunction with NPS Reduction Plan actions and strategies, such as the:
    - WRIA 55/57 – Middle Spokane River/Little Spokane River Watershed Detailed Implementation Plan (WRIA 55/57 Watershed Implementation Team, 2008).
    - Avista Utilities WQAP which should be completed in 2012.
    - Spokane County and Cities of Spokane and Spokane Valley Shoreline Master Plans.
    - Total phosphorus TMDLs for Newman Lake (Ecology, 2008a) and Liberty Lake (EPA, 1993).
    - The Stormwater Management Manual for Eastern Washington (Ecology, 2004b).
    - The Spokane Regional Stormwater Manual (Spokane County et al. 2008).
    - Other plans and requirements associated with reducing phosphorus and sediment loads to the Upper Spokane River WA subbasin.

11.4.2 Land Uses and Source Potential

This NPS Reduction Plan is intended to serve as a guiding document for where reduction actions and implementation should take place to have the most impact. Guidance is limited to the watershed and subbasin scale, similar to what was completed for the NPS Study. Actions by organizations are limited by their jurisdictions and authority. It is the responsibility of the organizations to review the existing conditions and determine the details of installations.

The NPS Reduction Plan analyses (Chapters 6 and 7) evaluated the dominant land uses and the phosphorus load potential for each subbasin. In some cases, the largest land use did not match the largest phosphorus load reduction potential. The following land uses have the highest priority for the Upper Spokane River WA subbasin with respect to nonpoint source phosphorus loading:

- Evergreen Forest Land.
- Cropland and Pasture.
- Other Urban.
- Urban or Built-up Land.

The analytical evaluation results indicated that the southeastern portion of the subbasin has the highest nonpoint source phosphorus loading rates in the Upper Spokane River WA subbasin (see Chapter 7). These two sub-subbasins are Saltese Creek (0.093 lbs/ac/yr) and Liberty Creek (0.087 lbs/ac/yr). These subareas should be considered as priority areas for action.

The Upper Spokane River WA subbasin is dominated by evergreen forest land (35 percent) and urban/suburban/residential land (36 percent). The land use with the greatest phosphorus removal potential in this subbasin is evergreen forest land followed by cropland and other urban land uses. Organizations are encouraged to take action in these high priority land use areas. It is also important that organizations are aware of other obvious areas for nonpoint source reduction opportunities.

11.4.3 Summary of Reduction Opportunities

BMPs have been prioritized first by their ability to remove nonpoint source phosphorus loads and then by land use type. The acres of land use by organization were computed and are tabulated in Table 11-3. The acres in Table 11-3 demonstrate how the land uses are distributed among land owners and where the greatest opportunities for reductions may exist.

The export coefficients summarized in Chapter 7, along with the land uses and areas, can be used to estimate potential nonpoint source phosphorus loads by organization. There is an associated range of reduction opportunities based on the potential to reduce phosphorus loads. These opportunities are presented in Table 11-4 by assigning a load reduction potential that ranges from low to high. The range is based on total phosphorus load; therefore, higher potential may be due to a greater export coefficient, the total land area, or a combination of both. Table 11-4 is intended to provide further guidance for considering and selecting BMPs for implementation.

Figure 11-2 shows land ownership with stream segments highlighted in areas of high potential for nonpoint source phosphorus reduction based on the land use and export coefficients. Stream

segments are shown since the highest priority BMPs in this subbasin generally relate to stream or riparian corridors.

Table 11-3. Organizations Land Area by Land Use

Land Owners	Agriculture[1] (acres)	Forested[1] (acres)	Rangeland[1] (acres)	Urban / Suburban[1] (acres)	Other[1] (acres)
Private					
Private	4,776	41,618	30,428	47,248	2,053
Incorporated Municipalities					
Liberty Lake	420	185	1,728	1,285	0
Millwood	0	10	0.4	477	7
Spokane	0	430	326	13,371	121
Spokane Valley	168	839	2,618	20,381	133
Local Governments					
Spokane County	4,776	47,846	30,862	47,579	2,864
State Agencies					
Washington Department of Fish and Wildlife	0	0	6	0	0
Washington State Department of Natural Resources	0	1,160	159	19	0
Washington State Parks and Recreation Commission	0	5,051	269	300	133

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation. Incorporated municipalities and local governments is the total land area within boundaries.

Table 11-4. Organizations and Potential for Nonpoint Source Phosphorus Reduction

Land Owners	Agriculture[1]	Forested[1]	Rangeland[1]	Urban / Suburban[1]	Other[1]
Private					
Private	High	High	High-Mod.	High	Low-Mod.
Incorporated Municipalities					
Liberty Lake	High-Mod.	Low-Mod.	Moderate	Moderate	n/a
Millwood	n/a	Low	Low	Low-Mod.	n/a
Spokane	n/a	Low-Mod.	Low-Mod.	High-Mod.	n/a
Spokane Valley	Moderate	Moderate	High-Mod.	High-Mod.	Low-Mod.
Local Governments					
Spokane County	High	High	High-Mod.	High	Moderate
State Agencies					
Washington Department of Fish and Wildlife	n/a	n/a	Low	n/a	n/a
Washington State Department of Natural Resources	n/a	Moderate	Low	Low	n/a
Washington State Parks and Recreation Commission	n/a	High-Mod.	Low-Mod.	Moderate	Low

[1] NPS load potential based on area and export classified into five categories, low, low-moderate, moderate, high-moderate, and high.

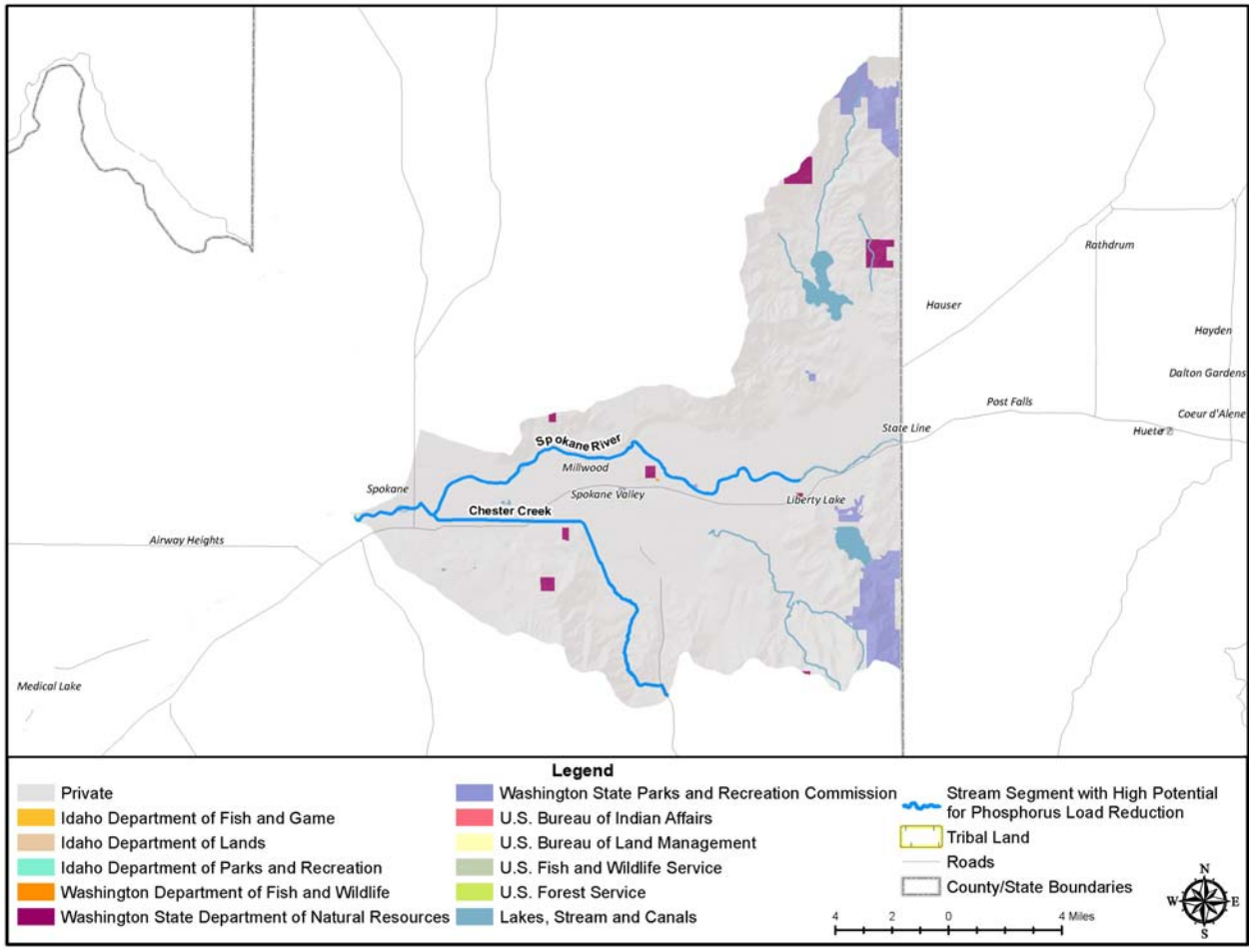

Figure 11-2. Upper Spokane River WA Subbasin High Potential Reduction Opportunities

11.5 Specific Actions by Category

This section includes a list of specific actions to reduce nonpoint source phosphorus loads and ultimately contribute to meeting water quality standards. A general description of each action, an activity summary, potential phosphorus load reduction, range of costs, potential timeline and potential lead entity are provided for each action. Although it was not a primary objective of the NPS Study to specify "who" implements phosphorus control measures, potential lead organizations are identified for some actions to help provide linkage to the "what" and "where" objectives of the NPS Study. The lead organization will need to assist local entities in developing detailed plans for the activities, as well as a schedule and plan for monitoring progress. When the information was available, the action also includes a description of the roles of the organization with responsibility to improve water quality, and the means through which the organization will address the water quality issues.

11.5.1 High Priority BMPs

The analysis provided in Chapter 8 described the following BMPs as having the highest priority for the Upper Spokane River WA subbasin:

- Streamside Management Zones.
- Riparian Zones and Buffer Strips.
- Stream Bank Stabilization.
- Vegetated Buffer / Filter Strips.

Specific details regarding implementation of these high priority BMPs are provided in Chapter 9. These BMPs are appropriate for implementation for land uses in the subbasin. The following sections summarize actions appropriate for the specific land uses within the Upper Spokane River WA subbasin.

11.5.2 Regional Phosphorus Management

Regional phosphorus control strategies are not specific to any one land use type or organization, and may contribute to the reduction of nonpoint source phosphorus loadings in the subbasin. Descriptions of the regional or watershed-scale phosphorus management actions intended to facilitate load reductions and/or establish the technical foundation for further phosphorus control activities are described in Chapter 9.

11.5.3 Agriculture Related Activities

BMPs related to agricultural practices can have substantial impacts on nonpoint source phosphorus loading since agricultural land uses tend to be phosphorus intensive. The Upper Spokane River WA subbasin consists of 24 percent rangeland and cropland. Agriculture was determined to be one of the top land uses with high phosphorus reduction potential.

USW-AR-1 Fertilizer Application Location and Timing

Managing the location and timing of fertilizer application can minimize the loss of phosphorus from the field and maximize plant uptake. Assistance may be obtained from the Spokane County Extension office or Spokane County Conservation District. These agencies could also provide free seminars and literature about implementing such BMPs, including conservation tillage/no-till/direct drill seeding.

Optimizing fertilizer application and timing can be achieved through the following actions:

- Incorporate or inject fertilizers with phosphorus below the soil surface to reduce the total and soluble phosphorus losses (Fawecett, unknown). “Subsurface injection of fertilizer, as compared to surface application, reduced losses by 39 percent for no-till and by 35 percent for conventional tillage” (Mostaghimi, et al., 1988).
- Establish fertilizer management areas and apply at agronomic rates for those areas with phosphorus deficits, see USW-AR-2 (Waskom and Bauder, unknown). “Maintain a buffer strip (where fertilizer and manure is not applied) a safe distance from surface water and drainage channels” (Waskom and Bauder, unknown). BMPs that buffer riparian zones were rated as high priority (Chapters 7 and 8).

- Avoid fertilizer and manure application to frozen and wet soils (Fawecett, unknown). For example, the earliest and latest spring freeze dates are March 28 and May 21 in Spokane (WRCC, 2011).

Activity: Provide support to growers with information on fertilizer management
Potential Phosphorus Load Reduction: TBD by Potential Lead
Range of Cost: TBD by Potential Lead
Potential Timeline: TBD by Potential Lead
Potential Lead: TBD

USW-AR-2 Fertilizer Application Rates

Sample the tillage layer of soil in each field on a regular basis and have soil analyzed to determine available soil phosphorus levels prior to applying fertilizers with phosphorus. Use crop and soil guides to determine agronomic application rates such as the University of Idaho Northern Idaho Fertilizer Guide or Washington State University Fertilizer Guides and Summary. The most common crops in this subbasin are spring wheat, winter wheat, alfalfa, and pasture grass and hay. Wheat has a relatively low demand for phosphorus. Alfalfa may need phosphorus fertilizer incorporated into the soil for seedlings. Pastures and established alfalfa may need phosphorus fertilizer every 2 to 3 years and should be done in the fall, as fertilization is less effective in the spring and winter when it is more susceptible to runoff.

Activity: Provide support to growers about soil phosphorus testing and fertilizer application rates
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-AR-3 Runoff Management and Treatment

Manage runoff, from stormwater and irrigation if irrigating, to minimize runoff and treat runoff before entering waterbodies. Employ contouring or other techniques to reduce runoff potential. Maintain grass filter strips on the downhill perimeter of erosive crop fields to catch and filter phosphorus in runoff. These types of BMPs were rated as high priority (Chapters 7 and 8). Manage irrigation water to minimize runoff and erosion with irrigation BMPs or NRCS irrigation water management practices.

Slope is one factor that affects runoff. In this subbasin, the percentage of agricultural land use by slope classes are generally 62 percent has 0 to 5 percent slope; 16 percent 5 to 10 percent slope; 17 percent 10 to 15 percent slope; 4 percent 15 to 20 percent slope; and 1 percent greater than 20 percent slope. These slopes in combination with the soil types and other factors result in 38 percent of agricultural land use in the subbasin having a capability description of “severe limitations that reduce the choice of plants or require special conservation practices, or both” and 28 percent as “very severe limitations that restrict the choice of plants, require very careful management, or both”. This matches with implementing the recommended BMPs for managing and treating runoff. About 71 percent of the agricultural land use in the subbasin is rated as “good” relative to herbaceous habitat for wildlife such as in buffer zones.

Activity: Provide support to growers about runoff management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-AR-4 Crop Management

Crop management is related to many agricultural BMPs, including tillage type (conservation tillage/no-till/direct drill seeding), contouring (contour plowing and terracing and contour strip crop), crop rotation and erosion management (see Chapter 8). Crop management is related to the typical crops grown in the subbasin. Crops grown in the subbasin include: alfalfa, apples, barley, Christmas trees, dry beans, lentils, oats, pasture grass, pasture hay, peas, grass seed, squash, strawberries, sweet corn, and spring and winter wheat. Economic crop management practices that also provide environmental benefits are supported in this action. This may require transformation in agency policies, new legislation, or other adjustments from historical practices that result in economic disincentives for implementing actions.

Activity: Provide support to growers about crop management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-AR-5 Animal Management

Animal management is related to many agricultural BMPs, including water supply, riparian zone exclusion, and feed, grazing and waste management (see Chapter 8). For example riparian fencing of stream corridors limits livestock access to streams and ultimately protects water quality. Animal management is related to the head of animals raised in the subbasin. However, operations with large numbers of animals including cattle, dairy cows, turkeys, broilers and laying hens may fall under confined animal feeding operation requirements instead. Smaller operations can also result in intense pressure on the land such as disturbance to drainages and stream banks, soil erosion, and animal wastes. Recommended priority BMPs such as buffers, riparian zones and stream bank stabilization are beneficial to reducing or eliminating these pressures.

Activity: Provide support to producers about animal management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

11.5.4 Forestry Related Activities

BMPs related to forestry practices can reduce nonpoint source phosphorus. While phosphorus export from forestry in general is low, local areas of intensive use can have higher phosphorus export rates. Since a large percentage of the Spokane River Watershed is forested, reductions in

nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing erosion, reducing sediment transport, and protecting and maintaining riparian corridors and streamside management zones.

The Upper Spokane River WA subbasin is approximately 35 percent evergreen forest land; therefore forestry-related phosphorus load reduction strategies are important in this subbasin. A brief description of phosphorus reduction actions related to evergreen forests is provided below.

USW-FR-1 Evaluate Forestry Practices

Washington's forest practices regulations include the Forest Practices Act as administered by the Department of Natural Resources. The state's forest practices regulations will be relied upon for both private and state forestlands and is a key strategy for source reduction strategy as identified in the Newman Lake TMDL (Ecology, 2009d). These regulations will be used as the basis for nonpoint source phosphorus load reduction from private and state forestlands. Ongoing practices should be reviewed by or as directed by the lead organization for compliance. If compliance with the existing regulations is not resulting in sufficient reduction, then more effective methods need to be promoted. Poorly performing practices need to be researched for the causes and potentially modified to improve the outcomes. Timber harvest planning should be done such that organizing, scheduling, and planning harvests to minimize nonpoint sources of pollution is achieved. The protection of stream crossings is another important BMP.

With large quantities of adjacent forested land, tributary water quality is likely affected by forest management practices. Logging and road building practices that have been common throughout the intermountain region from the late nineteenth century through most of the twentieth century have likely contributed to the degradation of water quality. In more recent times, implementation of more environmentally sound forest management practices has occurred.

The agencies have data on forest health, ecology, harvest areas, vegetation types, soil conditions and more. This information can be useful for identifying areas of greater nonpoint source phosphorus loading. However, much of this data is not readily available or in a format that can be interpreted by water quality managers. Coordination between forest and water quality managers is necessary to understand the data and select management activities.

Activity: Enforce existing regulations, evaluate existing practices, discourage poorly performing practices, and encourage best performing practices and improve coordination of sharing information.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-FR-2 Quantify Sediment-Phosphorus Relationship in Forested Areas

Quantifying phosphorus loading associated with forest management practices may provide additional information that support selection of successful BMPs. The construction and use of roadways represent a major source of sediment from timber harvest activities (DEQ, 2000). A

study to quantify the relationship between sediment associated with phosphorus in runoff from these roads can help determine whether additional measures should be undertaken.

Activity: Quantify relationship between sediment and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-FR-3 Subbasin Scale Road Planning and Rehabilitation

A subbasin-scale management survey should be completed to document ownership and identify and prioritize the total miles of erodible roads and road banks. The development of specific BMPs can be completed based on survey results to reduce miles of erodible roads associated with road construction, road conversions, and maintenance. The inventoried roads should be included in a database that tracks BMP implementation. This database and tracking is essential for determining BMP implementation success and accountability. Reduction plans should identify opportunities to abandon non-essential roads or restore roads on non-industrial forest lands and other county roads that contribute obvious erosion problems.

Activity: Quantify relationship between roads and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-FR-4 Commercial Forest Management

Commercial timber land in the State of Washington must implement a minimum level of BMPs under the Forest Practices Act (RCW Chapter 76.09) which is administered by the Washington State Department of Natural Resources. There are road maintenance and abandonment plans required in the current rules that should reduce phosphorus loads in forested areas. Timber harvest planning and protection of stream crossings are beneficial in reducing nonpoint source phosphorus.

Activity: Enforce BMP requirements in timber lands.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-FR-5 Washington Road Surface Erosion Model

The Cooperative Monitoring, Evaluation, and Research Committee of the Washington Forest Practices Board, has developed a tool that can be used by entities to calculate the average annual road surface erosion and sediment delivery to channels (DNR, 2011). This tool can be used for a single road up to all roads in a watershed. The model can be used for screening, planning-level assessment, a detailed assessment and scenario playing, or site/segment level monitoring.

Activity: Support assessment of phosphorus loads from timber lands.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-FR-6 Fire Rehabilitation Areas

Wild fires can significantly impact the landscape. Research has shown increased concentrations of suspended sediments, phosphorus, and potassium in streams below burned areas (Stednick, et al., 1982). Stream monitoring indicated an immediate flush of phosphorus in the runoff, followed by a slower release. Rehabilitation of burn areas, especially the riparian corridors to protect streams, will be important to reducing nonpoint source phosphorus in forested areas. The fire history from 2001 through 2010 suggests approximately 1,200 acres in the subbasin to have been burned and should be evaluated.

Activity: Identify and assist with rehabilitation of burned areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

11.5.5 Range Related Activities

BMPs related to rangeland practices can reduce nonpoint source phosphorus. Since range land is the second largest percentage of land uses in the Upper Spokane River WA subbasin, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing disturbance of range land, protecting and maintaining riparian zones and maintaining or stabilizing stream banks.

USW-RR-1 Evaluate Rangeland Practices

The state's regulations will be relied upon to reduce nonpoint source phosphorus loads from rangelands. Evaluate past and present impacts and review ongoing practices for compliance. The goal of evaluating past and present activities is to manage rangeland to maintain optimum soil and water quality. If compliance with the existing regulations is not resulting in sufficient nonpoint source phosphorus reduction, then more effective methods should be identified and promoted.

Activity: Evaluate existing practices, enforce existing regulations, and encourage BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

11.5.6 Urban/Suburban Related Activities

Urban/suburban areas can have the most variable impacts on nonpoint source phosphorus loading due to the diversity of development, uses, and control of stormwater runoff. BMPs under

this category are typically associated with minimization of pollution sources and the management of stormwater.

USW-UR-1 Business Practices to Prevent Stormwater Pollution

The Urban Waters Initiative managed by Ecology and Spokane Regional Health District has developed several practices to be implemented by local businesses to prevent stormwater pollution (Ecology, 2009c). These practices include eliminating wash water from storm drains, disposing of wastes properly, and regularly maintaining grease traps, oil-water separators, and catch basins. Because these activities are performed throughout a city, one of the local municipalities could be the lead for this effort.

Activity: Review existing practices, encourage BMP implementation, provide adequate resources and information to businesses.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-UR-2 Evaluate and Analyze Impervious Surfaces and Implement Stormwater BMPs

Impervious surfaces throughout the Upper Spokane River WA subbasin are the source of substantial stormwater runoff. In the Upper Spokane River WA subbasin stormwater runoff enters both surface water and groundwater via infiltration. An understanding of the area and location of the impervious surfaces in the subbasin will guide the need and responsibility for implementation.

Dye tracing of stormwater from drains to outfalls can be helpful to determine where the flows discharge and potential additional BMPs at the discharge location. Around Liberty Lake two drains were dye tested, found to discharge to the lake, and subsequently modified with the installation of bio-infiltration systems to provide treatment (Hamlin, 2010).

Activity: Evaluate and quantify existing impervious surfaces, identify areas where vegetated buffer/filter strips or other applicable stormwater BMPs (see Chapter 8) could be installed, and encourage installation.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-UR-3 Evaluate and Revise Stormwater Policies

Approximately 14 percent of the subbasin is within municipal boundaries. Review stormwater regulations of municipalities for water quality requirements. Municipalities have unique policies; however, working towards incorporating at least some minimum water quality requirements that address nonpoint source pollution including phosphorus across the watershed will provide some reduction in loads. Resources to consider include the Spokane Regional Stormwater Manual (Spokane County et. al, 2008), the Washington Department of Ecology Stormwater Management

Manual for Eastern Washington (Ecology, 2004b), and the Washington State Department of Transportation Highway Runoff Manual (WSDOT, 2010).

Consider holding a subbasin or watershed summit to evaluate and identify policies, and evaluate and determine areas throughout the Lower Spokane River subbasin for implementation and enforcement of the requirements. Keep in mind that some developed areas outside municipal jurisdictions should be considered.

Activity: Coordinate on minimum water quality stormwater treatment policies and requirements.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-UR-4 Strengthen Requirements for Stormwater Treatment BMPs in Key Areas

Stormwater treatment BMPs, such as bio-infiltration swales, bio-infiltration channels, vegetated buffer strips and infiltration basins are particularly important within the Upper Spokane River WA subbasin because: 1) near-river development frequently occurs above coarse-grained soils with limited treatment capacity and in close proximity to the Spokane River; 2) much of the subbasin directly overlies the sole-source SVRP Aquifer and is defined as both an Aquifer Sensitive Area and CARA; and 3) the Upper Spokane River WA subbasin contains the majority of the urbanized land use with the watershed.

Under ASA regulations, any project within the City of Spokane is required to provide treatment for all stormwater runoff from pollution generating impervious surfaces and bio-infiltration swales are the expected BMP for providing basic treatment (Spokane County et al. 2008). The Upper Spokane River WA subbasin contains the majority of the industrial land use with the Spokane River Watershed. Per CARA regulations, Spokane County requires that special consideration be given to stormwater runoff associated with commercial and industrial development such as outdoor loading docks, fueling stations, and those activities involving toxic and hazardous materials handling. More stringent requirements could be considered for implementation of BMPs intended to reduce industrial discharges of phosphorus. This could include installation of sand filters at or near stormwater discharges, installation of catch basin filtration systems, installation of flocculation systems, and/or multi-chambered treatment trains (DEQ, 2001).

The Spokane Regional Stormwater Manual (Spokane County et al. 2008) presents bio-infiltration swales, bio-infiltration channels, and vegetated buffer strips as stormwater treatment design alternatives. The regulatory threshold for requiring varies by jurisdiction. In Spokane County, the threshold is defined as “the addition or replacement of 5,000 square feet or more of impervious surfaces or the disturbance of 1acre or more.” In the City of Spokane, the threshold is defined as “the addition or replacement of any impervious surfaces.” Various exemptions, such as an exemption for redeveloped sites, are listed in the manual.

The Washington Department of Ecology Stormwater Management Manual for Eastern Washington (Ecology, 2004b) provides guidance regarding implementation of stormwater

BMPs. This manual lists infiltration ponds, infiltration trenches, infiltration swales, bio-infiltration swales, and vegetated filter strips as stormwater treatment BMP options.

Implementation of this action would strengthen requirements regarding implementation of the stormwater treatment BMPs listed in this section. These requirements could include developed and redeveloped commercial, industrial and residential properties within the following key areas:

- Overlying the SVRP Aquifer.
- Within aquifer zones defined as highly- or moderately-susceptible by Spokane County's CARA regulation.
- Within 1,000 feet of the Spokane River.

Particular emphasis with regard to the mitigation of phosphorus loading to groundwater from stormwater could be considered within proximity (for example, within 1,000 feet) of gaining reaches of the Spokane River. Within gaining reaches, the Spokane River gains considerable flow from groundwater discharge from the SVRP Aquifer. The SVRP Aquifer and overlying sediments are extremely coarse-grained and, as a result, have relatively little phosphorus removal capacity. It can be inferred, therefore, that within these areas much of the phosphorus dissolved within infiltrating stormwater impacts the Spokane River. Approximate locations of gaining reaches are presented by Hsieh et al. (2007) and GeoEngineers (2010a and 2010b). BMPs are also described below in the subactivities 'Install BMP' (see LWS-UR-4a through 4d).

Activity: Implement rigorous stormwater BMP requirements in key portions of subbasin.
Potential Phosphorus Load Reduction: Varies depending on BMP – refer to USW-UR-4a through USW-UR-4d.
Range of Cost: Varies depending on BMP – refer to USW-UR-4a through USW-UR-4d.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Spokane County, Stevens County, and/or City of Spokane.

USW-UR-4a Install Grassed Bio-Infiltration Swales

The Spokane Regional Stormwater Manual (Spokane County et al. 2008) specifies an achievement goal of 50 percent total phosphorus removal for a range of influent concentrations from 0.1 to 0.5 μg/l of total phosphorus. Bio-infiltration swales (also locally termed grassed percolation areas or "208" swales) are the only BMP presented in the manual that are assumed to meet this removal goal for phosphorus.

To implement this BMP, stormwater runoff is directed to a grassed swale where vegetative cover provides pretreatment of stormwater before infiltration to the subsurface. Infiltration occurs either through the swale or within drywells that receive stormwater once the swale is filled to a design overflow elevation. The area surrounding the drywell and underlying the swale should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and

ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone.

Specific details regarding bio-infiltration channel design and construction within the Upper Spokane WA subbasin are provided by Spokane County et al. (2008).

Potential Phosphorus Load Reduction: Grassed swales have a wide range of potential phosphorus removal efficiencies from 20 to 61 percent (Miller, 1987) to 29 to 99 percent (Yu et al., 2001).
Range of Cost: No specific quantitative information regarding the cost of grassed bio-infiltration swales was found during the project review. However, based on BMP characteristics, costs are expected to be moderate to high with respect to the other BMPs described in this plan.

USW-UR-4b Install Bio-Infiltration Channels

To implement this stormwater treatment BMP, stormwater runoff is directed to a bio-infiltration channel underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). A bio-infiltration channel is a sloped, vegetated channel or ditch that both conveys and treats stormwater runoff. It does not provide flow control but can convey runoff to facilities designed for that purpose (Spokane County et al., 2008). A bio-infiltration channel provides treatment as stormwater flows through vegetative cover and/or infiltrates. Channel flow can be directed to a pond or other facility. Infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Specific details regarding bio-infiltration channel and construction within the Upper Spokane WA subbasin are provided by Spokane County et al. (2008).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of bio-infiltration channels was found during planning. However, infiltration trenches and basins have a wide range of potential phosphorus removal efficiencies of 10 to 80 percent (EPA, 1999).
Range of Cost: No specific quantitative information regarding the cost of bio-infiltration channels was found during planning.

USW-UR-4c Install Vegetated Buffer Strips

Stormwater runoff is directed via sheet flow to a vegetated buffer strip situated adjacent to a rural roadway or parking lot. Vegetative cover within the buffer strip provides pretreatment of stormwater before infiltration to the subsurface, and/or evaporation. Vegetated buffer strips are used to intercept overland sheet flow runoff from adjacent impervious areas. They slow runoff velocities, filter out sediment and other pollutants, and provide infiltration into underlying soils. When buffer strips are used for infiltration, the area underlying the buffer strip should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide

sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone. Specific details regarding vegetated buffer strip design and construction within the Upper Spokane WA subbasin are provided by Spokane County et al. (2008).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness or cost of vegetated buffer strips was found during the project review. However, vegetated filter strips have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Grass filter strips have low phosphorus removal costs of $190 to $250 per pound (Sera-17, 2010).

USW-UR-4d Infiltration Areas

Stormwater runoff is directed to an infiltration area underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). The infiltration area can be equipped with a drainfield constructed of perforated pipe to facilitate infiltration. A suitable site requires soils with a sufficiently high permeability to allow for relatively rapid infiltration, but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Spokane County and the City of Spokane have recently constructed/enhanced a number of regional stormwater infiltration facilities for the purpose of managing stormwater runoff in areas with difficult infiltration conditions on a site-specific level. When these facilities are located over relatively thick glaciofluvial sand and gravel sequences, benefit of water quality treatment may be limited. Examples include: Hazel's Creek Drainage and Conservation Facility (City of Spokane), Browne's Mountain Regional Stormwater Facility (Spokane County), and Price and Wall Regional Stormwater Facility (Spokane County).

Potential Phosphorus Load Reduction: Infiltration basins have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999),
Range of Cost: Infiltration structures generally have high phosphorus removal costs of $2,500 to $3,000 per pound (Corrozi, 2009).

USW-UR-5 Evaluate Phosphorus Load from Septic Tanks within Spokane Valley and Other Densely Developed Areas

While there is historical literature that suggests septic systems and subsequent treatment in the unsaturated zone provides phosphorus removal from effluent, recent and emerging evidence indicates the contrary in many locations. Both the current science and measured groundwater concentrations of phosphorus clearly indicate that septic systems release significant phosphorus loads into underlying groundwater and that phosphorus loading can increase with time as a result

of the loading of sorption sites in the unsaturated zone. Moreover, the shallow hydrostratigraphy of many areas within the Upper Spokane WA subbasin consists of bedrock and/or coarse sediments, which have relatively little phosphorus removal capacity.

Removing septic systems and replacing with sewers involves considerable cost. Therefore, the reduction in phosphorus loading associated with septic tank removal within key densely developed areas should be conducted as a basis for future management decisions. Spokane County has initiated a Septic Tank Elimination Program (STEP) that has resulted in significant septic tank removal. Sewering of the STEP area is scheduled to be completed in 2012. However, there are still areas with dense distribution of septic tanks outside the STEP area within the Upper Spokane WA subbasin. The areas that should be considered include but are not limited to the following:

- A portion of Spokane Valley on both sides of Barker Road immediately north of the Spokane River.
- The Otis Orchards area, roughly bounded by Trent Avenue on the north, Barker Road on the west, the Spokane River on the south, and the state line on the east.
- The Glenrose Valley area immediately east of the City of Spokane and approximately bounded by the extensions of 18th Avenue on the north, Havana Street on the west, 57th Avenue on the south, and Thierman Street on the east.

Particular emphasis with regard to the analysis of the extent and mitigation of septic tank loading (Actions USW-UR-5 and USW-UR-6) could be considered within proximity (for example, within 1,000 feet) of gaining reaches of the Spokane River. Within gaining reaches, the Spokane River gains considerable flow from groundwater discharge from the SVRP Aquifer. The SVRP Aquifer and overlying sediments are extremely coarse-grained and, as a result, have relatively little phosphorus removal capacity. It can be inferred, therefore, that within these areas much of the phosphorus released from septic tanks impacts the Spokane River. Approximate locations of gaining reaches are presented by Hsieh et al. (2007) and GeoEngineers (2010a and 2010b).

Activity: Evaluate Phosphorus Load from Septic Tanks within Densely Developed Areas as a basis for future management decisions.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Spokane County or other municipalities.

USW-UR-6 Septic Tank Elimination within Spokane Valley and Other Areas

Removal of septic systems by connecting to sewer systems eliminates a source of pollution to surface and groundwater. Wastes are treated more thoroughly and phosphorus removal is more complete at a wastewater treatment facility designed for phosphorus removal than is possible with a septic system. For these reasons, septic tank elimination is an important long-term management approach to controlling nonpoint source phosphorus loading.

Septic tank elimination programs, beyond those accomplished through Spokane County's STEP, should be based on results of USW-UR-5, which will assist in identification of specific areas where infrastructure investment will lead to relatively large phosphorus loading reductions.

Activity: Remove septic systems and replace with sanitary sewer in key areas of the Upper Spokane WA subbasin.

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of septic tank elimination was found during planning. However, based on the phosphorus removal characteristics of area wastewater facilities and that septic tank discharges are completely eliminated during removal, the expected effectiveness is very high.

Range of Cost: No specific quantitative information regarding the cost of septic tank elimination was found during planning. Potential costs may range from low to high with respect to the other BMPs described in this plan.

Potential Timeline: TBD by Potential Lead

Potential Lead: **Spokane County**

USW-UR-7 Inspection and Pumping of Septic Systems within Key Areas

Regular inspection and pumping of septic systems prolongs the life of the system, reduces maintenance costs and contamination around the drain field, and slows the breakthrough of phosphorus to groundwater. The priority systems to target are older systems and systems near streams and areas with a high groundwater table. The septic tank should be pumped by a licensed septage waste-hauler on a regular basis and septage properly disposed of in an approved site or wastewater treatment facility.

Septic system inspection and pumping can be performed throughout the subbasin to achieve nonpoint source loading reduction to area surface water. However, it will have greatest positive impact within nearshore areas and with septic system overlying coarse soil and/or bedrock with minimal phosphorus treatment capacity. Areas to consider include:

- Overlying the SVRP Aquifer.
- Within aquifer zones defined as highly- or moderately-susceptible by Spokane County's CARA regulation.
- Within 1,000 feet of the Spokane River, Newman Lake, and/or Liberty Lake.

Activity: Require regular inspection and pumping of septic systems on a standard interval. The interval should vary as a function of septic tank size and persons per household to achieve acceptable retention times. Standard matrices are available for these requirements.
Potential Phosphorus Load Reduction: Inspection and pumping of septic systems has low to moderate phosphorus removal efficiencies of 40 to 55 percent (DDNR, 2010).
Range of Cost: Inspection and pumping of septic systems has very low phosphorus removal costs of $7 to $25 per pound (DDNR, 2010).
Potential Timeline: TBD by Potential Lead.

Potential Lead: Spokane County and/or Stevens County.

11.5.7 Supporting Phosphorus Reduction Activities

Supporting activities to be undertaken as part of this NPS Reduction Plan will provide valuable information for long-term success, in addition to the subbasin-specific actions and BMPs designed to provide direct phosphorus reduction. These activities are described in Chapter 9.

11.5.8 Additional Activities

Additional activities include indirect actions that either lead to overall improvements in ecological functions and thus water quality or provide additional insights into the overall health and conditions of the watershed. Activities are described in Chapter 9. Additional activities in the Upper Spokane River WA subbasin include the coordination of activities on Lake Spokane, nearshore, and upstream activities.

USW-AA-1 Recommended TMDLs and WQIP Actions

The TMDLs (Ecology, 2007 and Ecology, 2010) recognized that nonpoint source pollution contributes to the low oxygen condition of the Spokane River and Lake Spokane. Specific activities are identified that support overall watershed health and improvements in water quality. These actions align with the phosphorus nonpoint source reduction activities and are encouraged to be carried out.

Activity: Implement actions in the TMDLs and WQIPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-AA-2 Consider Phosphorus Free Fertilizer Ordinances

Municipalities across the U.S. have adopted phosphorus free fertilizer ordinances, such as a phosphate lawn fertilizer ban. Retailers and fertilizer producers have appropriate fertilizers products available that meet these ordinances. Some ordinances allow the use of fertilizer with phosphorus under specific circumstances such as if soil testing showing a phosphorus deficiency or for establishing new lawns or plants. A USGS study found that “runoff from lawn sites with non-phosphorus fertilizer applications had a median total phosphorus concentration that was similar to that of unfertilized sites, an indication that non-phosphorus fertilizer use may be an effective, low-cost practice for reducing phosphorus in runoff” (USGS, 2002). House Bill 1489 goes into effect January 2013 which restricts the sale and use of fertilizers containing phosphorus for turf lawns statewide. The bill allows fertilizers with phosphorus for new and damaged turf or when soil testing indicates a phosphorus deficiency.

Activity: Adopt ordinances that ban the use of fertilizer containing phosphorus.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-AA-3 Evaluate, Protect and Enhance Nearshore Areas

Nearshore land management and activities have the potential to impact phosphorus loads to surface water. Within the Upper Spokane River WA subbasin, these activities apply to areas nearshore to Liberty Lake, Newman Lake, and the Spokane River. Nearshore sources may transport phosphorus loads via surface water, stormwater runoff, interflow, and groundwater. Unlike activities and BMPs implemented upstream, there is no attenuation of phosphorus loads associated with nearshore sources. Therefore, reduction of loads from nearshore areas is important and should be considered as part of the overall nonpoint source phosphorus load reduction strategy. Nearshore areas should be inventoried to identify areas where BMPs should be implemented. BMPs that should be considered for nearshore areas include, but are not limited to:

- Erosion control and bank stabilization.
- Filter strips.
- Septic tank elimination.
- Inspection and pumping of septic systems.
- Phosphate lawn fertilizer ban.
- Riparian fencing, riparian zones and buffer strips.
- Education and outreach to nearshore property owners.

Additional detail regarding these BMPs is provided in Chapter 8.

Activity: Evaluate nearshore areas to Liberty Lake, Newman Lake, and the Spokane River and implement activities and BMPs to reduce nonpoint source phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-AA-4 Evaluate/Mitigate Source of Anomalous Phosphorus Concentrations in Groundwater

Anomalous concentrations of phosphorus have historically been observed in a monitoring well installed within the SVRP Aquifer and located near Plantes Ferry Park (south of the intersection of East River Drive and East Wellesley Street in Spokane County, Washington) and monitored by Spokane County personnel. Total phosphorus concentrations in this well can be 5 to 10 times higher than adjacent wells completed in a similar formation (though at different depth). This monitoring well is located within about a quarter mile of a gaining reach of the Spokane River that is estimated to receive an average loading from groundwater of about 86 pounds per day of total phosphorus (GeoEngineers, 2010a). Based on these considerations, a management action should be implemented that to identify the source(s) of phosphorus to the SVRP Aquifer in this location, estimate the associated impact to Spokane River water quality and evaluate the feasibility of BMPs to mitigate the source(s).

Activity: Evaluate anomalous concentrations of phosphorus in groundwater and evaluate management actions to reduce associated loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Spokane County.

11.5.9 Support Existing and Planned Activities

The NPS Reduction Plan supports existing water resources and water quality studies and planning. Protection of these resources also supports the reduction of phosphorus nonpoint sources. Critical planned activities specific to the NPS Reduction Plan are identified below.

USW-EP-1 Implement or Complement WRIA 57 Detailed Implementation Plan Recommendations to Reduce Nonpoint Source Phosphorus Loading

The WRIA 57 Middle Spokane Watershed Detailed Implementation Plan (WRIA 55/57 Watershed Implementation Team, 2008) notes increased nonpoint source pollution; growing demand for water due to increased development and population growth; declines in stream flows and groundwater levels; and the importance of interactions between the SVRP Aquifer and the Spokane River to maintain flows in the river.

The connection between land use, development and water conservation, reclamation and reuse was identified. Recommendations for water conservation, reclamation and reuse are provided that relate to nonpoint source phosphorus reduction (e.g., forest practices, agricultural practices, stormwater management, public and stakeholder education, landscaping practices and requirements, wetland restoration and creation, data collection and monitoring). Specific recommendations in the Detailed Implementation Plan that relate to or could complement efforts to reduce nonpoint source phosphorus loading should be reviewed and considered.

Activity: Implement or complement actions in the WRIA 57 Detailed Implementation Plan to achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-EP-2 Support and Supplement Avista Utilities WQAP Implementation

Avista Utilities is developing a WQAP to identify how they will mitigate for impacts to dissolved oxygen in Lake Spokane caused by the Long Lake Dam (Ecology, 2010). The WQAP should be completed in 2012. Avista's efforts to implement the plan elements should be supported. In addition, other organizations in the Upper Spokane River WA subbasin should look for ways to collaborate with and complement Avista's efforts to advance and expand success in reducing nonpoint source phosphorus loads.

Activity: Support and supplement Avista Utilities WQAP implementation to achieve nonpoint source phosphorus load reduction.

Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-EP-3 Support and Enforce Spokane County, City of Spokane, and City of Spokane Valley Shoreline Master Plans

Washington's Shoreline Management Act governs the use and development of Washington's shorelines and creates a unique partnership between local and state government. The Act strives to achieve responsible shoreline use and development, environmental protection, and public access. Local governments develop programs based on the Act and state guidance, and the state reviews local programs to consider statewide public interests, (Ecology, 2011b). Spokane, County, City of Spokane, and City of Spokane Valley, all have shoreline master plans that establish policies and regulations for shoreline use and modification activities. Each plan is unique and involves distinct requirements for different types of development, uses, activities, and distinct requirements for different water bodies; however, each plan has similar requirements relating to nonpoint source phosphorus reduction including:

- Setback requirements for structures and uses (ranging from 10 feet to 100 feet).
- Requirements for retaining and enhancing natural vegetation buffers and restoring shoreline functions.

Some of the plans include requirements that foster phosphorus load reduction, including specific requirements for on-site wastewater treatment systems.

Activity: Support and Enforce Spokane County, City of Spokane, and City of Spokane Valley Shoreline Master Plans to achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USW-EP-4 Support, Compliment and Enforce Permits, Ordinances, Plans and Activities Relating to Nonpoint Source Phosphorus Reduction

There are a variety of permits, ordinances, plans and activities within the Upper Spokane River WA subbasin that relate to nonpoint source phosphorus reduction, including:

- City of Spokane, City of Spokane Valley and Spokane County NPDES Phase II Stormwater Permit Requirements.
- 1992 Newman Lake Watershed Plan.
- 1993 Liberty Lake Total Phosphorus TMDL.
- 2009 Newman Lake Total Phosphorus TMDL: Water Quality Implementation Plan
- City and county critical area ordinances.

- Spokane Conservation District Natural Resource Conservation Plan.
- Spokane River Forum education efforts.

When taking actions and implementing BMPs to reduce nonpoint source phosphorus, consider these and other related plans, goals, requirements and efforts to optimize reduction potential. Review that erosion control BMPs are followed at land development projects and construction sites.

Activity: Support, compliment and enforce permits, ordinances, plans and activities to achieve nonpoint source phosphorus reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

Chapter 12

Little Spokane River Subbasin - Nonpoint Source Phosphorus Management Strategy and Actions

12.1 Introduction

An objective of this NPS Reduction Plan is to formulate nonpoint source control strategies that contribute to long-term reductions of phosphorus loads. It provides guidance on selecting 'what' strategies and actions to take and 'where' to apply them. Chapter 9 provides an introduction to the subbasin actions and strategies, background of the NPS Study objectives, how the subbasin chapters support the overall NPS Reduction Plan, and regional phosphorus control strategies that should be considered in all subbasins in the Spokane River Watershed.

This chapter identifies specific actions for entities located in the Little Spokane River subbasin and stakeholders supporting these entities to reduce nonpoint source phosphorus. Strategies, actions and areas to target within the subbasin are identified in this chapter. The guidance also identifies potential organization leads and potential timelines for initial and long-term reductions of nonpoint source phosphorus pollution.

The following sections of this chapter describe:

- The identification and relationship of entities and stakeholders in the watershed and associated acres of land ownership.
- An overview of reduction strategies, actions, and schedule for the subbasin.
- An overview of the nonpoint source reduction opportunities and guidance on 'what' BMPs to implement and 'where' to take these actions.
- The specific actions by category identified to be undertaken, including those identified by specific entities and stakeholders.

Estimates of the potential BMP phosphorus reductions and cost per pound are provided in Chapter 8. The overall phosphorus reduction potential is discussed in Chapter 9.

12.2 Entities and Stakeholders

As discussed in Chapter 9, accomplishing nonpoint source reductions will require engaging local, state, and federal agencies and land managers, as well as private land owners. The principal organizations involved with securing funding, identifying priority locations, selecting BMPs, and taking actions in the Little Spokane River subbasin include those shown in Table 12-1. These organizations are subdivided into entities and stakeholders as shown in Table 12-2, along with the area of land owned and miles of streams in the Little Spokane River subbasin. Land ownership for the subbasin is shown in Figure 12-1.

Table 12-1. Organizations and Nonpoint Source Phosphorus

Organization
Local Governments
Bonner, Pend Oreille, and Spokane Counties
Bonner County Soil and Water Conservation District
Pend Oreille County Conservation District
Spokane County Conservation District
Idaho Panhandle Health District 1
Spokane Regional Health District
Municipalities
Deer Park, Newport, Spokane
Utilities
Avista Utilities
Spokane County Utilities Division
Stevens Public Utility District
Approximately 15 municipal water service providers
State Agencies
Idaho Department of Environmental Quality
Idaho Department of Lands
Idaho Department of Parks and Recreation
Idaho Fish and Game
Idaho Forest Products Commission
Idaho Rangeland Resource Commission
Idaho Soil Conservation Commission & Idaho Soil and Water Conservation Commission
Idaho State Department of Agriculture
Idaho Transportation Department
Washington Department of Fish and Wildlife
Washington Forest Practices Board
Washington Land Use Study Commission
Washington State Conservation Commission
Washington State Department of Agriculture
Washington State Department of Ecology
Washington State Department of Natural Resources
Washington State Department of Transportation
Washington State Parks and Recreation Commission
Federal Agencies
U.S. Bureau of Land Management
U.S. Department of Agriculture – Natural Resource Conservation Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service

Table 12-2. Organizations and Land Area

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Private				
In Deer Park	4,390	Deer Park	Spokane County Conservation District	n/a
In Newport	571	Newport		
In Spokane	6,276	Spokane		
In Spokane County	249,693	Spokane County		1,068.3
In Bonner County	12,793	Bonner County	Bonner County Soil and Water Conservation District	21.0
In Pend Oreille County	105,379	Pend Oreille County	Pend Oreille County Conservation District	640.2
In Stevens County	58,591	Stevens County	Stevens County Conservation District	400.7
In Kaniksu National Forest	15,751	U.S. Forest Service	USDA – Natural Resource Conservation Service	161.4
Incorporated Municipalities[2]				
Deer Park	*4,390*	Washington Department of Ecology, U.S. Environmental Protection Agency	Washington State Department of Agriculture, Washington State Conservation Commission	9.5
Newport	*571*			1.4
Spokane	*6,277*			3.7
Local Governments[2]				
Bonner County	*15,816*	Idaho Department of Environmental Quality, U.S. Environmental Protection Agency, Idaho Fish and Game, U.S. Fish and Wildlife Service	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	24.3
Pend Oreille County	*112,762*	Washington Department of Ecology, U.S. Environmental Protection Agency, Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service	Washington State Department of Agriculture, Washington State Conservation Commission	673.3
Spokane County	*265,431*			1,174.3
Stevens County	*60,503*			411.7
State Agencies				
Idaho Department of Lands	1,825	Idaho Department of Environmental Quality, Idaho Fish and Game, U.S.	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health	3.2

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Idaho Transportation Department	48	Fish and Wildlife Service, U.S. Environmental Protection Agency	District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	n/a
Washington Department of Fish and Wildlife	2,950	Washington Department of Ecology, Forest Practices Board, Washington Department of Fish and Wildlife, U.S. Environmental Protection Agency	Washington State Department of Agriculture, Washington State Conservation Commission, Washington Land Use Study Commission	16.4
Washington State Department of Natural Resources	12,582			76.0
Washington State Department of Transportation	6,425			n/a
Washington State Parks and Recreation Commission	9,203			55.7
Federal Agencies				
U.S. Forest Service	1,488	U.S. Environmental Protection Agency	USDA – Natural Resource Conservation Service	2.0
Additional Land Areas				
Roads	2,185 miles		2,839 stream crossings	

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation, road miles include primary, secondary, local and forest service roads.

[2] Incorporated municipalities and local governments is total land area within boundaries, not land ownership.

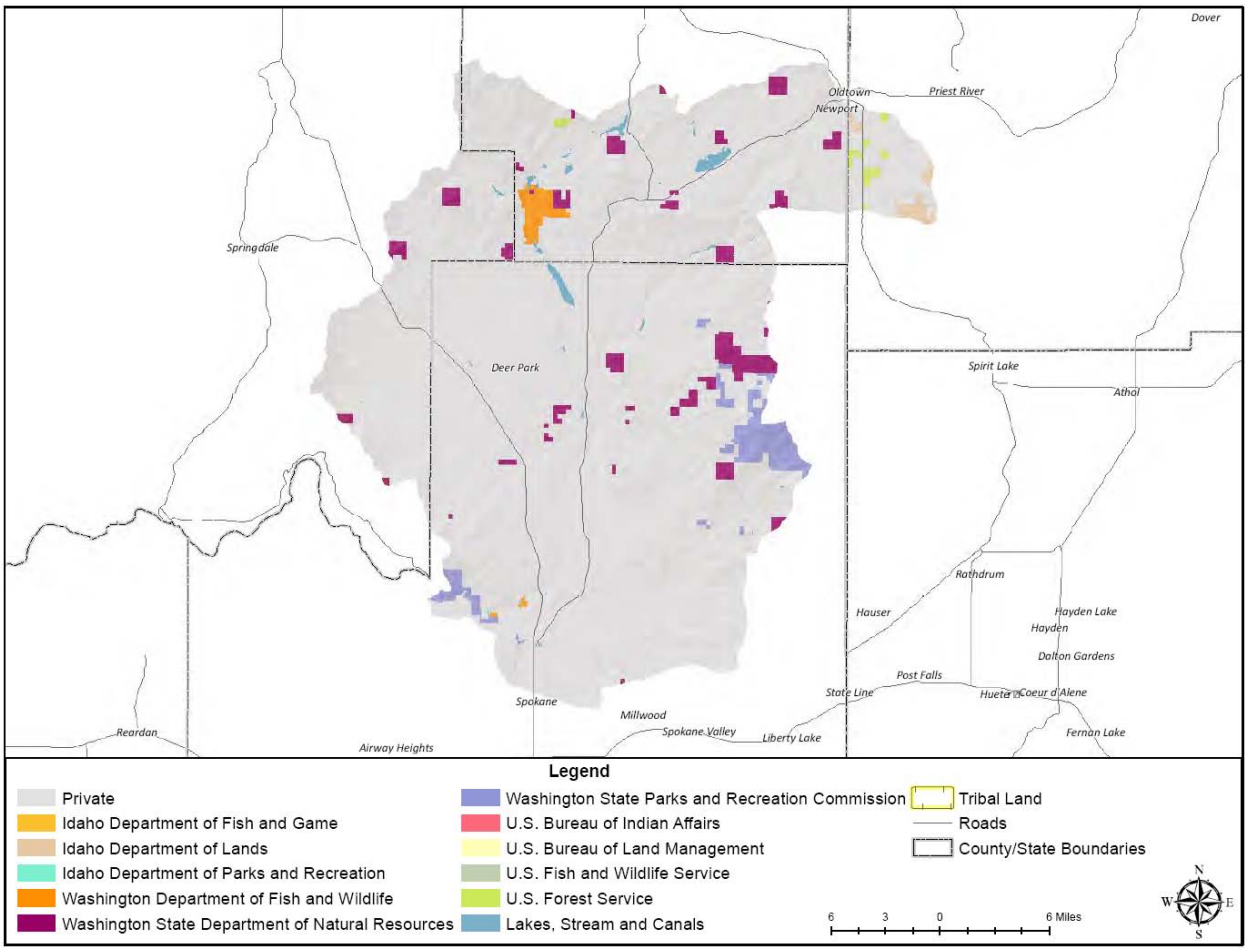

Figure 12-1. Little Spokane River Subbasin and Land Owners

12.3 Overview of Reduction Strategy, Actions, and Schedule

Identifying strategies for reducing nonpoint source phosphorus in the Little Spokane River subbasin is an important step to protect and restore water quality in Little Spokane River and the Spokane River. A successful strategy will also ultimately support improving dissolved oxygen concentrations in Lake Spokane. The extent of water quality improvements will depend on fate and transport processes which were not addressed in the NPS Study. Nonpoint source phosphorus reductions will have both local and watershed benefits.

12.3.1 Strategy

The strategy for addressing nonpoint sources of phosphorus includes taking actions throughout the subbasin. Nonpoint source reduction actions include addressing obvious problems and undertaking actions that can be readily completed. The strategy emphasizes reducing nonpoint source phosphorus from land uses that generate large phosphorus loads and cover large areas of the subbasin. A subbasin scale assessment of these land uses revealed that evergreen forest and shrub and brush rangeland are dominant throughout the subbasin (Chapter 3).

12.3.2 Actions

Actions are the measures or steps from planning through achievement of nonpoint source phosphorus reduction. Actions include sufficient description and specificity for a responsible party to decide to take the action. The actions also help the responsible party determine where, what, when, and how to achieve the potential suggested outcome.

BMPs are the core of the action; whereas, actions encompass the entire process from the identification of the area, selection and implementation of the BMP through post monitoring. BMPs for addressing nonpoint sources of phosphorus include structural (i.e., physical) and non-structural (i.e., educational) measures.

BMPs referenced in the actions in Section 12.5 were identified based on the dominant land uses and the associated loading potential of the land uses. BMP phosphorus percent reduction efficiency, costs, estimated longevity and implementation effectiveness were also key indicators for identifying high priority BMPs for the subbasin. See Chapter 8 Nonpoint Source Phosphorus Control Measures for information about BMPs and the prioritization process.

12.3.3 Schedule

The schedule for nonpoint source actions for this plan is based on meeting the schedule in the Spokane River DO TMDL (Ecology, 2010). The schedule targets expeditious management actions to reduce nonpoint source phosphorus over the next two decades. From the Spokane River DO TMDL approval (May 2010), progress will be evaluated every 5 years, with extensive assessments after 10 and 20 years. The results from the first 10 years will be used to guide actions during the second 10-year period. Actions initiated in the first 10 years and determined to be beneficial should be continued, including successful nonpoint source control.

12.3.4 Summary of Approach

A load allocation for the mouth of the Little Spokane River was assigned in the Spokane River DO TMDL (Ecology, 2010). A target reduction of 36 percent from March through October was determined as necessary to meet downstream targets (Ecology, 2010). Using an average efficiency of 54 percent for the priority BMPs (Chapter 8), 92 percent of the major land uses (evergreen forest and rangeland) would need BMPs applied to achieve the target. Based on the average cost for the priority BMPs of about $320/pound (Chapter 8), the total cost for the target reduction would be approximately $3,385,000. Achieving the target reduction over a 20-year period will require that approximately $169,000 is spent annually on BMPs in the subbasin.

12.4 Overview of Opportunities

Opportunities for organizations to undertake nonpoint source phosphorus reductions are available throughout the subbasin. This overview includes a description of what BMPs are the most relevant and where the BMPs should be implemented. Where the BMPs should be implemented is specific to land uses.

12.4.1 Control Measures and BMPs

BMPs specific to land use type and source are described in detail in Chapter 8. The background included in Chapter 8 narrowed the list of BMPs from 108 to 22 based on phosphorus percent reduction efficiency, cost, estimated longevity, and implementation effectiveness. This list of BMPs, if implemented for the appropriate land uses, could result in substantial net nonpoint source reduction of phosphorus.

There are several organizations throughout the Little Spokane River subbasin that can mitigate nonpoint source loads by incorporating BMPs. The agencies and organizations are encouraged to review the land and nonpoint phosphorus sources in their jurisdiction to further identify BMPs that are specific to their situation.

Organizations should examine areas within their influence to identify opportunities where these BMPs can be implemented to reduce nonpoint source phosphorus. These organizations should also examine their stormwater management practices and look for opportunities to implement BMPs since stormwater is a primary transport mechanism for nonpoint source phosphorus. Organizations identified in Tables 12-1 and 12-2 include private, municipal, state and federal entities. Associated opportunities for nonpoint source phosphorus reduction include:

- Private land owners may protect and restore riparian corridors; minimize stormwater runoff; and consider education, land evaluation, and/or aide available from the conservation organizations.
- Municipalities may install BMPs to treat and/or reduce stormwater discharge to water bodies; evaluate where stormwater is being discharged; and/or evaluate the pollutant loading by collecting samples for analysis.
- State and federal agencies should review activities occurring on the land, identify potential impacts, and implement applicable BMPs.
- Organizations should consider actions recommended in other plans that could be implemented in conjunction with NPS Reduction Plan actions and strategies, such as the:
    - WRIA 55/57 – Middle Spokane River/Little Spokane River Watershed Detailed Implementation Plan (WRIA 55/57 Watershed Implementation Team, 2008).
    - Avista Utilities WQAP which should be completed in 2012.
    - County Shoreline Master Plans (Spokane, Stevens, Pend Oreille, Bonner [ID]).
    - The Stormwater Management Manual for Eastern Washington (Ecology, 2004b).
    - The Spokane Regional Stormwater Manual (Spokane County et al. 2008).
    - Other plans and requirements associated with reducing phosphorus and sediment loads to the Little Spokane River subbasin.

12.4.2 Land Uses and Source Potential

The NPS Reduction Plan is meant to provide guidance on where to take action, as actions are voluntary and not mandatory. The NPS Study was conducted at the watershed and subbasin scales and is limited in its guidance to actions at those scales. Actions by organizations are

limited by their jurisdictions and authority. Organizations will need to examine local conditions to determine specifically where they choose to take action.

The NPS Reduction Plan analyses (Chapters 6 and 7) evaluated the dominant land uses and the phosphorus load potential for each subbasin. In some cases, the largest land use did not match the largest phosphorus load reduction potential. The following land uses have the highest priority for the Little Spokane River subbasin with respect to nonpoint source phosphorus loading:

- Evergreen Forest.
- Cropland and Pasture.

The analytical evaluation results indicated that two tributary areas of the subbasin have the highest nonpoint source phosphorus loading rates in the Little Spokane River subbasin (see Chapter 7). These two sub-subbasins are Deadman Creek (0.168 lbs/ac/yr) and Upper Dragoon Creek (0.128 lbs/ac/yr). These subareas should be considered as priority areas for action.

The Little Spokane River subbasin is dominated by evergreen forest land (57 percent). Shrub and Brush Rangeland, Herbaceous Rangeland, and Cropland and Pasture encompass 14, 11 and 9 percent of the subbasin, respectively. The land use with the greatest phosphorus removal potential in this subbasin is evergreen forest land followed by cropland and pasture. Organizations are encouraged to take action in these high priority land use areas. These particular land uses represent the priority areas where nonpoint source phosphorus reductions are necessary to achieve lower subbasin phosphorus loads.

Organizations should examine areas they own or are within their influence, and look for opportunities to reduce nonpoint source phosphorus from the prioritized land uses. Organizations should also examine areas within their jurisdiction that are obvious areas for nonpoint source reduction opportunities.

12.4.3 Summary of Reduction Opportunities

BMPs have been prioritized first by their ability to remove nonpoint source phosphorus loads and then by land use type. The acres of land use by organization were computed and are tabulated in Table 12-3. The acres in Table 12-3 demonstrate how the land uses are distributed among the land owners and where the opportunities for reductions may exist.

The export coefficients summarized in Chapter 7, along with the land uses and areas, can be used to estimate potential nonpoint source phosphorus loads by organization. There is an associated range of reduction opportunities based on the potential to reduce phosphorus loads. These opportunities are presented in Table 12-4 by assigning a load reduction potential that ranges from low to high. The range is based on total phosphorus load; therefore, higher potential may be due to a greater export coefficient, the total land area, or a combination of both. Table 12-4 is intended to provide further guidance for considering and selecting BMPs for implementation.

Figure 12-2 shows land ownership with stream segments highlighted in areas of high potential for nonpoint source phosphorus reduction based on the land use and export coefficients. Stream

segments are shown since the highest priority BMPs in this subbasin generally relate to stream or riparian corridors.

Table 12-3. Organizations Land Area by Land Use

Land Owners	Agriculture[1] (acres)	Forested[1] (acres)	Rangeland[1] (acres)	Urban / Suburban[1] (acres)	Other[1] (acres)
Private					
Private	44,131	233,221	111,550	30,218	7,585
Incorporated Municipalities[2]					
Deer Park	189	1,082	1,506	1,603	14
Newport	2	218	33	315	2
Spokane	202	217	643	5,219	0
Local Governments[2]					
Bonner County	121	13.132	2,143	401	16
Pend Oreille County	1,381	86,563	19,417	2,114	3,335
Spokane County	36,723	120,861	77,909	26,348	3,796
Stevens County	6,063	37,228	14,684	1,558	983
State Agencies					
Idaho Department of Lands	0	1,802	8	12	0
Washington Department of Fish and Wildlife	0	2,500	251	4	198
Washington State Department of Natural Resources	157	10,793	1,554	52	35
Washington State Parks and Recreation Commission	0	8,041	765	90	311
Federal Agencies					
U.S. Forest Service	0.02	1,419	24	46	0

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation.

[2] Incorporated municipalities and local governments is the total land area within boundaries.

Table 12-4. Organizations and Potential for Nonpoint Source Phosphorus Reduction

Land Owners	Agriculture[1]	Forested[1]	Rangeland1	Urban / Suburban[1]	Other[1]
Private					
Private	High	High	High	High	Moderate
Local Governments					
Deer Park	Moderate	Moderate	Moderate	High-Mod.	n/a
Newport	Low	Low-Mod.	Low	Low-Mod.	Low
Spokane	Moderate	Low-Mod.	Low-Mod.	High-Mod.	n/a
Local Governments					
Bonner County	Moderate	High-Mod.	Moderate	Moderate	Low
Pend Oreille County	High-Mod.	High	High-Mod.	High-Mod.	Low-Mod.
Spokane County	High	High	High	High	Moderate
Stevens County	High	High	High-Mod.	High-Mod.	Low-Mod.
State Agencies					
Idaho Department of Lands	n/a	High-Mod.	Low	Low	n/a
Washington Department of Fish and Wildlife	n/a	High-Mod.	Low-Mod.	Low	Low
Washington State Department of Natural Resources	Moderate	High-Mod.	Moderate	Low-Mod.	Low
Washington State Parks and Recreation Commission	n/a	High-Mod.	Low-Mod.	Low-Mod.	Low-Mod.
Federal Agencies					
U.S. Forest Service	Low	Moderate	Low	Low-Mod.	n/a

[1] NPS load potential based on area and export classified into five categories, low, low-moderate, moderate, high-moderate, and high.

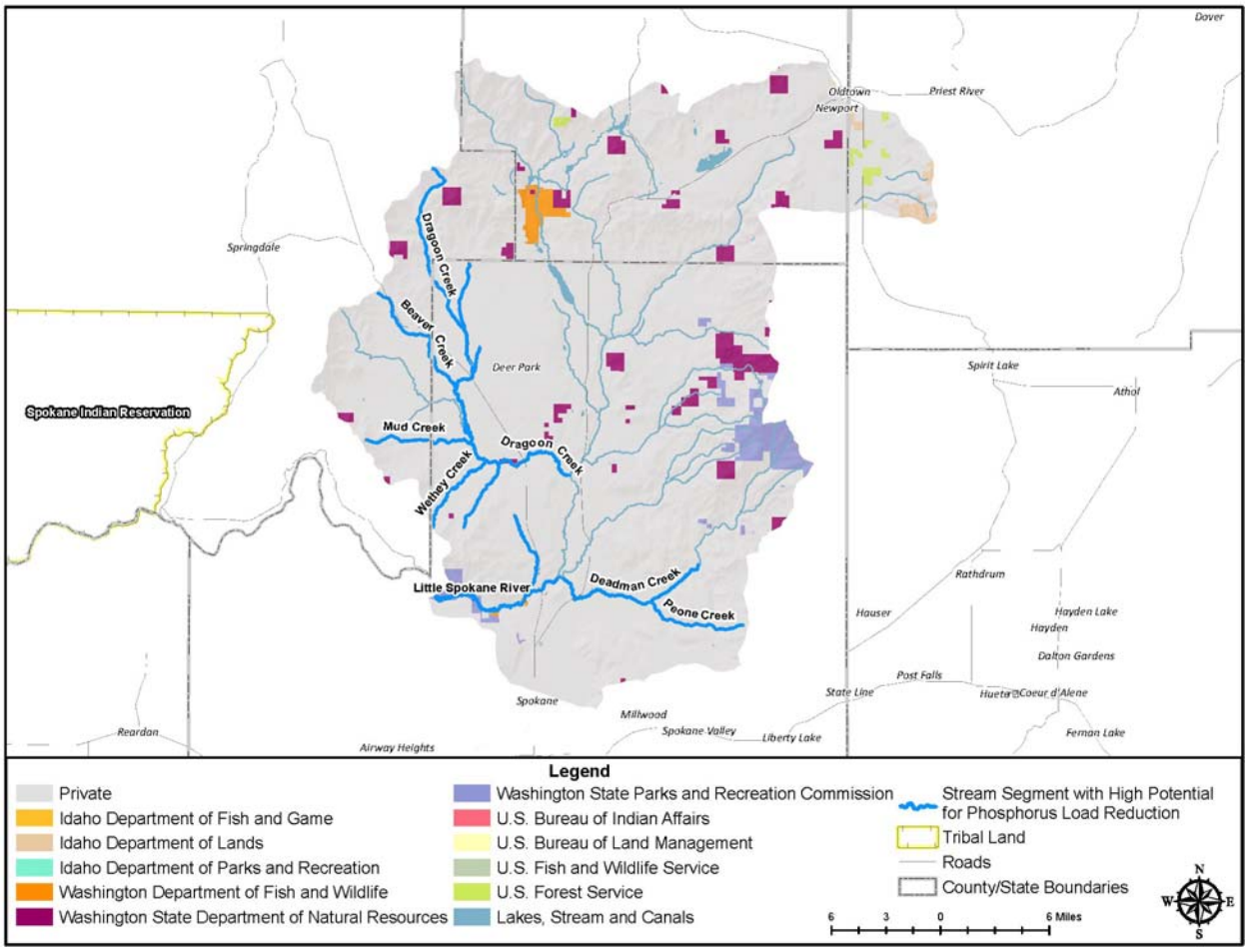

Figure 12-2. Little Spokane River Subbasin High Potential Reduction Opportunities

12.5 Specific Actions by Category

This section includes a list of specific actions to reduce nonpoint source phosphorus loads and ultimately contribute to meeting water quality standards. A general description of each action, an activity summary, potential phosphorus load reduction, range of costs, potential timeline and potential lead entity are provided for each action. Although it was not a primary objective of the NPS Study to specify "who" implements phosphorus control measures, potential lead organizations are identified for some actions to help provide linkage to the "what" and "where" objectives of the NPS Study. The lead organization will need to assist local entities in developing detailed plans for the activities, as well as a schedule and plan for monitoring progress. When the information was available, the action also includes a description of the roles of the organization with responsibility to improve water quality, and the means through which the organization will address the water quality issues.

The Little Spokane River subbasin contains varied land uses and because of this, varied opportunities exist for nonpoint source phosphorus reduction. However, the Little Spokane River subbasin is predominantly evergreen forest (57 percent); therefore, implementation of forestry-related BMPs and actions will be critical in this subbasin.

12.5.1 High Priority BMPs

The analysis provided in Chapter 8 described the following BMPs as having the highest priority for the Little Spokane River subbasin:

- Streamside Management Zones
- Riparian Zones and Buffer Strips
- Stream Bank Stabilization
- Vegetated Buffer/Filter Strips

Specific details regarding implementation of these high priority BMPs are provided in Chapter 9. These BMPs are appropriate for implementation for land uses in the subbasin. The following sections summarize actions appropriate for the specific land uses within the Little Spokane River subbasin.

12.5.2 Regional Phosphorus Management

Regional phosphorus control strategies are not specific to any one land use type or organization, and may contribute to the reduction of nonpoint source phosphorus loadings in the subbasin. Descriptions of the regional or watershed-scale phosphorus management actions intended to facilitate load reductions and/or establish the technical foundation for further phosphorus control activities are described in Chapter 9. Small and hobby farms are common in the Little Spokane River subbasin, therefore additional targeted educational outreach to this group is recommended.

LSR-RM-1 Public Education and Outreach Programs to Small and Hobby Farms

A comprehensive public education and outreach program to this group would help achieve nonpoint source phosphorus reduction. The abundance of hobby farms, rural residences, and livestock operations in the Little Spokane River subbasin are believed to be the major inputs of total phosphorus to the system (Ross, 2005). Awareness of the impacts of these practices and the availability of educational materials is an important message to convey to these land owners. Materials are readily available from entities like the county and conservation districts such as Living on the Land: Stewardship for Small Acreages (UNR, 2008) and Manure Management for Small and Hobby Farms (NERC, 2008). Simple and low cost BMPs can benefit water quality including erosion control, manure management, fertilizer management, and protection of riparian zones and establishing buffer strips.

Activity: Develop outreach programs to educate, promote, and adopt BMPs for small and hobby farms.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

12.5.3 Agriculture Related Activities

BMPs related to agricultural practices can have substantial impacts on nonpoint source phosphorus loading since agricultural land uses tend to be phosphorus intensive. Crop and

pasture land uses, rangeland, and livestock grazing practices are the drivers for BMPs under this category. Cropland and pasture comprises the majority of the agricultural land in the Little Spokane River subbasin.

LSR-AR-1 Fertilizer Application Location and Timing

Managing the location and timing of fertilizer application can minimize the loss of phosphorus from the field and maximize plant uptake. Assistance may be obtained from the Bonner, Pend Oreille, Spokane or Stevens County extension offices or Pend Oreille, Spokane or Stevens county conservation districts or Bonner Soil and Water Conservation District. These agencies could also provide free seminars and literature about implementing such BMPs, including conservation tillage/no-till/direct drill seeding.

Optimizing fertilizer application and timing can be achieved through the following actions:

- Incorporate or inject fertilizers with phosphorus below the soil surface to reduce the total and soluble phosphorus losses (Fawecett, unknown). "Subsurface injection of fertilizer, as compared to surface application, reduced losses by 39 percent for no-till and by 35 percent for conventional tillage" (Mostaghimi, et al., 1988).
- Establish fertilizer management areas and apply at agronomic rates for those areas with phosphorus deficits, see LSR-AR-2 (Waskom and Bauder, unknown). "Maintain a buffer strip (where fertilizer and manure is not applied) a safe distance from surface water and drainage channels" (Waskom and Bauder, unknown). BMPs that buffer riparian zones were rated as high priority (Chapters 7 and 8).
- Avoid fertilizer and manure application to frozen and wet soils (Fawecett, unknown). For example, the earliest and latest spring freeze dates are May 4th and July 29th in Deer Park and April 18th and July 30th in Newport, respectively (WRCC, 2011).

Activity: Provide support to growers with information on fertilizer management.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LSR-AR-2 Fertilizer Application Rates

Sample the tillage layer of soil in each field on a regular basis and have soil analyzed to determine available soil phosphorus levels prior to applying fertilizers with phosphorus. Use crop and soil guides to determine agronomic application rates such as the University of Idaho Northern Idaho Fertilizer Guide or Washington State University Fertilizer Guides and Summary. The most common crops in this subbasin are spring wheat, winter wheat, alfalfa, and pasture grass and hay. Wheat has a relatively low demand for phosphorus. Alfalfa may need phosphorus fertilizer incorporated into the soil for seedlings. Pastures and established alfalfa may need phosphorus fertilizer every 2 to 3years and should be done in the fall, as fertilization is less effective in the spring and winter when it is more susceptible to runoff.

Activity: Provide support to growers about soil phosphorus testing and fertilizer application rates.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LSR-AR-3 Runoff Management and Treatment

Manage runoff, from stormwater and irrigation if irrigating, to minimize runoff and treat runoff before entering waterbodies. Employ contouring or other techniques to reduce runoff potential. Maintain grass filter strips on the downhill perimeter of erosive crop fields to catch and filter phosphorus in runoff. These types of BMPs were rated as high priority (Chapters 7 and 8). Manage irrigation water to minimize runoff and erosion with irrigation BMPs or NRCS irrigation water management practices.

Slope is one factor that affects runoff. In this subbasin, the percentage of agricultural land use by slope classes are generally 62 percent has 0 to 5 percent slope; 17 percent 5 to 10 percent slope; 16 percent 10 to 15 percent slope; 3 percent 15 to 20 percent slope; and 2 percent greater than 20 percent slope. These slopes in combination with the soil types and other factors result in 33 percent of agricultural land use in the subbasin having a capability description of "severe limitations that reduce the choice of plants or require special conservation practices, or both" and 33 percent as "very severe limitations that restrict the choice of plants, require very careful management, or both". This matches with implementing the recommended BMPs for managing and treating runoff. About 89 percent of the agricultural land use in the subbasin is rated as "good" relative to herbaceous habitat for wildlife such as in buffer zones.

Activity: Provide support to growers about runoff management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LSR-AR-4 Crop Management

Crop management is related to many agricultural BMPs, including tillage type (conservation tillage/no-till/direct drill seeding), contouring (contour plowing and terracing and contour strip crop), crop rotation and erosion management (see Chapter 8). Crop management is related to the typical crops grown in the subbasin. Crops grown in the subbasin include: alfalfa, barley, canola, corn, dry beans, lentils, mustard, oats, pasture grass, pasture hay, peas, potatoes, grass seed, speltz, sweet corn, triticale, and spring and winter wheat. This action includes supporting economic crop management practices that also provide environmental benefits. This may require transformation in agency policies, new legislation, or other adjustments from historical practices that result in economic disincentives for implementing actions.

Activity: Provide support to growers about crop management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.

Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LSR-AR-5 Animal Management

Animal management is related to many agricultural BMPs, including water supply, riparian zone exclusion, and feed, grazing and waste management (see Chapter 8). For example riparian fencing of stream corridors limits livestock access to streams and ultimately protects water quality. Animal management is related to the head of animals raised in the subbasin. However, operations with large numbers of animals including cattle, dairy cows, turkeys, broilers and laying hens may fall under confined animal feeding operation requirements instead. Smaller operations can also result in intense pressure on the land such as disturbance to drainages and stream banks, soil erosion, and animal wastes. Recommended priority BMPs such as buffers, riparian zones and stream bank stabilization are beneficial to reducing or eliminating these pressures.

Activity: Provide support to producers about animal management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

12.5.4 Forestry Related Activities

BMPs related to forestry practices can reduce nonpoint source phosphorus. While phosphorus export from forestry in general is low, local areas of intensive use can have higher phosphorus export rates. Since a large percentage of the Spokane River Watershed is forested, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing erosion, reducing sediment transport, and protecting and maintaining riparian corridors and streamside management zones.

The Little Spokane River subbasin is approximately 57 percent forested land; therefore, forestry-related phosphorus-control strategies should be a high priority. The following sections provide brief descriptions of potential forestry-related phosphorus management actions.

LSR-FR-1 Evaluate Forestry Practices

Washington's forest practices regulations include the Forest Practices Act as administered by the Department of Natural Resources. These regulations will be used as the basis for nonpoint source phosphorus load reduction from private and state forestlands. Ongoing practices should be reviewed by or as directed by the lead organization for compliance. If compliance with the existing regulations is not resulting in sufficient reduction, then more effective methods need to be promoted. Poorly performing practices need to be researched for the causes and potentially modified to improve the outcomes. Timber harvest planning should be done such that organizing, scheduling, and planning harvests to minimize nonpoint sources of pollution is achieved. The protection of stream crossings is another important BMP.

Small scale harvest operations can impact nonpoint source phosphorus loads. The Small Forest Landowners Office of the Department of Natural Resources provides assistance to promote economic and ecological viability of small forest landowners. Both economic benefit and environmental protection can be achieved using alternative management and harvest plans (WDNR, 2006 and Oneil, 2003). In addition, Spokane County implements the Washington State Forest Practices Act (76.09 RCW) and within Spokane County, the authority to engage in logging operations or other types of forest practices may be granted from either the Washington State Department of Natural Resources (DNR) or from Spokane County Department of Building and Planning, depending upon the activity and its location. DNR's Forest Practice Permits and Spokane County's Timber Harvest Permits identify and mitigate, minimize or eliminate potential impacts from timber harvest on drainage courses and critical areas (Spokane County, unknown). All small scale logging should acquire and comply with these permits to reduce nonpoint source phosphorus loading.

With large quantities of adjacent forested land, tributary water quality is likely affected by forest management practices. Logging and road building practices that have been common throughout the intermountain region from the late nineteenth century through most of the twentieth century have likely contributed to the degradation of water quality. In more recent times, implementation of more environmentally sound forest management practices has occurred.

The agencies have data on forest health, ecology, harvest areas, vegetation types, soil conditions and more. This information can be useful for identifying areas of greater nonpoint source phosphorus loading. However, much of this data is not readily available or in a format that can be interpreted by water quality managers. Coordination between forest and water quality managers is necessary to understand the data and select management activities.

Activity: Enforce existing regulations, evaluate existing practices, discourage poorly performing practices, and encourage best performing practices and improve coordination of sharing information.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LSR-FR-2 Quantify Sediment-Phosphorus Relationship in Forested Areas

Quantifying phosphorus loading associated with forest management practices may provide additional information that support selection of successful BMPs. The construction and use of roadways represent a major source of sediment from timber harvest activities (DEQ, 2000). A study to quantify the relationship between sediment associated with phosphorus in runoff from these roads can help determine whether additional measures should be undertaken.

Activity: Quantify relationship between sediment and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LSR-FR-3 Subbasin Scale Road Planning and Rehabilitation

A subbasin-scale management survey should be completed to document ownership and identify and prioritize the total miles of erodible roads and road banks. The development of specific BMPs can be completed based on survey results to reduce miles of erodible roads associated with road construction, road conversions, and maintenance. The inventoried roads should be included in a database that tracks BMP implementation. This database and tracking is essential for determining BMP implementation success and accountability. Reduction plans should identify opportunities to abandon non-essential roads or restore roads on non-industrial forest lands and other county roads that contribute obvious erosion problems.

Activity: Quantify relationship between roads and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LSR-FR-4 Commercial Forest Management

Commercial timber land in the State of Washington must implement a minimum level of BMPs under the Forest Practices Act (RCW Chapter 76.09) which is administered by the Washington State Department of Natural Resources. There are road maintenance and abandonment plans required in the current rules that should reduce phosphorus loads in forested areas.

Activity: Enforce BMP requirements in timber lands.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Commercial timber land management.

LSR-FR-5 Washington Road Surface Erosion Model

The Cooperative Monitoring, Evaluation, and Research Committee of the Washington Forest Practices Board, has developed a tool that can be used by entities to calculate the average annual road surface erosion and sediment delivery to channels (DNR, 2011). This tool can be used for a single road up to all roads in a watershed. The model can be used for screening, planning-level assessment, a detailed assessment and scenario playing, or site/segment level monitoring.

Activity: Support assessment of phosphorus loads from timber lands.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Commercial timber land management.

LSR-FR-6 Fire Rehabilitation Areas

Wild fires can significantly impact the landscape. Research has shown increased concentrations of suspended sediments, phosphorus, and potassium in streams below burned areas (Stednick, et al., 1982). Stream monitoring indicated an immediate flush of phosphorus in the runoff,

followed by a slower release. Rehabilitation of burn areas, especially the riparian corridors to protect streams, will be important to reducing nonpoint source phosphorus in forested areas. The fire history from 2001 through 2010 suggests approximately 200 acres in the subbasin to have been burned and should be evaluated.

Activity: Identify and assist with rehabilitation of burned areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

12.5.5 Range Related Activities

BMPs related to rangeland practices can reduce nonpoint source phosphorus. Since range, shrub and brush land is the second largest percentage of land uses in the Little Spokane River subbasin, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing disturbance of range land, protecting and maintaining riparian zones and maintaining or stabilizing stream banks.

LSR-RR-1 Evaluate Rangeland Practices

The state's regulations will be relied upon to reduce nonpoint source phosphorus loads from rangelands. Evaluate past and present impacts and review ongoing practices for compliance. The goal of evaluating past and present activities is to manage rangeland to maintain optimum soil and water quality. If compliance with the existing regulations is not resulting in sufficient nonpoint source phosphorus reduction, then more effective methods should be identified and promoted.

Activity: Evaluate existing practices, enforce existing regulations, and encourage BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

12.5.6 Urban/Suburban Related Activities

Urban/suburban land use is relatively minor within the Little Spokane River subbasin, and primarily centered around the north portion of the City of Spokane and the City of Deer Park. Urban, other urban and residential land uses account for about 3, 2, and 1 percent of the subbasin, respectively. Nevertheless, urban/suburban areas can have the most variable impacts on nonpoint source phosphorus loading due to the diversity of development, uses, and control of stormwater runoff. BMPs under this category are typically associated with minimization of pollution sources and the management of stormwater.

LSR-UR-1 Business Practices to Prevent Stormwater Pollution

The Urban Waters Initiative managed by Ecology and Spokane Regional Health District has developed several practices to be implemented by local businesses to prevent stormwater pollution (Ecology, 2009c). These practices include eliminating wash water from storm drains,

disposing of wastes properly, and regularly maintaining grease traps, oil-water separators, and catch basins. Because these activities are performed throughout a city, one of the local municipalities could be the lead for this effort.

Activity: Review existing practices, encourage BMP implementation, provide adequate resources and information to businesses.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LSR-UR-2 Evaluate and Analyze Impervious Surfaces and Implement Stormwater BMPs

Impervious surfaces throughout the Little Spokane River subbasin are a source of substantial stormwater runoff. In the Little Spokane River subbasin, stormwater runoff enters both surface water and groundwater via infiltration. An understanding of the area and location of the impervious surfaces in the subbasin will guide the need and responsibility for implementation.

Activity: Evaluate and quantify existing impervious surfaces, identify areas where vegetated buffer/filter strips or other applicable stormwater BMPs (see Chapter 8) could be installed, and encourage installation.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LSR-UR-3 Evaluate and Revise Stormwater Policies

Approximately 2 percent of the subbasin is within municipal boundaries. Review the stormwater regulations of municipalities, potentially including subbasin or watershed summit, for water quality requirements. Municipalities have unique policies; however, working towards incorporating at least some minimum water quality requirements that address nonpoint source pollution including phosphorus across the watershed will provide some reduction in loads.

Activity: Coordinate on minimum water quality stormwater treatment policies.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LSR-UR-4 Strengthen Requirements for Stormwater Treatment BMPs in Key Areas

Stormwater treatment BMPs, such as bio-infiltration swales, bio-infiltration channels, vegetated buffer strips and infiltration basins are important within the Little Spokane River subbasin because: 1) near-river development frequently occurs above coarse-grained soils with limited treatment capacity and in close proximity to the Little Spokane River; 2) the southwestern portion of the subbasin directly overlies the sole-source SVRP Aquifer and is defined as an Aquifer Sensitive Area; 3) much of the Route 395 corridor and area underlain by the SVRP

Aquifer are within high susceptibility Critical Aquifer Recharge Area (CARA) boundaries; and 4) some of the southern portion of the subbasin is characterized by urbanized and industrial land uses.

Under ASA regulations, any project within the City of Spokane is required to provide treatment for all stormwater runoff from pollution generating impervious surfaces and bio-infiltration swales are the expected BMP for providing basic treatment (Spokane County et al. 2008). Per CARA regulations, Spokane County requires that special consideration be given to stormwater runoff associated with commercial and industrial development such as outdoor loading docks, fueling stations, and those activities involving toxic and hazardous materials handling. More stringent requirements could be considered for implementation of BMPs intended to reduce industrial discharges of phosphorus. This could include installation of sand filters at or near stormwater discharges, installation of catch basin filtration systems, installation of flocculation systems, and/or multi-chambered treatment trains (DEQ, 2001).

The Spokane Regional Stormwater Manual (Spokane County et al. 2008) presents bio-infiltration swales, bio-infiltration channels, and vegetated buffer strips as stormwater treatment design alternatives. The regulatory threshold for requiring varies by jurisdiction. In Spokane County, the threshold is defined as "the addition or replacement of 5,000 square feet or more of impervious surfaces or the disturbance of 1acre or more." In the City of Spokane, the threshold is defined as "the addition or replacement of any impervious surfaces." Various exemptions, such as an exemption for redeveloped sites, are listed in the manual.

The Washington Department of Ecology Stormwater Management Manual for Eastern Washington (Ecology, 2004b) provides guidance regarding implementation of stormwater BMPs. This manual lists infiltration ponds, infiltration trenches, infiltration swales, bio-infiltration swales, and vegetated filter strips as stormwater treatment BMP options.

Implementation of this action would strengthen requirements regarding implementation of the stormwater treatment BMPs listed in this section. These requirements could include developed and redeveloped commercial, industrial and residential properties within the following key areas:

- Overlying the SVRP Aquifer.
- Within aquifer zones defined as highly- or moderately-susceptible by Spokane County's CARA regulation.
- Within 1,000 feet of the Little Spokane River.

Particular emphasis with regard to the mitigation of phosphorus loading to groundwater from stormwater could be considered within proximity (for example, within 1,000 feet) of gaining reaches of the Little Spokane River. Within gaining reaches, the Little Spokane River gains considerable flow from groundwater discharge from the SVRP Aquifer. The SVRP Aquifer and overlying sediments are extremely coarse-grained and, as a result, have relatively little phosphorus removal capacity. It can be inferred, therefore, that within these areas much of the phosphorus dissolved within infiltrating stormwater impacts the Spokane River. Approximate locations of gaining reaches are presented by Hsieh et al. (2007) and GeoEngineers (2010a and

2010b). BMPs are also described below in the subactivities 'Install BMP' (see LWS-UR-4a through 4d).

Activity: Implement rigorous stormwater BMP requirements in key portions of subbasin.
Potential Phosphorus Load Reduction: Varies depending on BMP – refer to LSR-UR-4a through LSR-UR-4d.
Range of Cost: Varies depending on BMP – refer to LSR-UR-4a through LSR-UR-4d.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Spokane County, Stevens County, and/or City of Spokane.

LSR-UR-4a Install Grassed Bio-Infiltration Swales

The Spokane Regional Stormwater Manual (Spokane County et al. 2008) specifies an achievement goal of 50 percent total phosphorus removal for a range of influent concentrations from 0.1 to 0.5 μg/l of total phosphorus. Bio-infiltration swales (also locally termed grassed percolation areas or "208" swales) are the only BMP presented in the manual that are assumed to meet this removal goal for phosphorus.

To implement this BMP, stormwater runoff is directed to a grassed swale where vegetative cover provides pretreatment of stormwater before infiltration to the subsurface. Infiltration occurs either through the swale or within drywells that receive stormwater once the swale is filled to a design overflow elevation. The area surrounding the drywell and underlying the swale should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone.

Specific details regarding bio-infiltration channel design and construction within the Little Spokane River subbasin are provided by Spokane County et al. (2008).

Potential Phosphorus Load Reduction: Grassed swales have a wide range of potential phosphorus removal efficiencies from 20 to 61 percent (Miller, 1987) to 29 to 99 percent (Yu et al., 2001).
Range of Cost: No specific quantitative information regarding the cost of grassed bio-infiltration swales was found during the project review. However, based on BMP characteristics, costs are expected to be moderate to high with respect to the other BMPs described in this plan.

LSR-UR-4b Install Bio-Infiltration Channels

To implement this stormwater treatment BMP, stormwater runoff is directed to a bio-infiltration channel underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). A bio-infiltration channel is a sloped, vegetated channel or ditch that both conveys and treats stormwater runoff. It does not provide flow control but can

convey runoff to facilities designed for that purpose (Spokane County et al. 2008). A bio-infiltration channel provides treatment as stormwater flows through vegetative cover and/or infiltrates. Channel flow can be directed to a pond or other facility. Infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Specific details regarding bio-infiltration channel and construction within the Little Spokane River subbasin are provided by Spokane County et al. (2008).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of bio-infiltration channels was found during planning. However, infiltration trenches and basins have a wide range of potential phosphorus removal efficiencies of 10 to 80 percent (EPA, 1999).
Range of Cost: No specific quantitative information regarding the cost of bio-infiltration channels was found during planning.

LSR-UR-4c Install Vegetated Buffer Strips

Stormwater runoff is directed via sheet flow to a vegetated buffer strip situated adjacent to a rural roadway or parking lot. Vegetative cover within the buffer strip provides pretreatment of stormwater before infiltration to the subsurface, and/or evaporation. Vegetated buffer strips are used to intercept overland sheet flow runoff from adjacent impervious areas. They slow runoff velocities, filter out sediment and other pollutants, and provide infiltration into underlying soils.

When buffer strips are used for infiltration, the area underlying the buffer strip should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone. Specific details regarding vegetated buffer strip design and construction within the Little Spokane River subbasin are provided by Spokane County et al. (2008).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness or cost of vegetated buffer strips was found during the project review. However, vegetated filter strips have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Grass filter strips have low phosphorus removal costs of $190 to $250 per pound (Sera-17, 2010).

LSR-UR-4d Infiltration Areas

Stormwater runoff is directed to an infiltration area underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). The infiltration

area can be equipped with a drainfield constructed of perforated pipe to facilitate infiltration. A suitable site requires soils with a sufficiently high permeability to allow for relatively rapid infiltration, but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Spokane County and the City of Spokane have recently constructed/enhanced a number of regional stormwater infiltration facilities for the purpose of managing stormwater runoff in areas with difficult infiltration conditions on a site-specific level. When these facilities are located over relatively thick glaciofluvial sand and gravel sequences, benefit of water quality treatment may be limited. Examples include: Hazel's Creek Drainage and Conservation Facility (City of Spokane), Browne's Mountain Regional Stormwater Facility (Spokane County), and Price and Wall Regional Stormwater Facility (Spokane County).

Potential Phosphorus Load Reduction: Infiltration basins have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Infiltration structures generally have high phosphorus removal costs of $2,500 to $3,000 per pound (Corrozi, 2009).

LSR-UR-5 Evaluate Phosphorus Load from Septic Tanks within Mead and Other Densely Developed Areas

While there is historical literature that suggests septic systems and subsequent treatment in the unsaturated zone provides phosphorus removal from effluent, recent and emerging evidence indicates the contrary in many locations. Both the current science and measured groundwater concentrations of phosphorus clearly indicate that septic systems release significant phosphorus loads into underlying groundwater and that phosphorus loading can increase with time as a result of the loading of sorption sites in the unsaturated zone. Moreover, the shallow hydrostratigraphy of many areas within the Little Spokane River subbasin consists of bedrock and/or coarse sediments, which have relatively little phosphorus removal capacity.

Removing septic systems and replacing with sewers involves considerable cost. Therefore, the reduction in phosphorus loading associated with septic tank removal within key densely developed areas should be conducted as a basis for future management decisions. Spokane County has initiated a Septic Tank Elimination Program (STEP) that has resulted in significant septic tank removal. Sewering of the STEP area is scheduled to be completed in 2012. Within the Little Spokane River subbasin, sewered areas parallel the Route 395 corridor extending as far north as about West Monroe Road. However, there are still areas with relatively dense distribution of septic tanks outside the STEP area within the Little Spokane River subbasin. The areas that should be considered include but are not limited to the following:

- The community of Mead, roughly bounded by E. Center Road on the north, the North Spokane Freeway Corridor on the west, E. Stoneman Road on the south, and N. Fairview Road on the east.

- A portion of Spokane County north of Mead and roughly bounded by E. Greenbluff Road on the north, Route 2 on the west, Mt, Spokane Park Drive on the south and E. Lowe Road on the east.
- A portion of Spokane County immediately north and east of the City of Spokane service area and roughly bounded by E. Magnesium Road on the north, N. Crestline Street on the west, , E. Francis Avenue on the south and N. Freya Street on the east.
- The community of Chattaroy, roughly bounded by E. Buck Brush Avenue on the north, N. Regal Road on the west, N. Crescent Road on the south, and the Little Spokane River on the east.

Particular emphasis with regard to the analysis of the extent and mitigation of septic tank loading (Actions LSR-UR-5 and LSR -UR-6) could be considered within proximity (for example, within 1,000 feet) of gaining reaches of the Little Spokane River. Within gaining reaches, the Little Spokane River gains considerable flow from groundwater discharge from the SVRP Aquifer and other unconsolidated aquifers. The SVRP Aquifer and overlying sediments are extremely coarse-grained and, as a result, have relatively little phosphorus removal capacity. It can be inferred, therefore, that within these areas much of the phosphorus released from septic tanks impacts the Little Spokane River. Approximate locations of gaining reaches are presented by Hsieh et al. (2007) and GeoEngineers (2010a and 2010b).

Activity: Evaluate Phosphorus Load from Septic Tanks within Densely Developed Areas as a basis for future management decisions.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Spokane County or other municipalities.

LSR-UR-6 Septic Tank Elimination within Key Areas

Removal of septic systems by connecting to sewer systems eliminates a source of pollution to surface and groundwater. Wastes are treated more thoroughly and phosphorus removal is more complete at a wastewater treatment facility designed for phosphorus removal than is possible with a septic system. For these reasons, septic tank elimination is an important long-term management approach to controlling nonpoint source phosphorus loading.

Septic tank elimination programs, beyond those accomplished through Spokane County's STEP, should be based on results of LSR-UR-5, which will assist in identification of specific areas where infrastructure investment will lead to relatively large phosphorus loading reductions.

Activity: Remove septic systems and replace with sanitary sewer in key areas of the Little Spokane River subbasin.
Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of septic tank elimination was found during planning. However, based on the phosphorus removal characteristics of area wastewater facilities and that septic tank discharges are completely eliminated during removal, the expected effectiveness is very high.

Range of Cost: No specific quantitative information regarding the cost of septic tank elimination was found during planning. Potential costs may range from low to high with respect to the other BMPs described in this plan.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Spokane County.

LSR-UR-7 Inspection and Pumping of Septic Systems within Key Areas

Regular inspection and pumping of septic systems prolongs the life of the system, reduces maintenance costs and contamination around the drain field, and slows the breakthrough of phosphorus to groundwater. The priority systems to target are older systems and systems near streams and areas with a high groundwater table. The septic tank should be pumped by a licensed septage waste-hauler on a regular basis and septage properly disposed of in an approved site or wastewater treatment facility.

Septic system inspection and pumping can be performed throughout the subbasin to achieve nonpoint source loading reduction to area surface water. However, it will have greatest positive impact within nearshore areas and with septic system overlying coarse soil and/or bedrock with minimal phosphorus treatment capacity. Areas to consider include:

- Overlying the SVRP Aquifer.
- Within aquifer zones defined as highly- or moderately-susceptible by Spokane County's CARA regulation.
- Within 1,000 feet of the Little Spokane River, Eloika Lake, Bear Lake, Davis Lake and/or Sacheen Lake.

Activity: Require regular inspection and pumping of septic systems on a standard interval. The interval should vary as a function of septic tank size and persons per household to achieve acceptable retention times. Standard matrices are available for these requirements.
Potential Phosphorus Load Reduction: Inspection and pumping of septic systems has low to moderate phosphorus removal efficiencies of 40 to 55 percent (DDNR, 2010).
Range of Cost: Inspection and pumping of septic systems has very low phosphorus removal costs of $7 to $25 per pound (DDNR, 2010).
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

12.5.7 Supporting Phosphorus Reduction Activities

Supporting activities to be undertaken as part of this NPS Reduction Plan will provide valuable information for long-term success, in addition to the subbasin-specific actions and BMPs designed to provide direct phosphorus reduction. These activities are described in Chapter 9.

12.5.8 Additional Activities

Additional activities include indirect actions that either lead to overall improvements in ecological functions and thus water quality or provide additional insights into the overall health and conditions of the watershed. Activities are described in Chapter 9. Additional activities in the

Little Spokane River subbasin include the coordination of activities on Lake Spokane, nearshore, and upstream activities.

LSR-AA-1 Support Associated Cleanup Plans

Ecology and the Spokane County Conservation District are working together on a water quality clean-up plans. The Little Spokane River has multiple water quality issues including temperature, fecal coliform, dissolved oxygen, and pH. Many of the sources of these issues are similar sources as phosphorus. Therefore the cleanup efforts also address low oxygen and high nutrients. Issues identified include: sediment/nutrients from agricultural operations and from livestock and wildlife, nutrients from residential areas, nutrients from improper functioning septic systems, sediment from gravel and summer roads, sediment from stormwater, and forestry management (Ecology, undated). The Little Spokane's contribution of nutrients and sediment to the Spokane River, especially from these sources, is important component of the water quality of the Spokane River. Implementing these actions will be important to improving the water quality of both the Little Spokane River and Spokane River.

Activity: Implement clean-up plans.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LSR-AA-2 Consider Phosphorus Free Fertilizer Ordinances

Municipalities across the U.S. have adopted phosphorus free fertilizer ordinances, such as a phosphate lawn fertilizer ban. Retailers and fertilizer producers have appropriate fertilizers products available that meet these ordinances. Some ordinances allow the use of fertilizer with phosphorus under specific circumstances such as if soil testing showing a phosphorus deficiency or for establishing new lawns or plants. A USGS study found that "runoff from lawn sites with non-phosphorus fertilizer applications had a median total phosphorus concentration that was similar to that of unfertilized sites, an indication that non-phosphorus fertilizer use may be an effective, low-cost practice for reducing phosphorus in runoff" (USGS, 2002). House Bill 1489 goes into effect January 2013 which restricts the sale and use of fertilizers containing phosphorus for turf lawns statewide. The bill allows fertilizers with phosphorus for new and damaged turf or when soil testing indicates a phosphorus deficiency.

Activity: Adopt ordinances that ban the use of fertilizer containing phosphorus.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.

LSR-AA-3 Evaluate, Protect and Enhance Nearshore Areas

Nearshore land management and activities have the potential to impact phosphorus loads to surface water. Within the Little Spokane River subbasin, these activities apply to areas nearshore to Eloika Lake, Diamond Lake, Sacheen Lake, other small lakes in the subbasin, and the Little Spokane River. Nearshore sources may transport phosphorus loads via surface water, stormwater

runoff, interflow, and groundwater. Unlike activities and BMPs implemented upstream, there is no attenuation of phosphorus loads associated with nearshore sources. Soltero, et.al (1992), recommended a nearshore assessment of loads from nearshore Lake Spokane including evaluating surface water and groundwater sources. They stated that nearshore "property owners must be as responsible as possible to minimize their negative impact on water quality." Therefore, reduction of loads from nearshore areas is important and should be considered as part of the overall nonpoint source phosphorus load reduction strategy. Nearshore areas should be inventoried to identify areas where BMPs should be implemented. BMPs that should be considered for nearshore areas include, but are not limited to:

- Erosion control and bank stabilization.
- Filter strips.
- Septic tank elimination.
- Inspection and pumping of septic systems.
- Phosphate lawn fertilizer ban.
- Riparian fencing, riparian zones and buffer strips.
- Education and outreach to nearshore property owners.

Additional detail regarding these BMPs is provided in Chapter 8.

Activity: Evaluate nearshore areas to Eloika Lake, Diamond Lake, Sacheen Lake, other small lakes in subbasin, and the Little Spokane River and implement activities and BMPs to reduce nonpoint source phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

12.5.9 Support Existing and Planned Activities

The NPS Reduction Plan supports existing water resources and water quality studies and planning. Protection of these resources also supports the reduction phosphorus nonpoint sources. Critical planned activities specific to the NPS Reduction Plan are identified below.

LSR-EP-1 Implement or Complement WRIA 55 Detailed Implementation Plan Recommendations to Reduce Nonpoint Source Phosphorus Loading

The WRIA 55 Little Spokane Watershed Detailed Implementation Plan (WRIA 55/57 Watershed Implementation Team, 2008) notes increased nonpoint source pollution; growing demand for water due to increased development and population growth; declines in stream flows and groundwater levels; and the importance of interactions between the SVRP Aquifer and the Little Spokane River to maintain flows in the river.

The connection between land use, development and water conservation, reclamation and reuse was identified. Recommendations for water conservation, reclamation and reuse are provided

that relate to nonpoint source phosphorus reduction (e.g., forest practices, agricultural practices, stormwater management, public and stakeholder education, landscaping practices and requirements, wetland restoration and creation, data collection and monitoring). Specific recommendations in the Detailed Implementation Plan that relate to or could complement efforts to reduce nonpoint source phosphorus loading should be reviewed and considered.

Activity: Implement or complement actions in the WRIA 55 Detailed Implementation Plan to achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LTS-EP-1a Implement or Complement Plans Related to Beaver Issues

Beaver issues have been discussed for evaluation of impacts as beaver dams provide benefits, but also cause problems (Ecology, 2008c). Studies and assessments have been recommended to evaluate the land use and water quality impacts of beavers (Tetra Tech, 2010). The West Branch Little Spokane River Watershed Implementation Plan identifies beaver mitigation projects (Golder, 2008). A challenge though is appropriate beaver management to maximize benefits of mitigation including bank stabilization, shoreline re-vegetation and restoration, and water quality benefits while maintaining habitat and flow patterns. For nonpoint source phosphorus reduction, beavers generally are a benefit (Muskopf, 2007 and Maret, et.al, 1987).

Activity: Implement or complement actions related to beaver issues that also reduce nonpoint source phosphorus.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LTS-EP-1b Implement or Complement Plans Related to Restoration Projects

The Detailed Implement Plan identified the need to support the restoration, where feasible, of wetlands in areas where these features existed historically, but have been drained. It also indicated the need to prepare a strategy to identify historic sites that have been destroyed, and suggest restoration or exchange as mitigation for other projects (Ecology, 2008c). Preliminary wetland restoration and recharge opportunities were evaluated for the subbasin (PBS&J, 2009). The Pend Oreille and Spokane County Conservation Districts are important agencies for completing restoration projects in the subbasin. Priority actions include NPS Reduction Plan recommended BMPs such as establishment of riparian buffers, stream bank stabilization, and restoration projects (SCCD, 2010).

Activity: Implement or complement actions related to restoration projects that also reduce nonpoint source phosphorus.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.

Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LSR-EP-2 Support and Supplement Avista Utilities WQAP Implementation

Avista Utilities is developing a WQAP to identify how they will mitigate for impacts to dissolved oxygen in Lake Spokane caused by the Long Lake Dam (Ecology, 2010). The WQAP should be completed in 2012. Avista's efforts to implement the plan elements should be supported. In addition, other organizations in the Little Spokane River subbasin should look for ways to collaborate with and complement Avista's efforts to advance and expand success in reducing nonpoint source phosphorus loads.

Activity: Support and supplement Avista Utilities WQAP implementation to achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LSR-EP-3 Support and Enforce Spokane, Stevens and Pend Oreille Counties Shoreline Master Plans

Washington's Shoreline Management Act governs the use and development of Washington's shorelines and creates a unique partnership between local and state government. The Act strives to achieve responsible shoreline use and development, environmental protection, and public access. Local governments develop programs based on the Act and state guidance, and the state reviews local programs to consider statewide public interests, (Ecology, 2011b). Spokane, Stevens and Pend Oreille Counties all have shoreline master plans that establish policies and regulations for shoreline use and modification activities. Each plan is unique and involves distinct requirements for different types of development, uses, activities, and distinct requirements for different water bodies; however, each plan has similar requirements relating to nonpoint source phosphorus reduction including:

- Setback requirements for structures and uses.
- Requirements for retaining and enhancing natural vegetation buffers and restoring shoreline functions.

Some of the plans include requirements that foster phosphorus load reduction, including specific requirements for on-site wastewater treatment systems, aquaculture operations, etc.

Activity: Support and Enforce Spokane, Stevens and Pend Oreille Counties Shoreline Master Plans to achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

LSR-EP-4 Support, Compliment and Enforce Permits, Ordinances, Plans and Activities Relating to Nonpoint Source Phosphorus Reduction

There are a variety of permits, ordinances, plans and activities within the Little Spokane River subbasin that relate to nonpoint source phosphorus reduction, including:

- City of Spokane and Spokane County NPDES Phase II Stormwater Permit Requirements.
- Ecology and Spokane County Conservation District Little Spokane River water quality improvement project.
- City and county critical area ordinances.
- Spokane, Stevens and Pend Oreille Conservation Districts natural resource conservation plans.
- Spokane River Forum education efforts.

When taking actions and implementing BMPs to reduce nonpoint source phosphorus, consider these and other related plans, goals, requirements and efforts to optimize reduction potential. Review that erosion control BMPs are followed at land development projects and construction sites.

Activity: Support, compliment and enforce permits, ordinances, plans and activities to achieve nonpoint source phosphorus reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

Chapter 13

Hangman Creek Subbasin - Nonpoint Source Phosphorus Management Strategy and Actions

13.1 Introduction

An objective of this NPS Reduction Plan is to formulate nonpoint source control strategies that contribute to long-term reductions of phosphorus loads. It provides guidance on selecting 'what' strategies and actions to take and 'where' to apply them. Chapter 9 provides an introduction to the subbasin actions and strategies, background of the NPS Study objectives, how the subbasin chapters support the overall NPS Reduction Plan, and regional phosphorus control strategies that should be considered in all subbasins in the Spokane River Watershed.

This chapter identifies specific actions for entities located in the Hangman Creek subbasin and stakeholders supporting these entities to reduce nonpoint source phosphorus. Identified are strategies and actions and areas to target within the subbasin. The guidance identifies potential organization leads and potential timelines for initial and long-term reductions of nonpoint source phosphorus pollution.

The following sections of this chapter describe:

- The identification and relationship of entities and stakeholders in the watershed and associated acres of land ownership.
- An overview of reduction strategies, actions, and schedule for the subbasin.
- An overview of the nonpoint source reduction opportunities and guidance on 'what' BMPs to implement and 'where' to take these actions.
- The specific actions by category identified to be undertaken, including those identified by specific entities and stakeholders.

Estimates of the potential BMP phosphorus reductions and cost per pound are provided in Chapter 8. The overall phosphorus reduction potential is discussed in Chapter 9.

13.2 Entities and Stakeholders

As discussed in Chapter 9, accomplishing nonpoint source reductions will require engaging local, state, and federal agencies and land managers, as well as private land owners. The principal organizations involved with securing funding, identifying priority locations, selecting BMPs, and taking actions in the Hangman Creek subbasin include those shown in Table 13-1. These organizations are subdivided into entities and stakeholders as shown in Table 13-2, along with the area of land owned and miles of streams in the Hangman Creek subbasin. Land ownership for the subbasin is shown in Figure 13-1.

Table 13-1. Organizations and Nonpoint Source Phosphorus

Organization
Local Governments
Benewah, Spokane, and Whitman Counties
Benewah County Soil and Water Conservation District
Spokane County Conservation District
Whitman Conservation District
Idaho Panhandle Health District 1
Spokane Regional Health District
Municipalities
Cheney, Fairfield, Latah, Rockford, Spangle, Spokane, Tekoa, Tensed, Waverly, Worley
Utilities
Avista Utilities
Spokane County Utilities Division
Tribal Governments
Coeur d'Alene Tribe
State Agencies
Idaho Department of Environmental Quality
Idaho Department of Lands
Idaho Department of Parks and Recreation
Idaho Fish and Game
Idaho Forest Products Commission
Idaho Rangeland Resource Commission
Idaho Soil Conservation Commission & Idaho Soil and Water Conservation Commission
Idaho State Department of Agriculture
Idaho Transportation Department
Washington Department of Fish and Wildlife
Washington Forest Practices Board
Washington Land Use Study Commission
Washington State Conservation Commission
Washington State Department of Agriculture
Washington State Department of Ecology
Washington State Department of Natural Resources
Washington State Department of Transportation
Washington State Parks and Recreation Commission
Federal Agencies
U.S. Bureau of Indian Affairs
U.S. Bureau of Land Management
U.S. Department of Agriculture – Natural Resource Conservation Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service

Table 13-2. Organizations and Land Area

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Private				
In Cheney	2,493	Cheney	Spokane County Conservation District	n/a
In Spokane	7,027	Spokane		
In Fairfield	402	Fairfield		
In Latah	211	Latah		
In Rockford	417	Rockford		
In Spangle	174	Spangle		
In Tekoa	788	Tekoa		
In Waverly	260	Waverly		
In Spokane County	271,811	Spokane County		1,036.0
In Tensed	62	Tensed	Benewah County Soil and Water Conservation District	n/a
In Benewah County	82,339	Benewah County		346.8
In Worley	65	Worley	Whitman Conservation District	n/a
In Whitman County	14,763	Whitman County		65.5
In Kootenai County	18,875	Kootenai County	Kootenai-Shoshone Soil and Water Conservation District	64.8
In Latah County	70	Latah County	Latah Soil and Water Conservation District	0
Coeur d'Alene Tribe	95,215	Coeur d'Alene Tribe	Various Federal Agencies	391.2
In St. Joe National Forest	7,323	U.S. Forest Service	USDA - Natural Resource Conservation Service	27.1
In Turnbull National Wildlife Refuge	81	U.S. Environmental Protection Agency		0.7
Tribal Governments[2]				
Coeur d'Alene Tribe	*146,349*	U.S. Environmental Protection Agency	Benewah County Soil and Water Conservation District, USDA - Natural Resource Conservation Service	629.2

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Incorporated Municipalities[2]				
Cheney	*2,493*	Washington Department of Ecology, U.S. Environmental Protection Agency	Washington State Department of Agriculture, Washington State Conservation Commission	3.8
Spokane	*7,314*			22.1
Fairfield	*402*			2.0
Latah	*211*			1.0
Rockford	*417*			2.9
Spangle	*174*			1.0
Tekoa	*788*			4.1
Waverly	*260*			0.4
Tensed	*120*	Idaho Department of Environmental Quality, U.S. Environmental Protection Agency	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	0.4
Worley	*126*			0.1
Local Governments[2]				
Benewah County	*125,347*	Idaho Department of Environmental Quality, U.S. Environmental Protection Agency, Idaho Fish and Game, U.S. Fish and Wildlife Service	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	546.9
Kootenai County	*29,424*			108.1
Latah County	*222*			0
Spokane County	*277,087*	Washington Department of Ecology, U.S. Environmental Protection Agency, Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service	Washington State Department of Agriculture, Washington State Conservation Commission, Washington Land Use Study Commission	1,057.0
Whitman County	*15,183*			66.4
State Agencies				
Idaho Department of Lands	1,682	Idaho Department of Environmental Quality, Idaho Fish and Game, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	5.3
Idaho Department of Parks and Recreation	1,594			1.0
Idaho Transportation	351			n/a

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Department				
Washington State Department of Natural Resources	3,156	Washington Department of Ecology, Forest Practices Board, Washington Department of Fish and Wildlife, U.S. Environmental Protection Agency	Washington State Department of Agriculture, Washington State Conservation Commission, Washington Land Use Study Commission	14.1
Washington State Department of Transportation	632			n/a
Federal Agencies				
U.S. Bureau of Indian Affairs	47,848	U.S. Environmental Protection Agency	USDA – Natural Resource Conservation Service	229.9
U.S. Bureau of Land Management	49			0
U.S. Fish and Wildlife Service	2,479			7.7
U.S. Forest Service	2,529			7.1
Additional Land Areas				
Roads	1,733 miles		1,888 stream crossings	

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation, road miles include primary, secondary, local and forest service roads.

[2] Tribal governments, incorporated municipalities and local governments is total land area within boundaries, not land ownership.

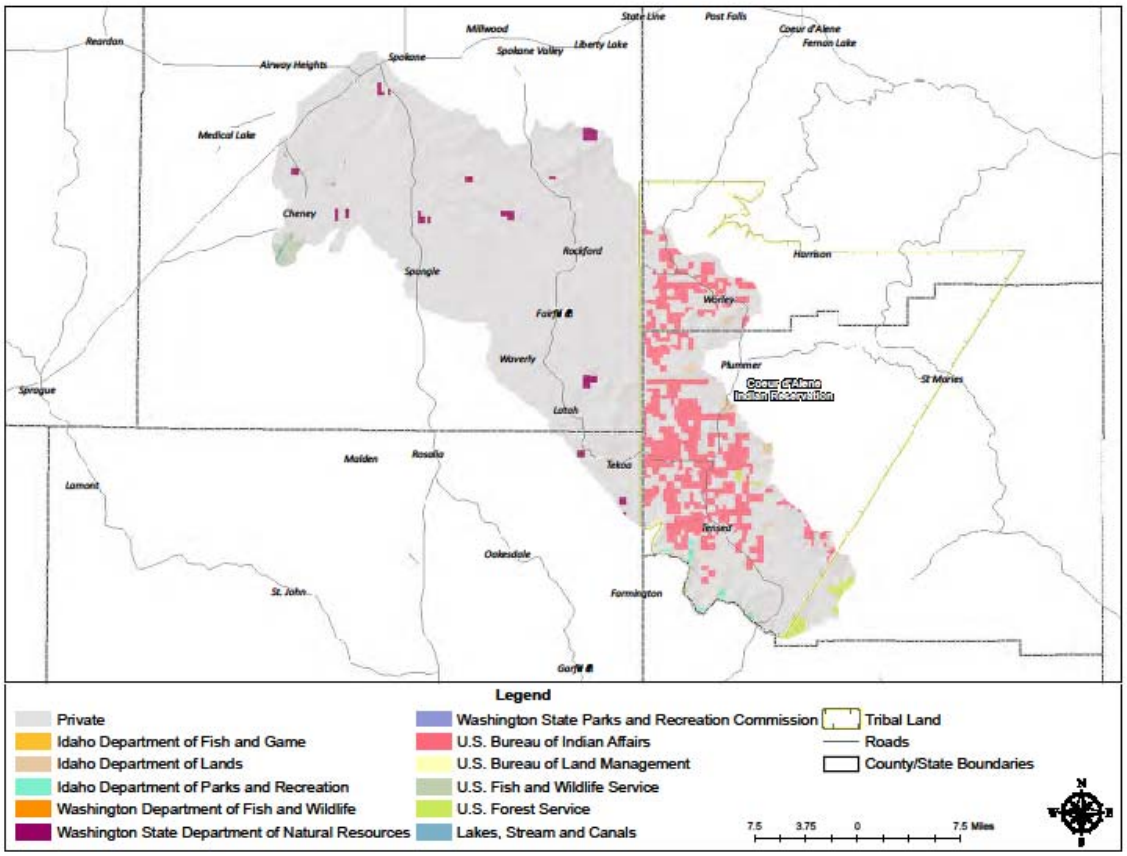

Figure 13-1. Hangman Creek Subbasin and Land Owners

13.3 Overview of Reduction Strategy, Actions, and Schedule

Identifying strategies for reducing nonpoint source phosphorus in the Hangman Creek subbasin is an important step to protect and restore water quality in Hangman Creek and the Spokane River. A successful strategy will also ultimately support improving dissolved oxygen concentrations in Lake Spokane. The extent of water quality improvements will depend on fate and transport processes which were not addressed in the NPS Study. Nonpoint source phosphorus reductions will have both local and watershed benefits.

13.3.1 Strategy

The strategy for addressing nonpoint sources of phosphorus includes taking actions throughout the subbasin. Nonpoint source reduction actions include addressing obvious problems and undertaking actions that can be readily completed. The strategy emphasizes reducing nonpoint source phosphorus from land uses that generate large phosphorus loads and cover large areas of the subbasin. A subbasin scale assessment of these land uses revealed that cropland and pasture land and evergreen forest are dominant throughout the subbasin (Chapter 3).

13.3.2 Actions

Actions are the measures or steps from planning through achievement of nonpoint source phosphorus reduction. Actions include sufficient description and specificity for a responsible party to decide to take the action. The actions also help the responsible party determine where, what, when, and how to achieve the potential suggested outcome.

BMPs are the core of the action; whereas, actions encompass the entire process from the identification of the area, selection and implementation of the BMP through post monitoring. BMPs for addressing nonpoint sources of phosphorus include structural (i.e., physical) and non-structural (i.e., educational) measures.

BMPs referenced in the actions in Section 13.5 were identified based on the dominant land uses and the associated loading potential of the land uses. BMP phosphorus percent reduction efficiency, costs, estimated longevity and implementation effectiveness were also key indicators for identifying high priority BMPs for the subbasin. See Chapter 8 (Nonpoint Source Phosphorus Control Measures) for information about BMPs and the processes used to prioritize them within the Hangman Creek subbasin.

13.3.3 Schedule

The schedule for nonpoint source actions for this plan is based on meeting the schedule in the Spokane River DO TMDL (Ecology, 2010). The schedule targets expeditious management actions to reduce nonpoint source phosphorus over the next two decades. From the Spokane River DO TMDL approval (May 2010), progress will be evaluated every 5 years, with extensive assessments after 10 and 20 years. The results from the first 10 years will be used to guide actions during the second 10-year period. Actions initiated in the first 10 years and determined to be beneficial should be continued, including successful nonpoint source control.

13.3.4 Summary of Approach

A load allocation for the mouth of Hangman Creek was assigned in the Spokane River DO TMDL. A target reduction of 20 percent from March through May, 40 percent in June and 50 percent from July through October was determined to be necessary to meet downstream targets (Ecology, 2010). Using an average efficiency of 54 percent for the priority BMPs (Chapter 8), approximately 68 percent of the major land uses (cropland and pasture and evergreen forest) would need BMPs applied to achieve the target. Based on the average cost for the priority BMPs of about $320/pound (Chapter 8), the total cost for the target reduction would be approximately $6,960,000. Achieving the target reduction over a 20-year period will require that approximately $350,000 is spent annually on BMPs in the subbasin.

13.4 Overview of Opportunities

Opportunities for organizations to undertake nonpoint source phosphorus reductions are available throughout the subbasin. This overview includes a description of what BMPs are the most relevant and where the BMPs should be implemented. Where the BMPs should be implemented is specific to land uses.

13.4.1 Control Measures and BMPs

BMPs specific to land use type and source are described in detail in Chapter 8. The background included in Chapter 8 narrowed the list of BMPs from 108 to 22 based on phosphorus percent reduction efficiency, cost, estimated longevity, and implementation effectiveness. This list of BMPs, if implemented for the appropriate land uses, could result in substantial net nonpoint source reduction of phosphorus.

There are several organizations throughout the Hangman Creek subbasin that can mitigate nonpoint source loads by incorporating BMPs. The agencies and organizations are encouraged to review the land and nonpoint phosphorus sources in their jurisdiction to further identify BMPs that are specific to their situation.

Organizations should examine areas within their influence to identify opportunities where these BMPs can be implemented to reduce nonpoint source phosphorus. These organizations should also examine their stormwater management practices and look for opportunities to implement BMPs since stormwater is a primary transport mechanism for nonpoint source phosphorus. Organizations identified in Tables 13-1 and 13-2 include private, municipal, state and federal entities. Associated opportunities for nonpoint source phosphorus reduction include:

- Private land owners may protect and restore riparian corridors; minimize stormwater runoff; and consider education, land evaluation, and/or aide available from the conservation organizations.
- Municipalities may install BMPs to treat and/or reduce stormwater discharge to water bodies; evaluate where stormwater is being discharged; and/or evaluate the pollutant loading by collecting samples for analysis.
- State and federal agencies should review activities occurring on the land, identify potential impacts, and implement applicable BMPs.
- Organizations should consider actions recommended in other plans that could be implemented in conjunction with NPS Reduction Plan actions and strategies, such as the:
    - WRIA 56 – Hangman Creek Watershed Detailed Implementation Plan.
    - Hangman (Latah) Creek Watershed Fecal Coliform, Temperature, and Turbidity Total Maximum Daily Load: Water Quality Improvement Report (Ecology, 2009a).
    - Upper Hangman Creek Subbasin Assessment and Total Maximum Daily Load (DEQ, 2007a).
    - County Shoreline Master Plans (Spokane, Whitman, Kootenai, Benewah [ID]).
    - The Stormwater Management Manual for Eastern Washington (Ecology, 2004b).
    - The Spokane Regional Stormwater Manual (Spokane County et al. 2008).
    - Other plans and requirements associated with reducing phosphorus and sediment loads to the Hangman Creek subbasin.

13.4.2 Land Uses and Source Potential

The NPS Reduction Plan is meant to provide guidance on where to take action, as actions are voluntary and not mandatory. The NPS Study was conducted at the watershed and subbasin scales and is limited in its guidance to actions at those scales. Actions by organizations are limited by their jurisdictions and authority. Organizations will need to examine local conditions to determine specifically where they choose to take action.

The NPS Reduction Plan analyses (Chapters 6 and 7) evaluated the dominant land uses and the phosphorus load potential for each subbasin. In some cases, the largest land use did not match the largest phosphorus load reduction potential. The following land uses have the highest priority for the Hangman Creek subbasin with respect to nonpoint source phosphorus loading:

- Cropland and Pasture.
- Evergreen Forest.

The analytical evaluation results indicated that the central portion of the subbasin has the highest nonpoint source phosphorus loading rates in the Hangman Creek subbasin (see Chapter 7). These two sub-subbasins with the highest estimated loadings are Rattler Run Creek (0.296 lbs/ac/yr) and Upper Rock Creek (0.284 lbs/ac/yr). These subareas should be considered as priority areas for action.

The Hangman Creek subbasin is dominated by cropland and pasture (51 percent) and evergreen forest land (27 percent). These land uses also have the greatest phosphorus removal potential. Organizations are encouraged to take action in these high priority land use areas. These particular land uses represent the priority areas where nonpoint source phosphorus actions are necessary to achieve a significant net reduction. Organizations should examine areas they own or are within their influence, and look for opportunities to reduce nonpoint source phosphorus from the prioritized land uses. Organizations should also identify areas within their jurisdiction that are obvious areas for nonpoint source reduction opportunities.

13.4.3 Summary of Reduction Opportunities

BMPs have been prioritized first by their ability to remove nonpoint source phosphorus loads and then by land use type. The acres of land use by organization were computed and are tabulated in Table 13-3. The acres in Table 13-3 demonstrate how the land uses are distributed among the land owners and where the opportunities for reductions may exist.

The export coefficients summarized in Chapter 7, along with the land uses and areas, can be used to estimate potential nonpoint source phosphorus loads by organization. There is an associated range of reduction opportunities based on the potential to reduce phosphorus loads. These opportunities are presented in Table 13-4 by assigning a load reduction potential that ranges from low to high. The range is based on total phosphorus load; therefore, higher potential may be due to a greater export coefficient, the total land area, or a combination of both. Table 13-4 is intended to provide further guidance for considering and selecting BMPs for implementation.

Figure 13-2 shows land ownership with stream segments highlighted in areas of high potential for nonpoint source phosphorus reduction based on the land use and export coefficients. Stream segments are shown since the highest priority BMPs in this subbasin generally relate to stream or riparian corridors.

Table 13-3. Organizations Land Area by Land Use

Land Owners	Agriculture[1] (acres)	Forested[1] (acres)	Rangeland[1] (acres)	Urban / Suburban[1] (acres)	Other[1] (acres)
Private					
Private	201,045	89,092	66,969	28,620	2,346
Tribal Governments					
Coeur d'Alene Tribe	74,723	44,963	19,433	6,030	1,310
Incorporated Municipalities[2]					
Cheney	264	426	584	1,191	27
Fairfield	131	3	0	266	2
Latah	108	3	2	99	0
Rockford	92	29	3	294	1
Spangle	54	2	2	116	0
Spokane	0	1,983	791	4,237	21
Tekoa	541	28	0	220	0
Waverly	189	9	0	57	4
Tensed	23	1	2	33	4
Worley	0.2	1	4	61	0
Local Governments[2]					
Benewah County	52,404	48,308	19,150	4,406	1,158
Kootenai County	21,107	4,349	2,119	1,695	176
Latah County	0	186	21	8	0
Spokane County	146,664	54,970	49,305	24,182	2,115
Whitman County	13,353	820	90	888	29
State Agencies					
Idaho Department of Lands	25	1,280	306	56	16
Idaho Department of Parks and Recreation	<1	1,523	41	25	0
Washington State Department of Natural Resources	923	1,874	217	98	45

Land Owners	Agriculture[1] (acres)	Forested[1] (acres)	Rangeland[1] (acres)	Urban / Suburban[1] (acres)	Other[1] (acres)
Federal Agencies					
U.S. Bureau of Indian Affairs	31,275	11,217	2,587	2,308	499
U.S. Bureau of Land Management	6	43	0	0	0
U.S. Fish and Wildlife Service	3	1,445	429	31	565
U.S. Forest Service	218	2,153	137	11	6

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation.

[2] Tribal governments, incorporated municipalities and local governments is the total land area within boundaries.

Table 13-4. Organizations and Potential for Nonpoint Source Phosphorus Reduction

Land Owners	Agriculture[1]	Forested[1]	Rangeland[1]	Urban / Suburban[1]	Other[1]
Private					
Private	High	High	High	High	Moderate
Tribal Governments					
Coeur d'Alene Tribe	High	High	High	High	Moderate
Incorporated Municipalities					
Cheney	High-Mod.	Moderate	Moderate	High-Mod.	Low-Mod.
Fairfield	High-Mod.	Low	n/a	Moderate	Low
Latah	Moderate	Low	Low	Moderate	n/a
Rockford	Moderate	Low-Mod.	Low	High-Mod.	Low
Spangle	Moderate	Low	Low	Moderate	n/a
Spokane	n/a	High-Mod.	Moderate	High-Mod.	Low
Tekoa	High-Mod.	Low-Mod.	n/a	Moderate	n/a
Waverly	High-Mod.	Low-Mod.	n/a	Moderate	Low
Tensed	Low-Mod.	Low	Low	Low-Mod.	Low
Worley	Low	Low	Low	Low-Mod.	n/a
Local Governments					
Benewah County	High	High	High	High	Moderate
Kootenai County	High	High	High-Mod.	High-Mod.	Low-Mod.
Latah County	n/a	Moderate	Low-Mod.	Low-Mod.	n/a
Spokane County	High	High	High	High	Moderate
Whitman County	High	High-Mod.	Low-Mod.	High-Mod.	Low

Land Owners	Agriculture[1]	Forested[1]	Rangeland[1]	Urban / Suburban[1]	Other[1]
State Agencies					
Idaho Department of Lands	Moderate	High-Mod.	Moderate	Moderate	Low
Idaho Department of Parks and Recreation	Low	High-Mod.	Low-Mod.	Low-Mod.	n/a
Washington State Department of Natural Resources	High-Mod.	High-Mod.	Moderate	Moderate	Low
Federal Agencies					
U.S. Bureau of Indian Affairs	High	High	High-Mod.	High-Mod.	Low-Mod.
U.S. Bureau of Land Management	Low-Mod.	Low-Mod.	n/a	n/a	n/a
U.S. Fish and Wildlife Service	Low-Mod.	High-Mod.	Moderate	Low-Mod.	Low-Mod.
U.S. Forest Service	High-Mod.	High-Mod.	Low-Mod.	Low-Mod.	Low

[1] NPS load potential based on area and export classified into five categories, low, low-moderate, moderate, high-moderate, and high.

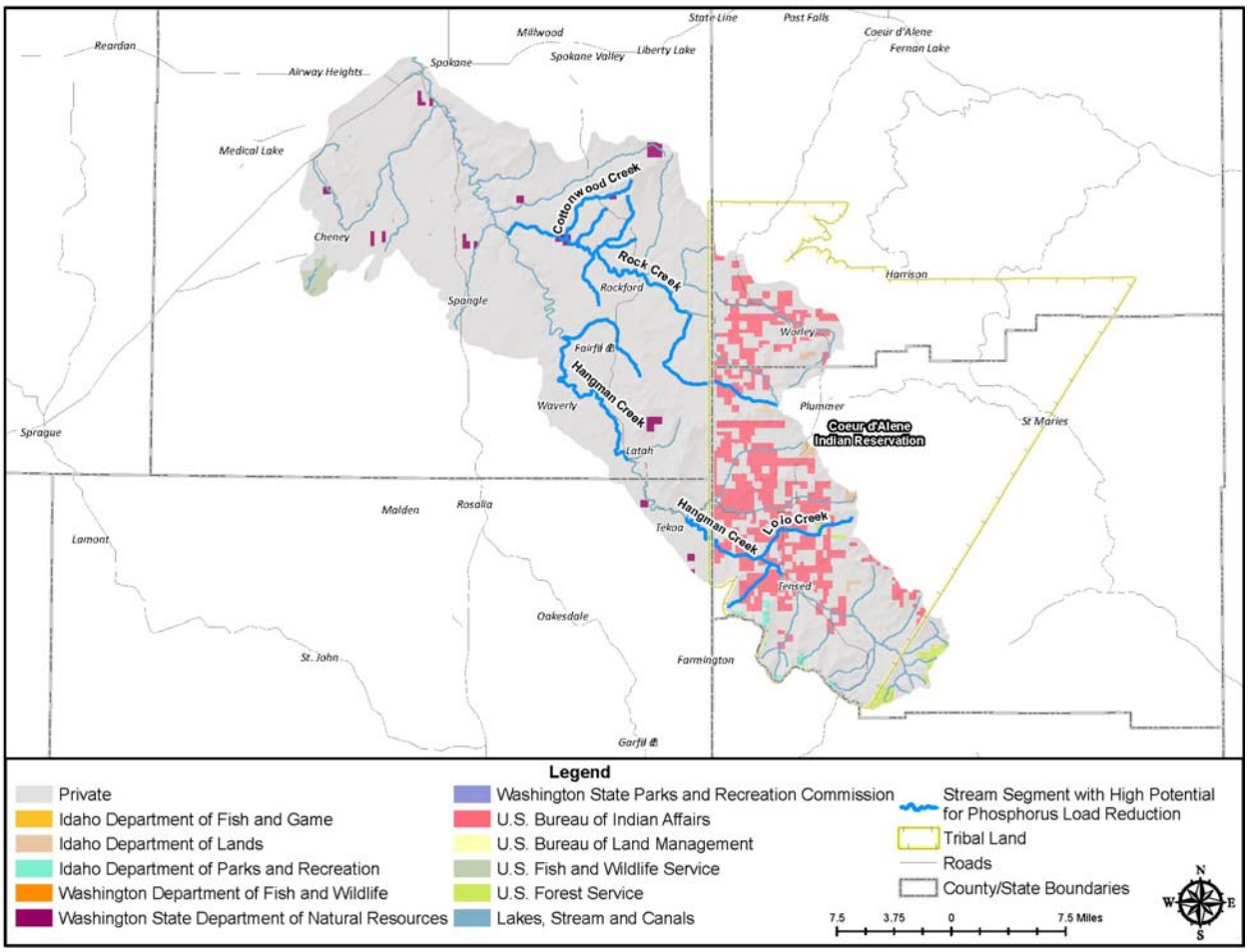

Figure 13-2. Hangman Creek Subbasin High Potential Reduction Opportunities

13.5 Specific Actions by Category

This section includes a list of specific actions to reduce nonpoint source phosphorus loads and ultimately contribute to meeting water quality standards. A general description of each action, an activity summary, potential phosphorus load reduction, a range of costs, potential timelines, and the potential lead entity are provided for each action. Although it was not a primary objective of the NPS Study to specify "who" implements phosphorus control measures, potential lead organizations are identified for some actions to help provide linkage to the "what" and "where" objectives of the NPS Study. The lead organization will need to assist local entities in developing detailed plans for the activities, as well as a schedule and plan for monitoring progress. When the information was available, the action also includes a description of the roles of the organization with responsibility to improve water quality, and the means through which the organization will address the water quality issues.

13.5.1 High Priority BMPs

The analysis provided in Chapter 8 described the following BMPs as having the highest priority for the Hangman Creek subbasin:

- Vegetated Buffer/Filter Strips.
- Riparian Zones and Buffer Strips.
- Stream Bank Stabilization.
- Erosion Control.

Specific details regarding implementation of these high priority BMPs are provided in Chapter 9. These BMPs are appropriate for implementation for land uses in the subbasin. The following sections summarize actions appropriate for the specific land uses within the Hangman Creek subbasin.

13.5.2 Regional Phosphorus Management

Regional phosphorus control strategies are not specific to any one land use type or organization, and may contribute to the reduction of nonpoint source phosphorus loadings in the subbasin. Descriptions of the regional or watershed-scale phosphorus management actions intended to facilitate load reductions and/or establish the technical foundation for further phosphorus control activities are described in Chapter 9.

13.5.3 Agriculture Related Activities

BMPs related to agricultural practices can have substantial impacts on nonpoint source phosphorus loading since agricultural land uses tend to be phosphorus intensive. BMPs under this category are typically associated with crop land uses, crop till management, and livestock grazing practices.

HLC-AR-1 Assess Impacts of Tillage on Phosphorus Export

Crop tilling practices can impact surface water runoff and ultimately affect local water quality. A 2006 national review of annual nutrient loading data provided insight into the effects of tillage (Harmel, et al, 2006). The data was limited to sites with a single land use, either cultivated agriculture, pasture, or rangeland on sites greater than 0.009 hectares. A comparison of agriculture tilling practice was completed and annual nutrient loads were calculated. The practices reviewed included no-till, conservation tillage, conventional tillage, and pasture. Conservation tillage assumes that the crop residue is left on the soil surface. Pasture represents rangeland that may be grazed. The annual median total phosphorus export coefficient reported in the literature for conventional tillage, conservation tillage, and no-till practices were 0.93 pounds per acre (lb/ac), 1.05 lb/ac, and 0.56 lb/ac, respectively. With an export coefficient of approximately half, practicing no-till on cropland can significantly reduce phosphorus in overland runoff. Alternatively, conservation tillage appears to be the crop tilling practice that results in the most phosphorus leaving the site.

A study conducted near Waverly, Washington suggested that water quality improvements result from implementation of tillage-related BMPs when compared to a control basin, but the extent of improvement could not be quantified (SCCD, 2000). The Hangman Creek Water Resources Management Plan indicates that, beginning in the early 1970s, the local conservation districts, private landowners, and producers implemented BMPs, initiated conservation tillage operations, stabilized stream banks, and rehabilitated riparian areas. Associated impacts on water quantity

were never fully evaluated. To do so, suggested monitoring plans included quantifying the effectiveness of erosion-reducing BMPs on water quality (SCCD, 2005). Assisting with tillage practices and conducting monitoring matches with the long term goals and strategies of the SCCD (SCCD, 2010).

Activity: Review current practices and refine the estimate of phosphorus export using various tillage methods.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-AR-2 Fertilizer Application Location and Timing

Managing the location and timing of fertilizer application can minimize the loss of phosphorus from agricultural fields and maximize plant uptake. Assistance may be obtained from the Benewah, Latah, Kootenai, Spokane or Whitman county extension offices or Spokane or Whitman county conservation districts or Benewah, Latah, Kootenai-Shoshone County soil and water conservation districts. These agencies could also provide free seminars and literature about implementing such BMPs.

Optimizing fertilizer application and timing can be achieved through the following practices and actions:

- Incorporate or inject fertilizers with phosphorus below the soil surface to reduce the total and soluble phosphorus losses (Fawecett, unknown). “Subsurface injection of fertilizer, as compared to surface application, reduced losses by 39 percent for no-till and by 35 percent for conventional tillage” (Mostaghimi, et al., 1988).
- Establish fertilizer management areas and apply at agronomic rates for those areas with phosphorus deficits, see HLC-AR-3 (Waskom and Bauder, unknown). “Maintain a buffer strip (where fertilizer and manure is not applied) a safe distance from surface water and drainage channels” (Waskom and Bauder, unknown). BMPs that buffer riparian zones were rated as high priority (Chapters 7 and 8).
- Avoid fertilizer and manure application to frozen and wet soils (Fawecett, unknown). For example, the earliest and latest spring freeze dates are April 21 and July 23rd in Cheney, April 3 and July 11 in Rosalia, and January 6 and March 30 in Tekoa, respectively (WRCC, 2011).

Activity: Provide support to growers with information on fertilizer management.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-AR-3 Fertilizer Application Rates

Sample the tillage layer of soil in each field on a regular basis and have soil analyzed to determine available soil phosphorus levels prior to applying fertilizers with phosphorus. An example of a detailed large scale soil sampling effort showed that total phosphorus concentrations were highest in agricultural fields and livestock areas (SCCD, 2009). The individual field fertilizer schedules likely contributed to these high concentrations.

Use crop and soil guides to determine agronomic application rates such as the University of Idaho Northern Idaho Fertilizer Guide or Washington State University Fertilizer Guides and Summary. The most common crops in this subbasin are winter wheat, spring wheat, lentils, sod/grass seed, and pasture/grass. Fertilizer application should consider the following:

- Wheat has a relatively low demand for phosphorus.
- Lentils are especially dependent on the soil conditions and application method.
- Grass seed and pasture may need phosphorus fertilizer every 2 to 3years and should be done in the fall as spring, as fertilization is less effective in the spring and winter when it is more susceptible to runoff.

Activity: Provide support to growers about soil phosphorus testing and fertilizer application rates.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-AR-4 Runoff Management and Treatment

Runoff management is important within the Hangman Creek subbasin. The SCCD has found that the highest nutrient levels, particularly total phosphorus, are generally associated with high suspended sediment concentrations during runoff events and phosphorus levels are generally highest during high flows (SCCD, 1997). The following runoff-related BMPs were rated as high priority in Chapters 7 and 8 and should be considered within this subbasin:

- Manage runoff, from stormwater and irrigation if irrigating, to minimize runoff and treat runoff before entering waterbodies.
- Employ contouring or other techniques to reduce runoff potential.
- Maintain grass filter strips on the downhill perimeter of erosive crop fields to catch and filter phosphorus in runoff.
- Manage irrigation water to minimize runoff and erosion with irrigation BMPs or NRCS irrigation water management practices.

Slope is one factor that affects runoff. In the Hangman Creek subbasin, the approximate percentage of agricultural land within individual slope classes is summarized by the following:

- 15 percent has 0 to 5 percent slope.

- 11 percent has 5 to 10 percent slope.
- 28 percent has 10 to 15 percent slope.
- 40 percent has 15 to 20 percent slope.
- 6 percent has greater than 20 percent slope.

These slopes in combination with the soil types and other factors result in 81 percent of agricultural land use in the subbasin having a capability description of "very severe limitations that restrict the choice of plants, require very careful management, or both" (NRCS, 2011). This slope distribution demonstrates the need to implement the recommended BMPs for managing and treating runoff.

About 97 percent of the agricultural land use in the subbasin is rated as "good" relative to herbaceous habitat for wildlife such as in buffer zones (NRCS, 2011).

Activity: Provide support to growers about runoff management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-AR-5 Crop Management

Crop management is related to many agricultural BMPs, including tillage type (conservation tillage/no-till/direct drill seeding), contouring (contour plowing and terracing and contour strip crop), crop rotation and erosion management (see Chapter 8). Crop management is related to the typical crops grown in the subbasin. Crops grown in the subbasin include: alfalfa, barley, canola, clover/wildflowers, dry beans, herbs, lentils, mustard, nectarines, oats, pasture grass, pasture hay, peas, potatoes, grass seed, squash, triticale, and spring and winter wheat.

This action includes supporting economic crop management practices that also provide environmental benefits. This may require transformation in agency policies, new legislation, or other adjustments from historical practices that result in economic disincentives for implementing actions.

Activity: Provide support to growers about crop management and associated BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-AR-6 Animal Management

Animal management is related to many agricultural BMPs, including water supply, riparian zone exclusion, and feed, grazing and waste management (see Chapter 8). For example fencing riparian corridors limits livestock access to streams and ultimately protects water quality. Animal management is related to the head of animals raised in the subbasin. However, operations with large numbers of animals including cattle, dairy cows, turkeys, broilers and laying hens, may fall

under confined animal feeding operation requirements instead. Smaller operations can also result in intense pressure on the land such as disturbance to drainages and streambanks, soil erosion, and animal wastes. Recommended priority BMPs such as buffers and riparian zones are beneficial to reducing or eliminating these pressures.

Activity: Provide support to producers about animal management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

13.5.4 Forestry Related Activities

BMPs related to forestry practices can reduce nonpoint source phosphorus. While phosphorus export rates related to forestry in general are low, local areas of intensive use can have higher phosphorus export rates. Because the second highest land use within the Hangman Creek subbasin is forest, reductions in nonpoint source phosphorus from forested areas will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing erosion, reducing sediment transport, protecting and maintaining riparian corridors and streamside management zones.

HLC-FR-1 Evaluate Forestry Practices

Washington's forest practices regulations include the Forest Practices Act as administered by the Department of Natural Resources. These regulations will be used as the basis for nonpoint source phosphorus load reduction from private and state forestlands. Ongoing practices should be reviewed by or as directed by the lead organization for compliance. If compliance with the existing regulations is not resulting in sufficient reduction, then more effective methods need to be promoted. Poorly performing practices need to be researched for the causes and potentially modified to improve the outcomes.

With large quantities of adjacent forested land, tributary water quality is likely affected by forest management practices. Logging and road building practices that have been common throughout the intermountain region from the late nineteenth century through most of the twentieth century have likely contributed to the degradation of water quality. In more recent times, implementation of more environmentally sound forest management practices has occurred.

State agencies have data on forest health, ecology, harvest areas, vegetation types, soil conditions and more. This information can be useful for identifying areas of greater nonpoint source phosphorus loading. However, much of this data is not readily available or in a format that can be interpreted by water quality managers. Coordination between forest and water quality managers is necessary to understand the data and select management activities.

Activity: Enforce existing regulations, evaluate existing practices, discourage poorly performing practices, and encourage best performing practices and improve coordination of sharing information.
Potential Phosphorus Load Reduction: TBD by Potential Lead.

Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-FR-2 Quantify Sediment-Phosphorus Relationship in Forested Areas

Quantifying phosphorus loading associated with forest management practices may provide additional information that support selection of successful BMPs. The construction and use of roadways represent a major source of sediment from timber harvest activities (DEQ, 2000). A study to quantify the relationship between sediment associated with phosphorus in runoff from these roads can help determine whether additional measures should be undertaken.

Activity: Quantify relationship between sediment and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-FR-3 Subbasin Scale Road Planning and Rehabilitation

A subbasin-scale management survey should be completed to document ownership and identify and prioritize the total miles of erodible roads and road banks within the Hangman Creek subbasin. The development of specific BMPs can be completed based on survey results to reduce miles of erodible roads associated with road construction, road conversions, and maintenance. The inventoried roads should be included in a database that tracks BMP implementation. This database and tracking is essential for determining BMP implementation success and accountability. Road reduction plans should identify opportunities to abandon non-essential roads or restore roads on non-industrial forest lands and other county roads that contribute obvious erosion problems.

Activity: Quantify relationship between roads and phosphorus in forested areas and identify opportunities for road reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-FR-4 Commercial Forest Management

Commercial timber land in the State of Washington must implement a minimum level of BMPs under the Forest Practices Act (RCW Chapter 76.09) which is administered by the Washington State Department of Natural Resources. There are road maintenance and abandonment plans required in the current rules that should reduce phosphorus loads in forested areas.

Activity: Enforce BMP requirements in timber lands.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.

Potential Lead: Commercial timber land management.

HLC-FR-5 Washington Road Surface Erosion Model

The Cooperative Monitoring, Evaluation, and Research Committee of the Washington Forest Practices Board, has developed a tool that can be used by entities to calculate the average annual road surface erosion and sediment delivery to channels (DNR, 2011). This tool can be used for a single road up to all roads in a watershed. The model can be used for screening, planning-level assessment, a detailed assessment and scenario playing, or site/segment level monitoring.

Activity: Support assessment of phosphorus loads from timber lands.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Commercial timber land management.

HLC-FR-6 Fire Rehabilitation Areas

Wild fires can significantly impact the landscape. Research has shown increased concentrations of suspended sediments, phosphorus, and potassium in streams below burned areas (Stednick, et al., 1982). Stream monitoring indicated an immediate flush of phosphorus in the runoff, followed by a slower release. Rehabilitation of burn areas, especially the riparian corridors to protect streams, will be important to reducing nonpoint source phosphorus in forested areas. The fire history from 2001 through 2010 suggests approximately 300 acres in the subbasin to have been burned and should be evaluated.

Activity: Identify and assist with rehabilitation of burned areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

13.5.5 Range Related Activities

BMPs related to rangeland practices can reduce nonpoint source phosphorus. Since range, shrub and brush land is the third largest percentage of land uses in the Hangman Creek subbasin, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing disturbance of range land, protecting and maintaining riparian zones and maintaining or stabilizing stream banks.

HLC-RR-1 Evaluate Rangeland Practices

Washington and Idaho's regulations will be relied upon to reduce nonpoint source phosphorus loads from rangelands. Evaluate past and present impacts and review ongoing practices for compliance. The goal of evaluating past and present activities is to manage rangeland to maintain optimum soil and water quality. If compliance with the existing regulations is not resulting in sufficient nonpoint source phosphorus reduction, then more effective methods should be identified and promoted.

Activity: Evaluate existing practices, enforce existing regulations, and encourage BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

13.5.6 Urban/Suburban Related Activities

Urban/suburban land use is relatively minor within the Hangman Creek subbasin, and primarily centered around the southwest portion of the City of Spokane and the Cities of Fairfield, Latah, Rockford, Spangle, Tekoa, and Waverly. Other urban, urban, and residential land uses account for about 4, 2, and 1 percent of the subbasin, respectively. Nevertheless, urban/suburban areas can have the most variable impacts on nonpoint source phosphorus loading due to the diversity of development, uses, and control of stormwater runoff. BMPs under this category are typically associated with minimization of pollution sources and the management of stormwater.

HLC-UR-1 Business Practices to Prevent Stormwater Pollution

The Urban Waters Initiative managed by the Washington Department of Ecology and Spokane Regional Health District has developed several practices to be implemented by local businesses to prevent stormwater pollution (Ecology, 2009c). These practices include eliminating wash water from storm drains, disposing of wastes properly, and regularly maintaining grease traps, oil-water separators, and catch basins. Because these activities are performed throughout a city, the local municipality could be the lead for this effort.

Activity: Review existing practices, encourage BMP implementation, provide adequate resources and information to businesses.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-UR-2 Evaluate and Analyze Impervious Surfaces and Implement Stormwater BMPs

Impervious surfaces throughout the Hangman Creek subbasin are a source of substantial stormwater runoff. Within the subbasin, stormwater runoff enters both surface water and groundwater via infiltration. An understanding of the area and location of the impervious surfaces in the subbasin will guide the need and responsibility for stormwater-related BMP implementation.

Activity: Evaluate and quantify existing impervious surfaces, identify areas where vegetated buffer / filter strips or other applicable stormwater BMPs (see Chapter 8) could be installed, and encourage installation.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-UR-3 Evaluate and Revise Stormwater Policies

Approximately 3 percent of the subbasin is within municipal boundaries. That action consists of the review and revision of the stormwater regulations of municipalities, potentially including a subbasin or watershed summit, for water quality requirements. Municipalities have unique policies; however, working towards incorporating at least some minimum water quality requirements that address nonpoint source pollution including phosphorus across the watershed will provide some reduction in loads.

Activity: Coordinate on minimum water quality stormwater treatment policies.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HL-UR-4 Strengthen Requirements for Stormwater Treatment BMPs in Key Areas

Stormwater treatment BMPs, such as bio-infiltration swales, bio-infiltration channels, vegetated buffer strips and infiltration basins are important within the Hangman Creek subbasin because: 1) development frequently occurs in close proximity to Hangman Creek; 2) most of the urban and residential land use within the subbasin occurs at the north (downstream) edge of the subbasin with relatively limited travel time and load attenuation before impacting the Spokane River; and 3) much of the Hangman Creek corridor overlies aquifer zones defined as highly susceptible to groundwater contamination by Spokane County's Critical Aquifer Recharge Area (CARA) regulation.

Per CARA regulations, Spokane County requires that special consideration be given to stormwater runoff associated with commercial and industrial development such as outdoor loading docks, fueling stations, and those activities involving toxic and hazardous materials handling. More stringent requirements could be considered for implementation of BMPs intended to reduce industrial discharges of phosphorus. This could include installation of sand filters at or near stormwater discharges, installation of catch basin filtration systems, installation of flocculation systems, and/or multi-chambered treatment trains (DEQ, 2001).

The Spokane Regional Stormwater Manual (Spokane County et al. 2008) presents bio-infiltration swales, bio-infiltration channels, and vegetated buffer strips as stormwater treatment design alternatives. The regulatory threshold for requiring varies by jurisdiction. In Spokane County, the threshold is defined as "the addition or replacement of 5,000 square feet or more of impervious surfaces or the disturbance of 1acre or more." In the City of Spokane, the threshold is defined as "the addition or replacement of any impervious surfaces." Various exemptions, such as an exemption for redeveloped sites, are listed in the manual.

The Washington Department of Ecology Stormwater Management Manual for Eastern Washington (Ecology, 2004b) provides guidance regarding implementation of stormwater BMPs. This manual lists infiltration ponds, infiltration trenches, infiltration swales, bio-infiltration swales, and vegetated filter strips as stormwater treatment BMP options.

Implementation of this action would strengthen requirements regarding implementation of the stormwater treatment BMPs listed in this section. These requirements could include developed and redeveloped commercial, industrial and residential properties within the following key areas:

- Within aquifer zones defined as highly- or moderately-susceptible by Spokane County's CARA regulation.
- Within 1,000 feet of Hangman Creek.

Particular emphasis with regard to the mitigation of phosphorus loading to groundwater from stormwater could be considered within proximity (for example, within 1,000 feet) of gaining reaches of Hangman Creek. Within gaining reaches, the Hangman Creek gains considerable flow from groundwater discharge from the adjacent Hangman Valley aquifer system. It is possible, therefore, that within these areas much of the phosphorus dissolved within infiltrating stormwater impacts Hangman Creek and ultimately the Spokane River. Approximate locations of gaining reaches are presented by SCCD (2005) and GeoEngineers (2010a and 2010b).

Activity: Implement rigorous stormwater BMP requirements in key portions of subbasin.
Potential Phosphorus Load Reduction: Varies depending on BMP; refer to HLC-UR-4a through HLC-UR-4d.
Range of Cost: Varies depending on BMP; refer to HLC-UR-4a through HLC-UR-4d.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Spokane County.

Specific information regarding stormwater treatment BMPs is provided in HLC-UR-4a through HLC-UR-4d.

HLC-UR-4a Install Grassed Bio-Infiltration Swales

The Spokane Regional Stormwater Manual (Spokane County et al. 2008) specifies an achievement goal of 50 percent total phosphorus removal for a range of influent concentrations from 0.1 to 0.5 μg/l of total phosphorus. Bio-infiltration swales (also locally termed grassed percolation areas or "208" swales) are the only BMP presented in the manual that are assumed to meet this removal goal for phosphorus.

To implement this BMP, stormwater runoff is directed to a grassed swale where vegetative cover provides pretreatment of stormwater before infiltration to the subsurface. Infiltration occurs either through the swale or within drywells that receive stormwater once the swale is filled to a design overflow elevation. The area surrounding the drywell and underlying the swale should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone.

Specific details regarding bio-infiltration channel design and construction within the Hangman Creek subbasin are provided by Spokane County et al. (2008).

Potential Phosphorus Load Reduction: Grassed swales have a wide range of potential phosphorus removal efficiencies from 20 to 61 percent (Miller, 1987) to 29 to 99 percent (Yu et al., 2001).
Range of Cost: No specific quantitative information regarding the cost of grassed bio-infiltration swales was found during the project review. However, based on BMP characteristics, costs are expected to be moderate to high with respect to the other BMPs described in this plan.

HLC-UR-4b Install Bio-Infiltration Channels

To implement this stormwater treatment BMP, stormwater runoff is directed to a bio-infiltration channel underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). A bio-infiltration channel is a sloped, vegetated channel or ditch that both conveys and treats stormwater runoff. It does not provide flow control but can convey runoff to facilities designed for that purpose (Spokane County et al. 2008). A bio-infiltration channel provides treatment as stormwater flows through vegetative cover and/or infiltrates. Channel flow can be directed to a pond or other facility. Infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Specific details regarding bio-infiltration channel and construction within the Hangman Creek subbasin are provided by Spokane County et al. (2008).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of bio-infiltration channels was found during planning. However, infiltration trenches and basins have a wide range of potential phosphorus removal efficiencies of 10 to 80 percent (EPA, 1999).
Range of Cost: No specific quantitative information regarding the cost of bio-infiltration channels was found during planning.

HLC-UR-4c Install Vegetated Buffer Strips

Stormwater runoff is directed via sheet flow to a vegetated buffer strip situated adjacent to a rural roadway or parking lot. Vegetative cover within the buffer strip provides pretreatment of stormwater before infiltration to the subsurface, and/or evaporation. Vegetated buffer strips are used to intercept overland sheet flow runoff from adjacent impervious areas. They slow runoff velocities, filter out sediment and other pollutants, and provide infiltration into underlying soils.

When buffer strips are used for infiltration, the area underlying the buffer strip should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system

removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone. Specific details regarding vegetated buffer strip design and construction within the Hangman Creek subbasin are provided by Spokane County et al. (2008).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness or cost of vegetated buffer strips was found during the project review. However, vegetated filter strips have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Grass filter strips have low phosphorus removal costs of $190 to $250 per pound (Sera-17, 2010).

HLC-UR-4d Infiltration Areas

Stormwater runoff is directed to an infiltration area underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). The infiltration area can be equipped with a drainfield constructed of perforated pipe to facilitate infiltration. A suitable site requires soils with a sufficiently high permeability to allow for relatively rapid infiltration, but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Spokane County and the City of Spokane have recently constructed/enhanced a number of regional stormwater infiltration facilities for the purpose of managing stormwater runoff in areas with difficult infiltration conditions on a site-specific level. When these facilities are located over relatively thick glaciofluvial sand and gravel sequences, benefit of water quality treatment may be limited. Examples include: Hazel's Creek Drainage and Conservation Facility (City of Spokane), Browne's Mountain Regional Stormwater Facility (Spokane County), and Price and Wall Regional Stormwater Facility (Spokane County).

Potential Phosphorus Load Reduction: Infiltration basins have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Infiltration structures generally have high phosphorus removal costs of $2,500 to $3,000 per pound (Corrozi, 2009).

HLC-UR-5 Evaluate Phosphorus Load from Septic Tanks within the Hangman Valley

While there is historical literature that suggests septic systems and subsequent treatment in the unsaturated zone provides phosphorus removal from effluent, recent and emerging evidence indicates the contrary in many locations. Both the current science and measured groundwater concentrations of phosphorus clearly indicate that septic systems release significant phosphorus loads into underlying groundwater and that phosphorus loading can increase with time as a result of the loading of sorption sites in the unsaturated zone. Moreover, the shallow hydrostratigraphy of many areas within the Hangman Creek subbasin consists of bedrock and/or thin overlying unconsolidated sediments, which have relatively little phosphorus removal capacity.

Removing septic systems and replacing with sewers involves considerable cost. Therefore, the reduction in phosphorus loading associated with septic tank removal within key densely developed areas should be conducted as a basis for future management decisions. Spokane County has initiated a Septic Tank Elimination Program (STEP) that has resulted in significant septic tank removal. Sewering of the STEP area is scheduled to be completed in 2012. The STEP is primarily centered around septic tank elimination within the Upper Spokane River WA and Little Spokane River subbasins. However, there are still areas with relatively dense distribution of septic tanks outside the STEP area and within the Hangman Creek subbasin. The areas that should be considered include but are not limited to the following:

- Developed areas surrounding the west and south sides of Hangman Creek Golf Course.

Particular emphasis with regard to the analysis of the extent and mitigation of septic tank loading (Actions HLC-UR-5 and HLC-UR-6) could be considered within proximity (for example, within 1,000 feet) of gaining reaches of the Hangman Creek. Within gaining reaches, the Hangman Creek gains considerable flow from groundwater discharge from the Hangman Valley aquifer system. It is possible that a considerable proportion of the phosphorus released from septic tanks impacts Hangman Creek. Approximate locations of gaining reaches are presented by GeoEngineers (2010a and 2010b).

Activity: Evaluate Phosphorus Load from Septic Tanks within Densely Developed Areas as a basis for future management decisions.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Spokane County or other municipalities.

HLC-UR-6 Septic Tank Elimination within Key Areas

Removal of septic systems by connecting to sewer systems eliminates a source of pollution to surface and groundwater. Wastes are treated more thoroughly and phosphorus removal is more complete at a wastewater treatment facility designed for phosphorus removal than is possible with a septic system. For these reasons, septic tank elimination is an important long-term management approach to controlling nonpoint source phosphorus loading.

Septic tank elimination programs, beyond those accomplished through Spokane County's STEP, should be based on results of HLC-UR-5, which will assist in identification of specific areas where infrastructure investment will lead to relatively large phosphorus loading reductions.

Activity: Remove septic systems and replace with sanitary sewer in key areas of Hangman Creek subbasin.
Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of septic tank elimination was found during planning. However, based on the phosphorus removal characteristics of area wastewater facilities and that septic tank discharges are completely eliminated during removal, the expected effectiveness is very high.

Range of Cost: No specific quantitative information regarding the cost of septic tank elimination was found during planning. Potential costs may range from low to high with respect to the other BMPs described in this plan.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Spokane County.

HLC-UR-7 Inspection and Pumping of Septic Systems within Key Areas

Regular inspection and pumping of septic systems prolongs the life of the system, reduces maintenance costs and contamination around the drain field, and slows the breakthrough of phosphorus to groundwater. The priority systems to target are older systems and systems near streams and areas with a high groundwater table. The septic tank should be pumped by a licensed septage waste-hauler on a regular basis and septage properly disposed of in an approved site or wastewater treatment facility.

Septic system inspection and pumping can be performed throughout the subbasin to achieve nonpoint source loading reduction to area surface water. However, it will have greatest positive impact within near-stream areas and with septic system overlying coarse soil and/or bedrock with minimal phosphorus treatment capacity. Areas to consider include:

- Within aquifer zones defined as highly- or moderately-susceptible by Spokane County's CARA regulation.
- Within 1,000 feet of Hangman Creek.

Activity: Require regular inspection and pumping of septic systems on a standard interval. The interval should vary as a function of septic tank size and persons per household to achieve acceptable retention times. Standard matrices are available for these requirements.
Potential Phosphorus Load Reduction: Inspection and pumping of septic systems has low to moderate phosphorus removal efficiencies of 40 to 55 percent (DDNR, 2010).
Range of Cost: Inspection and pumping of septic systems has very low phosphorus removal costs of $7 to $25 per pound (DDNR, 2010).
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-UR-8 Develop a Small Community Program for Phosphorus Loading Reduction

Small communities have a unique set of associated phosphorus loading mechanisms that, in many cases, are not specifically targeted by existing guidelines and regulation. A number of the small towns within the Hangman Creek subbasin are along or within close proximity to a tributary of Hangman Creek. As a result, phosphorus loading from these areas can quickly impact subbasin surface water.

The intent of this action is to develop a program to assist smaller communities to develop the tools they need to reduce phosphorus loading. This program could include generation of guidance documents and/or ordinances. Components of the program could include the following:

- Community outreach and education.

- Training programs targeted at local government officials and managers.
- Retrofit of existing stormwater management structures to comply with guidelines described in Action HLC-UR-4.
- Guidance and/or requirements for Low Impact Development (LID) practices in construction and stormwater management.
- Management and education intended to reduce of impact of pet waste on water quality.
- Septic system elimination (if applicable) per Action HLC-UR-6 and inspection/pumping per Action HLC-UR-7.
- Recommendation or requirement for use of phosphorus-free fertilizer, per Action HLC-AA-3.
- Recommendation to retain grass clippings/leaves on lawns or as properly-disposed of solid waste, rather than within runoff.

Activity: Develop a program to assist smaller communities to develop the tools they need to reduce phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

13.5.7 Supporting Phosphorus Reduction Activities

Supporting activities to be undertaken as part of this NPS Reduction Plan will provide valuable information for long-term success, in addition to the subbasin-specific actions and BMPs designed to provide direct phosphorus reduction. These activities are described in Chapter 9.

HLC-SA-1 Identify Data Gaps

The available data in the Hangman Creek subbasin should be inventoried and significant data gaps should be identified as recommended in the Hangman Creek Water Resources Management Plan (Ecology, 2005). Understanding where more information is needed will help with selecting monitoring decisions.

Activity: Review available data and determine where data gaps exist.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

13.5.8 Additional Activities

Additional activities include indirect actions that either lead to overall improvements in ecological functions and thus water quality or provide additional insights into the overall health and conditions of the watershed. Activities are described in Chapter 9. Additional activities in the Hangman Creek subbasin include the coordination of activities on Lake Spokane, nearshore, and upstream activities.

HLC-AA-1 Consider Phosphorus Free Fertilizer Ordinances

Municipalities across the U.S. have adopted phosphorus free fertilizer ordinances, such as a phosphate lawn fertilizer ban. Retailers and fertilizer producers have appropriate fertilizers products available that meet these ordinances. Some ordinances allow the use of fertilizer with phosphorus under specific circumstances such as if soil testing showing a phosphorus deficiency or for establishing new lawns or plants. A USGS study found that "runoff from lawn sites with non-phosphorus fertilizer applications had a median total phosphorus concentration that was similar to that of unfertilized sites, an indication that non-phosphorus fertilizer use may be an effective, low-cost practice for reducing phosphorus in runoff" (USGS, 2002). House Bill 1489 goes into effect January 2013 which restricts the sale and use of fertilizers containing phosphorus for turf lawns statewide. The bill allows fertilizers with phosphorus for new and damaged turf or when soil testing indicates a phosphorus deficiency.

Activity: Adopt ordinances that ban the use of fertilizer containing phosphorus.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.

HLC-AA-2 Evaluate, Protect and Enhance Nearshore Areas

Nearshore land management and activities have the potential to impact phosphorus loads to surface water. Within the Hangman Creek subbasin, these activities apply to areas nearshore to Hangman Creek, Rock Creek, California Creek and other tributaries in the subbasin. Stream bank erosion and mass wasting along Hangman Creek, along with agricultural practices, are the largest source of sediment loads to Hangman Creek (Ecology 2009a). The Spokane County Conservation District, in collaboration with property owners, has implemented numerous stream bank stabilization projects in the subbasin.

Nearshore sources may transport phosphorus loads via surface water, stormwater runoff, interflow, and groundwater. Unlike activities and BMPs implemented upstream, there is no attenuation of phosphorus loads associated with nearshore sources. Therefore, reduction of loads from nearshore areas is important and should be considered as part of the overall nonpoint source phosphorus load reduction strategy. Nearshore areas should be inventoried to identify areas where BMPs should be implemented. BMPs that should be considered for nearshore areas include, but are not limited to:

- Erosion control and bank stabilization.
- Filter strips.
- Septic tank elimination.
- Inspection and pumping of septic systems.
- Phosphate lawn fertilizer ban.
- Riparian fencing, riparian zones and buffer strips.
- Education and outreach to nearshore property owners.

Additional detail regarding these BMPs is provided in Chapter 8.

Activity: Evaluate nearshore areas to Hangman Creek, Rock Creek, California Creek and other tributaries in the subbasin and implement activities and BMPs to reduce nonpoint source phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

13.5.9 Support Existing and Planned Activities

The NPS Reduction Plan supports existing water resources and water quality studies and planning. Protection of these resources also supports the reduction phosphorus nonpoint sources. Critical planned activities specific to the NPS Reduction Plan are identified below.

HLC-EP-1 Implement or Complement WRIA 56 Detailed Implementation Plan

The WRIA 56 Hangman (Latah) Creek Watershed Detailed Implementation Plan (Ecology, 2008b) recognized that nonpoint source pollution contributes to the low oxygen condition of the Spokane River and Lake Spokane. Land use and water quantity and quality are inextricably linked. One of the objectives was to reduce the threats to water quality from nonpoint sources. Some of the activities identified include improving and protecting riparian zones, starting management programs in the communities, and enforcing appropriate septic system construction care, inspection, upgrades, and maintenance. Another aspect is the coordination of cross state stakeholders. These groups are working together to organize and implement individual efforts that integrated together will protect and improve water quality in the Hangman Creek. The coordination between the states for the Hangman Creek Subbasin can also serve as a model for coordination in the larger Spokane River Watershed.

Activity: Implement actions in the WRIA 56 Detailed Implementation Plan.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-EP-2 Implement Recommended TMDL Actions

IDEQ completed sediment, bacteria and temperature TMDLs for seven named streams with the Idaho portion of the Hangman Creek subbasin, but outside of the Coeur d'Alene Indian Reservation. These TMDLs were approved by EPA in 2007. The sediment TMDL identified roads, mass failures, and accelerated stream bank erosion as sources of sediment. (DEQ, 2007a)

In the Washington portion of the subbasin, Ecology and the Spokane County Conservation District worked together to develop a fecal coliform bacteria, temperature, and turbidity TMDL. EPA approved the report in 2009. Ecology and the Spokane County Conservation District have been developing an Implementation Plan outlining what needs to occur to meet water quality targets in the watershed and various commitments to the effort. The draft plan was completed in

early 2011 (Ecology, 2011). The draft Implementation Plan primarily focuses on addressing sediment and nutrient pollution. It identifies the need for: agricultural BMPs that keep soil on fields and reduce erosion; riparian fencing with off-stream watering for livestock; education about proper household fertilizer and chemical use and disposal; education about proper maintenance and inspection of septic systems; measures to address sediment from gravel roads, sheer/undercut banks, and stormwater; and compliance with forestry management regulations (Ecology, 2011).

Hangman Creek also has dissolved oxygen and pH impairments which are typically the result of excess nitrogen and phosphorus. A separate TMDL to address these parameters will be developed when resources become available. However, many of the Implementation Plan strategies from the fecal coliform, temperature, and turbidity TMDL are expected to also address nonpoint sources contributing to the dissolved oxygen and pH impairments. (Ecology, 2011)

Because sediments transport phosphorus, the turbidity TMDLs relates to nonpoint source phosphorus load reductions. The actions in both the Idaho and Washington turbidity and dissolved oxygen TMDLs are encourage to be carried out.

Activity: Implement actions in the Idaho and Washington turbidity and dissolved oxygen TMDLs to reduce nonpoint source phosphorus loads.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-EP-3 Support and Supplement Avista Utilities WQAP Implementation

Avista Utilities is developing WQAP to identify how they will mitigate for impacts to dissolved oxygen in Lake Spokane caused by the Long Lake Dam (Ecology, 2010). The WQAP should be completed in 2012. Avista's efforts to implement the plan elements should be supported. In addition, other organizations in the Hangman Creek subbasin should look for ways to collaborate with and complement Avista's efforts to advance and expand success in reducing nonpoint source phosphorus loads.

Activity: Support and supplement Avista Utilities WQAP implementation to achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-EP-4 Support Existing Stream Restoration Activities

The Lands Council has been completing stream restoration activities and planting trees with volunteer help from various organizations (Table 13-5). These events have provided educational opportunities as well as benefited the environment. These activities support the reduction of nonpoint source phosphorus.

Table 13-5. Stream Restoration and Tree Plant Events

Tree-Planting Location	Number of Trees Planted	Number of Participants	Volunteer Affiliation (if applicable)
Hangman Creek, Campion Park	450	85	Garfield Elementary School, APPLE program
Hangman Creek, Spangle area	3,000	10	"Willow Warriors," Spokane County Conservation District
Hangman Creek, Campion Park	120	40	Gonzaga Mentoring/Shaw Middle School Connections program
Hangman Creek, Spangle area	200	20	Inland Northwest Land Trust
People's Park	270	45	North Central and Lewis & Clark High Schools
Hangman Creek, Spangle area	2,000	10	N/A
Hangman Creek, Spangle area	140	60	West Valley Outdoor Learning Center

Activity: Support The Lands Council and others existing stream restoration activities.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-EP-5 Support and Enforce Spokane County and City of Spokane Shoreline Master Plans

Washington's Shoreline Management Act governs the use and development of Washington's shorelines and creates a unique partnership between local and state government. The Act strives to achieve responsible shoreline use and development, environmental protection, and public access. Local governments develop programs based on the Act and state guidance, and the state reviews local programs to consider statewide public interests, (Ecology, 2011b). Spokane County and the City of Spokane have shoreline master plans that establish policies and regulations for shoreline use and modification activities. Each plan is unique and involves distinct requirements for different types of development, uses, activities, and distinct requirements for different water bodies; however, each plan has similar requirements relating to nonpoint source phosphorus reduction including:

- Setback requirements for structures and uses.
- Requirements for retaining and enhancing natural vegetation buffers and restoring shoreline functions.

Both plans include specific designations for Hangman Creek shorelines, and Spokane County's plan includes specific requirements for on-site wastewater treatment systems.

Activity: Support and Enforce County Shoreline Master Plans to achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

HLC-EP-6 Support, Compliment and Enforce Permits, Ordinances, Plans and Activities Relating to Nonpoint Source Phosphorus Reduction

There are a variety of permits, ordinances, plans and activities within the Hangman Creek subbasin that relate to nonpoint source phosphorus reduction, including:

- Coeur d'Alene Tribe water quality standards, natural resource requirements and water resource program.
- City of Spokane and Spokane County NPDES Phase II Stormwater Permit Requirements.
- City of Spokane and Spokane County critical area ordinances.
- Spokane County Conservation District natural resource conservation plan.
- Spokane River Forum education efforts.

When taking actions and implementing BMPs to reduce nonpoint source phosphorus, consider these and other related plans, goals, requirements and efforts to optimize reduction potential. Review that erosion control BMPs are followed at land development projects and construction sites.

Activity: Support, compliment and enforce permits, ordinances, plans and activities to achieve nonpoint source phosphorus reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

Chapter 14

Upper Spokane River, ID Subbasin - Nonpoint Source Phosphorus Management Strategy and Actions

14.1 Introduction

An objective of this NPS Reduction Plan is to formulate nonpoint source control strategies that contribute to long-term reductions of phosphorus loads. It provides guidance on selecting 'what' strategies and actions to take and 'where' to apply them. Chapter 9 provides an introduction to the subbasin actions and strategies, background of the NPS Study objectives, how the subbasin chapters support the overall NPS Reduction Plan, and regional phosphorus control strategies that should be considered in all subbasins in the Spokane River Watershed.

This chapter identifies specific actions for entities located in the Upper Spokane River, ID subbasin and stakeholders supporting these entities to reduce nonpoint source phosphorus. Identified are strategies and actions and areas to target within the subbasin. The guidance identifies potential organization leads and potential timelines for initial and long-term reductions of nonpoint source phosphorus pollution.

The following sections of this chapter describe:

- The identification and relationship of entities and stakeholders in the watershed and associated acres of land ownership.
- An overview of reduction strategies, actions, and schedule for the subbasin.
- An overview of the nonpoint source reduction opportunities and guidance on 'what' BMPs to implement and 'where' to take these actions.
- The specific actions by category identified to be undertaken, including those identified by specific entities and stakeholders.

Estimates of the potential BMP phosphorus reductions and cost per pound are provided in Chapter 8. The overall phosphorus reduction potential is discussed in Chapter 9.

14.2 Entities and Stakeholders

As discussed in Chapter 9, accomplishing nonpoint source reductions will require engaging local, state, and federal agencies and land managers, as well as private land owners. The principal organizations involved with securing funding, identifying priority locations, selecting BMPs, and taking actions in the Upper Spokane River, ID subbasin include those shown in Table 14-1. These organizations are subdivided into entities and stakeholders as shown in Table 14-2, along with the area of land owned and miles of streams in the Upper Spokane River, ID subbasin. Land ownership for the subbasin is shown in Figure 14-1.

Table 14-1. Organizations and Nonpoint Source Phosphorus

Organization
Local Governments
Kootenai County
Shoshone County
Kootenai-Shoshone Soil and Water Conservation District
Idaho Panhandle Health District 1
Municipalities
Athol, Coeur d'Alene, Dalton Gardens, Hauser, Hayden, Hayden Lake, Huetter, Post Falls, Rathdrum
Utilities
Avista Utilities
Hayden Area Regional Sewer Board
Approximately 20 municipal water service providers
Tribal Governments
None identified
State Agencies
Idaho Department of Environmental Quality
Idaho Department of Lands
Idaho Department of Parks and Recreation
Idaho Fish and Game
Idaho Forest Products Commission
Idaho Rangeland Resource Commission
Idaho Soil Conservation Commission & Idaho Soil and Water Conservation Commission
Idaho State Department of Agriculture
Idaho Transportation Department
Federal Agencies
Coeur d'Alene National Forest
U.S. Bureau of Land Management
U.S. Department of Agriculture – Natural Resource Conservation Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service

Table 14-2. Organizations and Land Area

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Private				
In Athol	415	Athol	Kootenai-Shoshone Soil and Water Conservation District	n/a
In Coeur d'Alene	7,290	Coeur d'Alene		
In Dalton Gardens	1,519	Dalton Gardens		
In Hauser	532	Hauser		
In Hayden	5,992	Hayden		
In Hayden Lake	393	Hayden Lake		
In Huetter	25	Huetter		
In Post Falls	8,884	Post Falls		
In Rathdrum	3,065	Rathdrum		
In Stateline	66	Stateline		
In Kootenai County	190,635	Kootenai County		298.8
In Coeur d'Alene National Forest	9,701	U.S. Forest Service	USDA – Natural Resource Conservation Service	32.4
Incorporated Municipalities[2]				
Athol	*482*	Idaho Department of Environmental Quality, U.S. Environmental Protection Agency	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	0
Coeur d'Alene	*7,422*			4.2
Dalton Gardens	*1,519*			0.3
Hauser	*567*			0.5
Hayden	*6,025*			1.4
Hayden Lake	*503*			0.8
Huetter	*25*			0
Post Falls	*8,982*			3.1
Rathdrum	*3,067*			3.0

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Local Governments[2]				
Kootenai County	*243,684*	Idaho Department of Environmental Quality, U.S. Environmental Protection Agency, Idaho Fish and Game, U.S. Fish and Wildlife Service	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	475.5
State Agencies				
Idaho Department of Fish and Game	82	Idaho Department of Environmental Quality, Idaho Fish and Game, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	0.3
Idaho Department of Lands	10,488			24.3
Idaho Department of Parks and Recreation	49			0
Idaho Transportation of Department	798			n/a
Federal Agencies				
U.S. Bureau of Land Management	223	U.S. Environmental Protection Agency	USDA – Natural Resource Conservation Service	
U.S. Forest Service	35,419			
Additional Land Areas				
Roads	798 miles		474 stream crossings	

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation, road miles include primary, secondary, local and forest service roads.

[2] Incorporated municipalities and local governments is total land area within boundaries, not land ownership.

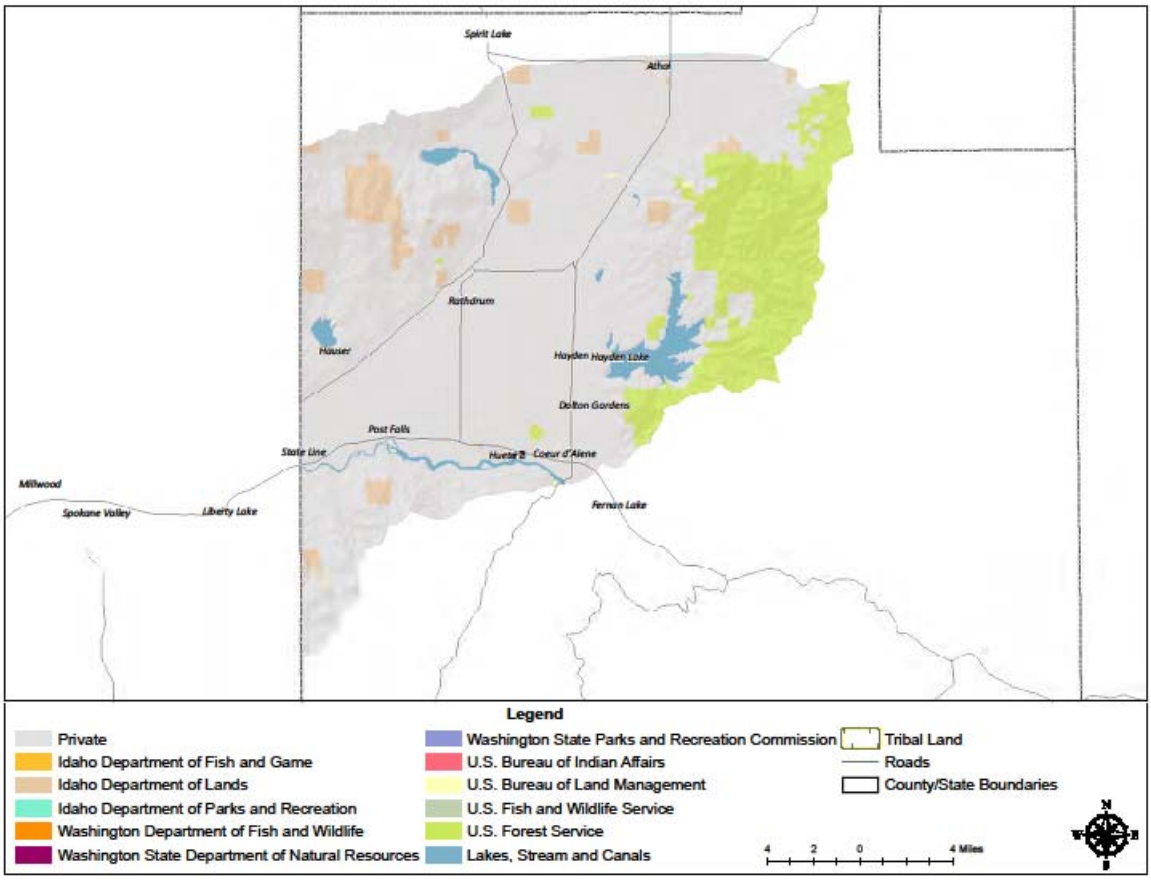

Figure 14-1. Upper Spokane River, ID Subbasin and Land Owners

14.3 Overview of Reduction Strategy, Actions, and Schedule

Identifying strategies for reducing nonpoint source phosphorus in the Upper Spokane River, ID subbasin is an important step to protect and restore water quality in the Spokane River. A successful strategy will also ultimately support improving dissolved oxygen concentrations in Lake Spokane. The extent of water quality improvements will depend on fate and transport processes which were not addressed in the NPS Study. Nonpoint source phosphorus reductions will have both local and watershed benefits.

14.3.1 Strategy

The strategy for addressing nonpoint sources of phosphorus includes taking actions throughout the subbasin. Nonpoint source reduction actions include addressing obvious problems and undertaking actions that can be readily completed. The strategy emphasizes reducing nonpoint source phosphorus from land uses that generate large phosphorus loads and cover large areas of the subbasin. A subbasin scale assessment of these land uses revealed that cropland and pasture land and evergreen forest are dominant throughout the subbasin (Chapter 3).

14.3.2 Actions

Actions are the measures or steps from planning through achievement of nonpoint source phosphorus reduction. Actions include sufficient description and specificity for a responsible party to decide to take the action. The actions also help the responsible party determine where, what, when, and how to achieve the potential suggested outcome.

BMPs are the core of the action; whereas, actions encompass the entire process from the identification of the area, selection and implementation of the BMP through post monitoring. BMPs for addressing nonpoint sources of phosphorus include structural (i.e., physical) and non-structural (i.e., educational) measures.

BMPs referenced in the actions in Section 14.5 were identified based on the dominant land uses and the associated loading potential of the land uses. BMP phosphorus percent reduction efficiency, costs, estimated longevity and implementation effectiveness were also key indicators for identifying high priority BMPs for the subbasin. See Chapter 8 Nonpoint Source Phosphorus Control Measures for information about BMPs and the prioritization process.

14.3.3 Schedule

The schedule for nonpoint source actions for this plan is based on meeting the schedule in the Spokane River DO TMDL (Ecology, 2010). The schedule targets expeditious management actions to reduce nonpoint source phosphorus over the next two decades. From the Spokane River DO TMDL approval (May 2010), progress will be evaluated every 5 years, with extensive assessments after 10 and 20 years. The results from the first 10 years will be used to guide actions during the second 10-year period. Actions initiated in the first 10 years and determined to be beneficial should be continued, including successful nonpoint source control.

14.3.4 Summary of Approach

DEQ has not developed a TMDL and load allocation for the Upper Spokane River, ID subbasin to match with the Spokane River DO TMDL (Ecology, 2010). Ecology assigned load allocations for the Little Spokane River and Hangman Creek subbasins and provided seasonal estimates for the percent reduction in nonpoint source phosphorus loads. These seasonal estimates were converted to average annual equivalents. Based on the reductions for the Little Spokane and Hangman Creek subbasins, a target reduction of approximately 25 percent within upstream subbasins is estimated to be necessary to meet downstream targets. Using an average efficiency of 54 percent for the priority BMPs (Chapter 8), approximately 85 percent of the major land uses (cropland and pasture and evergreen forest) would need BMPs applied to achieve the target. Based on the average cost for the priority BMPs of about $320/pound (Chapter 8), the total cost for the target reduction would be approximately $1,744,000. Achieving the target reduction over a 20-year period will require that approximately $87,000 is spent annually on BMPs in the subbasin.

14.4 Overview of Opportunities

Opportunities for organizations to undertake nonpoint source phosphorus reductions are available throughout the subbasin. This overview includes a description of what BMPs are the

most relevant and where the BMPs should be implemented. Where the BMPs should be implemented is specific to land uses.

14.4.1 Control Measures and BMPs

BMPs specific to land use type and source are described in detail in Chapter 8. The background included in Chapter 8 narrowed the list of BMPs from 108 to 22 based on phosphorus percent reduction efficiency, cost, estimated longevity, and implementation effectiveness. This list of BMPs, if implemented for the appropriate land uses, could result in substantial net nonpoint source reduction of phosphorus.

There are several organizations throughout the Upper Spokane River, ID subbasin that can mitigate nonpoint source loads by incorporating BMPs. The agencies and organizations are encouraged to review the land and nonpoint phosphorus sources in their jurisdiction to further identify BMPs that are specific to their situation.

Organizations should examine areas within their influence to identify opportunities where these BMPs can be implemented to reduce nonpoint source phosphorus. These organizations should also examine their stormwater management practices and look for opportunities to implement BMPs since stormwater is a primary transport mechanism for nonpoint source phosphorus. Organizations identified in Tables 14-1 and 14-2 include private, municipal, state and federal entities. Associated opportunities for nonpoint source phosphorus reduction include:

- Private land owners may protect and restore riparian corridors; minimize stormwater runoff; and consider education, land evaluation, and/or aide available from the conservation organizations.
- Municipalities may install BMPs to treat and/or reduce stormwater discharge to water bodies; evaluate where stormwater is being discharged; and/or evaluate the pollutant loading by collecting samples for analysis.
- State and federal agencies should review activities occurring on the land, identify potential impacts, and implement applicable BMPs.

14.4.2 Land Uses and Source Potential

The NPS Reduction Plan is meant to provide guidance on where to take action, as actions are voluntary and not mandatory. The NPS Study was conducted at the watershed and subbasin scales and is limited in its guidance to actions at those scales. Actions by organizations are limited by their jurisdictions and authority. Organizations will need to examine local conditions to determine specifically where they choose to take action.

The NPS Reduction Plan analyses (Chapters 6 and 7) evaluated the dominant land uses and the phosphorus load potential for each subbasin. In some cases, the largest land use did not match the largest phosphorus load reduction potential. The following land uses have the highest priority for the Upper Spokane River, ID subbasin with respect to nonpoint source phosphorus loading:

- Evergreen Forest.
- Range.

The analytical evaluation results indicated that the Spokane River corridor of the subbasin has the highest nonpoint source phosphorus loading rates in the Upper Spokane River, ID subbasin (see Chapter 7). These two sub-subbasins with the highest estimated loadings are Cable Creek (0.107 lbs/ac/yr) and Rathdrum Prairie (0.104 lbs/ac/yr). These subareas should be considered as priority areas for action.

The Upper Spokane River, ID subbasin is dominated by evergreen forest land (61 percent) and shrub and brush rangeland (13 percent). These land uses also have the greatest phosphorus removal potential. Organizations are encouraged to take action in these high priority land use areas. These particular land uses represent the priority areas where nonpoint source phosphorus actions are necessary to achieve a significant net reduction. Organizations should examine areas they own or are within their influence, and look for opportunities to reduce nonpoint source phosphorus from the prioritized land uses. Organizations should also examine areas within their jurisdiction that are obvious areas for nonpoint source reduction opportunities.

14.4.3 Summary of Reduction Opportunities

BMPs have been prioritized first by their ability to remove nonpoint source phosphorus loads and then by land use type. The acres of land use by organization were computed and are tabulated in Table 14-3. The acres in Table 14-3 demonstrate how the land uses are distributed among the land owners and where the opportunities for reductions may exist.

The export coefficients summarized in Chapter 7, along with the land uses and areas, can be used to estimate potential nonpoint source phosphorus loads by organization. There is an associated range of reduction opportunities based on the potential to reduce phosphorus loads. These opportunities are presented in Table 14-4 by assigning a load reduction potential that ranges from low to high. The range is based on total phosphorus load; therefore, higher potential may be due to a greater export coefficient, the total land area, or a combination of both. Table 14-4 is intended to provide further guidance for considering and selecting BMPs for implementation.

Figure 14-2 shows land ownership with stream segments highlighted in areas of high potential for nonpoint source phosphorus reduction based on the land use and export coefficients. Stream segments are shown since the highest priority BMPs in this subbasin generally relate to stream or riparian corridors.

Table 14-3. Organizations Land Area by Land Use

Land Owners	Agriculture[1] (acres)	Forested[1] (acres)	Rangeland[1] (acres)	Urban / Suburban[1] (acres)	Other[1] (acres)
Private					
Private	16,050	102,203	43,001	27,980	1,950
Incorporated Municipalities[2]					
Athol	0	121	62	229	3
Coeur d'Alene	940	439	472	5,440	6
Dalton Gardens	0	98	57	1,365	1
Hauser	0	276	131	117	8
Hayden	1,503	626	667	3,194	7
Hayden Lake	0	117	11	233	33
Huetter	0	5	0	19	0
Post Falls	1,673	337	2,058	4,818	6
Rathdrum	380	245	1,489	947	6
Stateline	0	0	43	24	0
Local Governments[2]					
Kootenai County	16,018	146,724	44,728	28,501	7,897
Shoshone County	32	328	113	33	1
State Agencies					
Idaho Department of Fish and Game	0	15	28	32	7
Idaho Department of Lands	0	9,892	517	84	2
Idaho Department of Parks and Recreation	0	39	4	5	0
Federal Agencies					
U.S. Bureau of Land Management	0	171	12	39	2
U.S. Forest Service	0	34,079	1,081	217	64

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation.

[2] Incorporated municipalities and local governments is the total land area within boundaries.

Table 14-4. Organizations and Potential for Nonpoint Source Phosphorus Reduction

Land Owners	Agriculture[1]	Forested[1]	Rangeland[1]	Urban / Suburban[1]	Other[1]
Private					
Private	High	High	High	High	High-Mod.
Incorporated Municipalities					
Athol	n/a	Moderate	Low-Mod.	Moderate	Low-Mod.
Coeur d'Alene	High	High-Mod.	Moderate	High	Low
Dalton Gardens	n/a	Moderate	Low-Mod.	High-Mod.	Low
Hauser	n/a	Moderate	Moderate	Moderate	Low-Mod.
Hayden	High	High-Mod.	Moderate	High-Mod.	Low
Hayden Lake	n/a	Moderate	Low	High-Mod.	n/a
Huetter	n/a	Low	n/a	Low-Mod.	n/a
Post Falls	High	High-Mod.	High-Mod.	High-Mod.	n/a
Rathdrum	High-Mod.	Moderate	High-Mod.	High-Mod.	Low
Stateline	Low	n/a	Low-Mod.	Low-Mod.	n/a
Local Governments					
Kootenai County	High	High	High	High	High-Mod.
Shoshone County	Moderate	High-Mod.	Low-Mod.	Low-Mod.	Low
State Agencies					
Idaho Department of Fish and Game	n/a	Low-Mod.	Low-Mod.	Low-Mod.	Low
Idaho Department of Lands	n/a	High	Moderate	Moderate	Low
Idaho Department of Parks and Recreation	n/a	Low-Mod.	Low	Low	n/a
Federal Agencies					
U.S. Bureau of Land Management	n/a	Moderate	Low	Low-Mod.	Low
U.S. Forest Service	n/a	High	High-Mod.	Moderate	Low-Mod.

[1] NPS load potential based on area and export classified into five categories, low, low-moderate, moderate, high-moderate, and high.

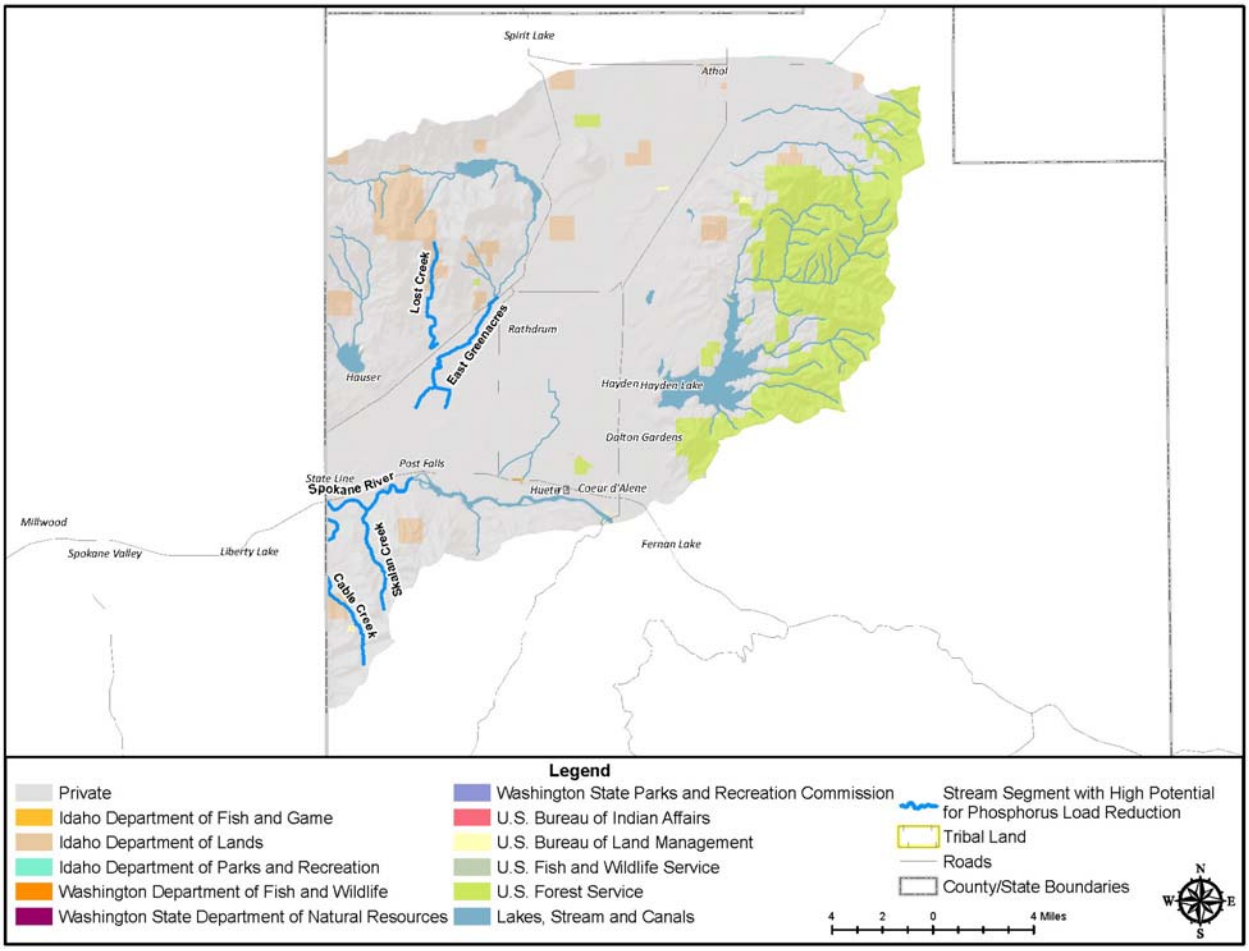

Figure 14-2. Upper Spokane River, ID Subbasin High Potential Reduction Opportunities

14.5 Specific Actions by Category

This section includes a list of specific actions to reduce nonpoint source phosphorus loads and ultimately contribute to meeting water quality standards. A general description of each action, an activity summary, potential phosphorus load reduction, a range of costs, potential timelines, and the potential lead entity are provided for each action. Although it was not a primary objective of the NPS Study to specify "who" implements phosphorus control measures, potential lead organizations are identified for some actions to help provide linkage to the "what" and "where" objectives of the NPS Study. The lead organization will need to assist local entities in developing detailed plans for the activities, as well as a schedule and plan for monitoring progress. When the information was available, the action also includes a description of the roles of the organization with responsibility to improve water quality, and the means through which the organization will address the water quality issues.

14.5.1 High Priority BMPs

The analysis provided in Chapter 8 described the following BMPs as having the highest priority for the Upper Spokane River, ID subbasin:

- Streamside Management Zones.
- Riparian Zones and Buffer Strips.
- Stream Bank Stabilization.
- Erosion Control.

Specific details regarding implementation of these high priority BMPs are provided in Chapter 9. These BMPs are appropriate for implementation for land uses in the subbasin. The following sections summarize actions appropriate for the specific land uses within the Upper Spokane River, ID subbasin.

14.5.2 Regional Phosphorus Management

Regional phosphorus control strategies are not specific to any one land use type or organization, and may contribute to the reduction of nonpoint source phosphorus loadings in the subbasin. Descriptions of the regional or watershed-scale phosphorus management actions intended to facilitate load reductions and/or establish the technical foundation for further phosphorus control activities are described in Chapter 9.

14.5.3 Agriculture Related Activities

BMPs related to agricultural practices can have substantial impacts on nonpoint source phosphorus loading since agricultural land uses tend to be phosphorus intensive. BMPs under this category are typically associated with crop land uses, crop till management, and livestock grazing practices.

USI-AR-1 Fertilizer Application Location and Timing

Managing the location and timing of fertilizer application can minimize the loss of phosphorus from the field and maximize plant uptake. Assistance may be obtained from the Kootenai or Shoshone county extension offices or Kootenai-Shoshone Soil and Water Conservation District. These agencies could also provide free seminars and literature about implementing such BMPs.

Optimizing fertilizer application and timing can be achieved through the following actions:

- Incorporate or inject fertilizers with phosphorus below the soil surface to reduce the total and soluble phosphorus losses (Fawecett, unknown). “Subsurface injection of fertilizer, as compared to surface application, reduced losses by 39 percent for no-till and by 35 percent for conventional tillage” (Mostaghimi, et al., 1988).
- Establish fertilizer management areas and apply at agronomic rates for those areas with phosphorus deficits, see USI-AR-2 (Waskom and Bauder, unknown). “Maintain a buffer strip (where fertilizer and manure is not applied) a safe distance from surface water and drainage channels” (Waskom and Bauder, unknown). BMPs that buffer riparian zones were rated as high priority (Chapters 7 and 8).
- Avoid fertilizer and manure application to frozen and wet soils (Fawecett, unknown). For example, the earliest and latest spring freeze dates are April 4 and June 18 in Coeur d’Alene (WRCC, 2011).

Activity: Provide support to growers with information on fertilizer management.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-AR-2 Fertilizer Application Rates

Sample the tillage layer of soil in each field on a regular basis and have soil analyzed to determine available soil phosphorus levels prior to applying fertilizers with phosphorus. Use crop and soil guides to determine agronomic application rates such as the University of Idaho Northern Idaho Fertilizer Guide or Washington State University Fertilizer Guides and Summary. The most common crops in this subbasin are alfalfa, spring wheat, herbs, winter wheat, and pasture/hay. Alfalfa may need phosphorus fertilizer incorporated into the soil for seedlings. Established alfalfa and pasture may need phosphorus fertilizer every 2 to 3 years and should be done in the fall as spring, as fertilization is less effective in the spring and winter when it is more susceptible to runoff. Wheat has a relatively low demand for phosphorus. Herbs are dependent on the type, soil conditions and application method.

Activity: Provide support to growers about soil phosphorus testing and fertilizer application rates.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-AR-3 Runoff Management and Treatment

Manage runoff, from stormwater and irrigation if irrigating, to minimize runoff and treat runoff before entering waterbodies. Employ contouring or other techniques to reduce runoff potential. Maintain grass filter strips on the downhill perimeter of erosive crop fields to catch and filter phosphorus in runoff. These types of BMPs were rated as high priority (Chapters 7 and 8). Manage irrigation water to minimize runoff and erosion with irrigation BMPs or NRCS irrigation water management practices.

Slope is one factor that affects runoff. In this subbasin, the percentage of agricultural land use by slope classes are generally 94 percent has 0 to 5 percent slope; 3 percent 5 to 10 percent slope; 1 percent 10 to 15 percent slope; 1 percent 15 to 20 percent slope; and 1 percent greater than 20 percent slope. These slopes in combination with the soil types and other factors result in 87 percent of agricultural land use in the subbasin having a capability description of “severe limitations that reduce the choice of plants or require special conservation practices, or both”. This matches with implementing the recommended BMPs for managing and treating runoff. About 92 percent of the agricultural land use in the subbasin is rated as “good” relative to herbaceous habitat for wildlife such as in buffer zones.

Activity: Provide support to growers about runoff management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.

Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-AR-4 Crop Management

Crop management is related to many agricultural BMPs, including tillage type (conservation tillage/no-till/direct drill seeding), contouring (contour plowing and terracing and contour strip crop), crop rotation and erosion management (see Chapter 8). Crop management is related to the typical crops grown in the subbasin. Crops grown in the subbasin include: alfalfa, barley, canola, clover/wildflowers, dry beans, herbs, lentils, mustard, oats, pasture grass, pasture hay, peas, potatoes, rape seed, grass seed, and spring and winter wheat. Support economic crop management practices that also provide environmental benefits. This may require transformation in agency policies, new legislation, or other adjustments from historical practices that result in economic disincentives for implementing actions.

Activity: Provide support to growers about crop management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-AR-5 Animal Management

Animal management is related to many agricultural BMPs, including water supply, riparian zone exclusion, and feed, grazing and waste management (see Chapter 8). For example fencing riparian corridors limits livestock access to streams and ultimately protects water quality. Animal management is related to the head of animals raised in the subbasin. However, operations with large numbers of animals including cattle, dairy cows, turkeys, broilers and laying hens, may fall under confined animal feeding operation requirements instead. Smaller operations can also result in intense pressure on the land such as disturbance to drainages and streambanks, soil erosion, and animal wastes. Recommended priority BMPs such as buffers and riparian zones are beneficial to reducing or eliminating these pressures.

Activity: Provide support to producers about animal management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

14.5.4 Forestry Related Activities

BMPs related to forestry practices can reduce nonpoint source phosphorus. While phosphorus export forestry in general is low, local areas of intensive use can have higher phosphorus export rates. Since the Upper Spokane River, ID subbasin is mostly forested, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing erosion, reducing sediment transport, protecting and maintaining riparian corridors and streamside management zones.

USI-FR-1 Evaluate Forestry Practices

Idaho's forest practices regulations will be relied upon to reduce nonpoint source phosphorus loads from private and state forestlands. Ongoing practices should be reviewed by or as directed by the lead organization for compliance. If compliance with the existing regulations is not resulting in sufficient reduction, then more effective methods need to be promoted. Poorly performing practices need to be researched for the causes and potentially modified to improve the outcomes.

With large quantities of adjacent forested land, tributary water quality is likely affected by forest management practices. Logging and road building practices that have been common throughout the intermountain region from the late nineteenth century through most of the twentieth century have likely contributed to the degradation of water quality. In more recent times, implementation of more environmentally sound forest management practices has occurred. These practices may have reduced forestry-related phosphorus loading within the subbasin but additional reductions are still possible.

The Idaho Forest Practices Act (IDAPA 20.02.01) defines the minimum level of best management practices (BMPs) required to be implemented for commercial timber lands in Idaho. It is anticipated that the new road maintenance and abandonment plans required by the current forest practices rules will slowly reduce phosphorus export from harvested forests.

The agencies have data on forest health, ecology, harvest areas, vegetation types, soil conditions and more. This information can be useful for identifying areas of greater nonpoint source phosphorus loading. However, much of this data is not readily available or in a format that can be interpreted by water quality managers. Coordination between forest and water quality managers is necessary to understand the data and select management activities.

Activity: Enforce existing regulations, evaluate existing practices, discourage poorly performing practices, and encourage best performing practices and improve coordination of sharing information.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-FR-2 Quantify Sediment-Phosphorus Relationship in Forested Areas

Quantifying phosphorus loading associated with forest management practices may provide additional information that support selection of successful BMPs. The construction and use of roadways represent a major source of sediment from timber harvest activities (DEQ, 2000). A study to quantify the relationship between sediment associated with phosphorus in runoff from these roads can help determine whether additional measures should be undertaken.

Activity: Quantify relationship between sediment and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.

Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-FR-3 Subbasin Scale Road Planning and Rehabilitation

Conduct a subbasin-scale management survey to inventory ownership and identify and prioritize the total miles of erodible roads and road banks. Specific BMPs may then be developed based on survey results to reduce miles of erodible roads associated with road construction, road conversions, and maintenance. A database of roads with tracking of BMP implementation is essential for determining success and accountability. Reduction plans should identify opportunities to abandon non-essential roads or restore roads on non-industrial forest lands and other county roads that contribute obvious erosion problems.

Activity: Quantify relationship between roads and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-FR-4 Fire Rehabilitation Areas

Wild fires can significantly impact the landscape. Research has shown increased concentrations of suspended sediments, phosphorus, and potassium in streams below burned areas (Stednick, et al., 1982). Stream monitoring indicated an immediate flush of phosphorus in the runoff, followed by a slower release. Rehabilitation of burn areas, especially the riparian corridors to protect streams, will be important to reducing nonpoint source phosphorus in forested areas. The fire history from 2001 through 2010 suggests approximately 200 acres in the subbasin to have been burned and should be evaluated.

Activity: Identify and assist with rehabilitation of burned areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

14.5.5 Range Related Activities

BMPs related to rangeland practices can reduce nonpoint source phosphorus. Since range, shrub and brush land is the second largest percentage of land uses in the Upper Spokane River, ID subbasin, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing disturbance of range land, protecting and maintaining riparian zones and maintaining or stabilizing stream banks.

USI-RR-1 Evaluate Rangeland Practices

The state's regulations will be relied upon to reduce nonpoint source phosphorus loads from rangelands. Evaluate past and present impacts and review ongoing practices for compliance. The goal of evaluating past and present activities is to manage rangeland to maintain optimum soil

and water quality. If compliance with the existing regulations is not resulting in sufficient nonpoint source phosphorus reduction, then more effective methods should be identified and promoted.

Activity: Evaluate existing practices, enforce existing regulations, and encourage BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

14.5.6 Urban/Suburban Related Activities

Urban/suburban areas can have the most variable impacts on nonpoint source phosphorus loading due to the diversity of development, uses, and control of stormwater runoff. BMPs under this category are typically associated with minimization of pollution sources and the management of stormwater.

USI-UR-1 Business Practices to Prevent Stormwater and other Pollution

The Upper Spokane River, ID subbasin contains a relatively high percentage of the watershed business activity within the State of Idaho. Volume 5 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ 2005) provides a list and descriptions of BMPs geared toward contaminant loading reduction for commercial and industrial facilities. These practices include the following:

- Loading dock and equipment yard design elements.
- Material loading and storage practices.
- Restaurant control practices.
- Surface cleaning control practices.
- Spill prevention, control, and cleanup.
- Employee training.

Volume 2 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ 2005) provides a list and descriptions of BMPs geared toward contaminant loading reduction for construction practices. These largely deal with erosion and sediment controls and include the following:

- Construction timing.
- Temporary road construction practices.
- Stockpile and waste management.
- Slope protection and stabilization.
- Construction stormwater collection and handling.

Activity: Review existing practices, encourage BMP implementation, provide adequate resources and information to businesses.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-UR-2 Evaluate and Analyze Impervious Surfaces and Implement Stormwater BMPs

Impervious surfaces throughout the Upper Spokane River, ID subbasin are the source of substantial stormwater runoff. Within the subbasin, stormwater runoff enters both surface water and groundwater via infiltration. An understanding of the area and location of the impervious surfaces in the subbasin will guide the need and responsibility for implementation.

Dye tracing of stormwater from drains to outfalls can be helpful to determine where the flows discharge and potential additional BMPs at the discharge location. Around Liberty Lake, Washington, for example, two drains were dye tested, found to discharge to the lake, and subsequently modified with the installation of bio-infiltration systems to provide treatment (Hamlin, 2010).

Activity: Evaluate and quantify existing impervious surfaces, identify areas where vegetated buffer/filter strips or other applicable stormwater BMPs (see Chapter 8) could be installed, and encourage installation.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-UR-3 Evaluate and Revise Stormwater Policies

Approximately 11 percent of the subbasin contains urban and/or suburban land use. This action consists of a review of stormwater regulations of municipalities for water quality requirements. Municipalities have unique policies; however, working towards incorporating at least some minimum water quality requirements that address nonpoint source pollution including phosphorus across the watershed will provide some reduction in loads. Resources to consider include the following:

- DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ 2005).
- Idaho Department of Transportation's Erosion & Sediment Control—Best Management Practices Manual (Idaho DOT, 2011).
- DEQ's Compendium of Best Management Practices To Control Polluted Runoff, A Source Book (Metl and Maquire, 2003).
- The Spokane Regional Stormwater Manual (Spokane County et. al, 2008).

Consider holding a subbasin or watershed summit to evaluate and identify policies, and evaluate and determine areas throughout the Upper Spokane River, ID subbasin for implementation and

enforcement of the requirements. Keep in mind that some developed areas outside municipal jurisdictions should be considered.

Activity: Coordinate on minimum water quality stormwater treatment policies and requirements.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-UR-4 Strengthen Requirements for Stormwater Treatment BMPs in Key Areas

Stormwater treatment BMPs, such as bio-infiltration swales, bio-infiltration channels, vegetated buffer strips and infiltration basins are particularly important within the Upper Spokane River, ID subbasin because: 1) development frequently occurs above coarse-grained soils with limited treatment capacity and in close proximity to the Spokane River; 2) the Rathdrum Prairie portion of the subbasin directly overlies the sole-source SVRP Aquifer and is designated as the only Sensitive Resource Aquifer by the State of Idaho; 3) much of the forested upland area surrounding within the subbasins drains to and infiltrates to the SVRP Aquifer; and 4) the Upper Spokane River, ID subbasin contains the majority of the urbanized land use with the Idaho portion of the watershed.

Under Idaho's groundwater quality rule, activities with the potential to degrade Sensitive Resource Aquifers shall be managed in a manner which maintains or improves existing ground water quality through the use of BMPs and best available methods (IDAPA 58.01.11). Volume 4 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005) provides a list and description of permanent stormwater BMPs designed to control stormwater based contaminant loading. These include BMPs that treat stormwater through filtration, infiltration and/or detention.

The Upper Spokane River, ID subbasin contains the majority of the industrial land use within the Idaho side of the Spokane River Watershed. More stringent requirements could be considered for implementation of BMPs intended to reduce industrial discharges of phosphorus. This could include installation of sand filters at or near stormwater discharges, installation of catch basin filtration systems, installation of flocculation systems, and/or multi-chambered treatment trains (DEQ, 2005 and DEQ, 2001).

Implementation of this action would strengthen requirements regarding implementation of the stormwater treatment BMPs listed in this section. These requirements could include developed and redeveloped commercial, industrial and residential properties within the following key areas:

- Within Sensitive Resource Aquifer boundaries.
- Within 1,000 feet of the Spokane River and subbasin lakes (Hayden Lake, Hauser Lake, and Twin Lakes).

This action also could include guidelines regarding BMP maintenance. Stormwater systems that are properly operated and maintained function better and reduce maintenance costs and liability problems. Volume 4 of DEQ's Catalog of Stormwater Best Management Practices for Idaho

Cities and Counties (DEQ 2005) provides information on properly operating and maintaining stormwater systems for residential, commercial, or industrial developments. DEQ (2005) also include inspection and maintenance forms that prompt the user to identify problems that commonly occur with various stormwater control BMPs and provide recommendations for maintenance.

BMPs are also described below in the subactivities 'Install BMP' (see USI-UR-4a through 4d).

Activity: Implement rigorous stormwater BMP requirements in key portions of subbasin.
Potential Phosphorus Load Reduction: Varies depending on BMP – refer to USI-UR-4a through USI-UR-4d.
Range of Cost: Varies depending on BMP – refer to USI-UR-4a through USI-UR-4d.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County, City of Post Falls, City of Coeur d'Alene.

USI-UR-4a Install Grassed Bio-Infiltration Swales

To implement this BMP, stormwater runoff is directed to a grassed swale where vegetative cover provides pretreatment of stormwater before infiltration to the subsurface. Infiltration occurs either through the swale or within drywells that receive stormwater once the swale is filled to a design overflow elevation. The area surrounding the drywell and underlying the swale should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone.

Specific details regarding bio-infiltration swale design and construction within the Upper Spokane River, ID subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: Grassed swales have a wide range of potential phosphorus removal efficiencies from 20 to 61 percent (Miller, 1987) to 29 to 99 percent (Yu et al., 2001).
Range of Cost: No specific quantitative information regarding the cost of grassed bio-infiltration swales was found during the project review. However, based on BMP characteristics, costs are expected to be moderate to high with respect to the other BMPs described in this plan.

USI-UR-4b Install Bio-Infiltration Channels

To implement this stormwater treatment BMP, stormwater runoff is directed to a bio-infiltration channel underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). A bio-infiltration channel is a sloped, vegetated channel or ditch that both conveys and treats stormwater runoff. It does not provide flow control but can convey runoff to facilities designed for that purpose (Spokane County et al., 2008). A

bio-infiltration channel provides treatment as stormwater flows through vegetative cover and/or infiltrates. Channel flow can be directed to a pond or other facility. Infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Specific details regarding bio-infiltration channel and construction (also termed infiltration channels) within the Upper Spokane River, ID subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of bio-infiltration channels was found during planning. However, infiltration trenches and basins have a wide range of potential phosphorus removal efficiencies of 10 to 80 percent (EPA, 1999).
Range of Cost: No specific quantitative information regarding the cost of bio-infiltration channels was found during planning.

USI-UR-4c Install Vegetated Buffer Strips

Stormwater runoff is directed via sheet flow to a vegetated buffer strip situated adjacent to a rural roadway or parking lot. Vegetative cover within the buffer strip provides pretreatment of stormwater before infiltration to the subsurface, and/or evaporation. Vegetated buffer strips are used to intercept overland sheet flow runoff from adjacent impervious areas. They slow runoff velocities, filter out sediment and other pollutants, and provide infiltration into underlying soils. When buffer strips are used for infiltration, the area underlying the buffer strip should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone. Specific details regarding vegetated buffer strip design and construction within the Upper Spokane River, ID subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness or cost of vegetated buffer strips was found during the project review. However, vegetated filter strips have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Grass filter strips have low phosphorus removal costs of $190 to $250 per pound (Sera-17, 2010).

USI-UR-4d Infiltration Areas/Bioretention Basins

Stormwater runoff is directed to an infiltration area underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). The infiltration area can be equipped with a drainfield constructed of perforated pipe to facilitate infiltration. A suitable site requires soils with a sufficiently high permeability to allow for relatively rapid

infiltration, but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Spokane County and the City of Spokane have recently constructed/enhanced a number of regional stormwater infiltration facilities for the purpose of managing stormwater runoff in areas with difficult infiltration conditions on a site-specific level. When these facilities are located over relatively thick glaciofluvial sand and gravel sequences, benefit of water quality treatment may be limited. Examples include: Hazel's Creek Drainage and Conservation Facility (City of Spokane), Browne's Mountain Regional Stormwater Facility (Spokane County), and Price and Wall Regional Stormwater Facility (Spokane County).

DEQ (2005) provides guidance regarding bio-infiltration basins, which have similar design and operational elements.

Potential Phosphorus Load Reduction: Infiltration basins have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Infiltration structures generally have high phosphorus removal costs of $2,500 to $3,000 per pound (Corrozi, 2009).

USI-UR-5 Evaluate Phosphorus Load from Septic Tanks within Densely Developed Areas

While there is historical literature that suggests septic systems and subsequent treatment in the unsaturated zone provides phosphorus removal from effluent, recent and emerging evidence indicates the contrary in many locations. Both the current science and measured groundwater concentrations of phosphorus clearly indicate that septic systems release significant phosphorus loads into underlying groundwater and that phosphorus loading can increase with time as a result of the loading of sorption sites in the unsaturated zone. Moreover, the shallow hydrostratigraphy of many areas within the Upper Spokane River, ID subbasin consists of bedrock and/or coarse sediments, which have relatively little phosphorus removal capacity.

Removing septic systems and replacing with sewers involves considerable cost. Therefore, the reduction in phosphorus loading associated with septic tank removal within key densely developed areas that are outside of sewer service areas should be conducted as a basis for future management decisions. Septic system density within the Upper Spokane River, ID subbasin is summarized in Figure 4-6. The areas that should be considered include but are not limited to the following:

- Several anomalous areas of high septic system density within the portion of the Post Falls area within about 2 miles of the intersection of Interstate 90 and State Route 41.
- Residential developments surrounding Seltice Way between about Empire Center Boulevard to the east and Beck Road to the west.
- An area of anomalous high septic system density within the north portion of the City of Hayden, Idaho.
- Dalton Gardens, Idaho.

Particular emphasis with regard to the analysis of the extent and mitigation of septic tank loading (Actions USI-UR-5 and USI-UR-6) could be considered above Sensitive Resource Aquifers such as the SVRP Aquifer.

Activity: Evaluate phosphorus load from septic tanks within densely developed areas as a basis for future management decisions.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County or other municipalities.

USI-UR-6 Septic Tank Elimination within Key Areas

Removal of septic systems by connecting to sewer systems eliminates a source of pollution to surface and groundwater. Wastes are treated more thoroughly and phosphorus removal is more complete at a wastewater treatment facility designed for phosphorus removal than is possible with a septic system. For these reasons, septic tank elimination is an important long-term management approach to controlling nonpoint source phosphorus loading.

Septic tank elimination programs should be based on results of USI-UR-5, which will assist in identification of specific areas where infrastructure investment will lead to relatively large phosphorus loading reductions.

Activity: Remove septic systems and replace with sanitary sewer in key areas of the Upper Spokane River, ID subbasin.
Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of septic tank elimination was found during planning. However, based on the phosphorus removal characteristics of area wastewater facilities and that septic tank discharges are completely eliminated during removal, the expected effectiveness is very high.
Range of Cost: No specific quantitative information regarding the cost of septic tank elimination was found during planning. Potential costs may range from low to high with respect to the other BMPs described in this plan.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County.

USI-UR-7 Inspection and Pumping of Septic Systems within Key Areas

Regular inspection and pumping of septic systems prolongs the life of the system, reduces maintenance costs and contamination around the drain field, and slows the breakthrough of phosphorus to groundwater. The priority systems to target are older systems and systems near streams and areas with a high groundwater table. The septic tank should be pumped by a licensed septage waste-hauler on a regular basis and septage properly disposed of in an approved site or wastewater treatment facility.

Septic system inspection and pumping can be performed throughout the subbasin to achieve nonpoint source loading reduction to area surface water. However, it will have greatest positive

impact within nearshore areas and with septic system overlying coarse soil and/or bedrock with minimal phosphorus treatment capacity. Areas to consider include:

- Within Sensitive Resource Aquifer boundaries.
- Within 1,000 feet of the Spokane River and subbasin lakes (Hayden Lake, Hauser Lake, and Twin Lakes).

Activity: Require regular inspection and pumping of septic systems on a standard interval. The interval should vary as a function of septic tank size and persons per household to achieve acceptable retention times. Standard matrices are available for these requirements.
Potential Phosphorus Load Reduction: Inspection and pumping of septic systems has low to moderate phosphorus removal efficiencies of 40 to 55 percent (DDNR, 2010).
Range of Cost: Inspection and pumping of septic systems has very low phosphorus removal costs of $7 to $25 per pound (DDNR, 2010).
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County.

USI-UR-8 Develop a Small Community Program for Phosphorus Loading Reduction

Small communities within the Upper Spokane River, ID subbasin include Rathdrum, Garwood, Athol, and others. These communities have a unique set of associated phosphorus loading mechanisms that, in many cases, are not specifically targeted by existing guidelines and regulation. A number of the small communities within the Lower Spokane River, ID subbasin overly or drain to the SVRP Aquifer. Because of anticipated limited treatment capacity in coarse-grained soils overlying the SVRP Aquifer, phosphorus loading from these areas could impact subbasin groundwater and surface water.

The intent of this action is to develop a program to assist smaller communities to develop the tools they need to reduce phosphorus loading. This program could include generation of guidance documents and/or ordinances. Components of the program could include the following:

- Community outreach and education.
- Training programs targeted at local government officials and managers.
- Retrofit of existing stormwater management structures to comply with guidelines described in Action USI-UR-4.
- Management and education intended to reduce of impact of pet waste on water quality.
- Septic system elimination (if applicable) per Action USI-UR-6 and inspection/pumping per Action USI-UR-7.
- Recommendation or requirement for use of phosphorus-free fertilizer, per Action USI-AA-2.
- Recommendation to retain grass clippings/leaves on lawns or as properly-disposed of solid waste, rather than within runoff.

This action will also include guidance and/or requirements for LID practices in construction and stormwater management. LID practices that could be applicable to the Upper Spokane River, ID

subbasin are presented in detail in Volume 3 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ 2005). Described LID practices include:

- Clearing and grading practices.
- Use of aquatic buffers and preservation of natural hydrologic function.
- Impervious area practices.
- Green roofs and parking lots.
- Pervious pavement.
- Soil amendments and restoration.
- Rainwater harvesting and reuse.
- Created wetlands.

Activity: Develop a Small Community Program for Phosphorus Loading Reduction to assist smaller communities in developing the tools they need to reduce phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County or other municipalities.

USI-UR-9 Marina Practices to Prevent Stormwater and other Pollution

Numerous marinas, docks, house boat, and other facilities are situated within the Coeur d'Alene Lake subbasin, particularly along Hayden Lake. Each of these facilities deal with septic and other wastes and are potential sources of phosphorus directly to surface water. BMP information specific to marina operations is provided in DEQ's Compendium of Best Management Practices To Control Polluted Runoff (Meitl and Maguire, 2003) and Volume 2 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ 2005). Types of BMPs that pertain to marinas and boating operations include the following:

- Marina siting and design practices.
- Shoreline stabilization.
- Stormwater management.
- Sewage and solid waste management.
- Boat cleaning practices.
- Establishment of no wake zones and other boat management practices.
- Public education.

Activity: Review existing practices, encourage BMP implementation, provide adequate resources and information to marinas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.

Potential Lead: TBD.

14.5.7 Supporting Phosphorus Reduction Activities

Supporting activities to be undertaken as part of this NPS Reduction Plan will provide valuable information for long-term success, in addition to subbasin-specific actions and BMPs designed to provide direct phosphorus reduction. These activities are described in Chapter 9.

14.5.8 Additional Activities

Additional activities include indirect actions that either lead to overall improvements in ecological functions and thus water quality or provide additional insights into the overall health and conditions of the watershed. Activities are described in Chapter 9. Additional activities in the Upper Spokane River, ID subbasin include the coordination of activities on Lake Spokane, nearshore, and upstream activities.

USI-AA-1 Recommended TMDL and Managed Implementation Plan Actions

The Spokane River DO TMDL and associated Managed Implementation Plan (Ecology, 2010) recognized that nonpoint source pollution contributes to the low oxygen condition in the Spokane River and Lake Spokane. Specific activities are identified that support overall watershed health and improvements in water quality. These actions align with the phosphorus nonpoint source reduction activities and are encouraged to be carried out.

Activity: Implement actions in the Spokane River DO TMDL and associated Managed Implementation Plan.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-AA-2 Consider Phosphorus Free Fertilizer Ordinances

Municipalities across the U.S. have adopted phosphorus free fertilizer ordinances, such as a phosphate lawn fertilizer ban. Retailers and fertilizer producers have appropriate fertilizers products available that meet these ordinances. Some ordinances allow the use of fertilizer with phosphorus under specific circumstances such as if soil testing showing a phosphorus deficiency or for establishing new lawns or plants. A USGS study found that “runoff from lawn sites with non-phosphorus fertilizer applications had a median total phosphorus concentration that was similar to that of unfertilized sites, an indication that non-phosphorus fertilizer use may be an effective, low-cost practice for reducing phosphorus in runoff” (USGS, 2002).

Activity: Adopt ordinances that ban the use of fertilizer containing phosphorus.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.

USI-AA-3 Evaluate, Protect and Enhance Nearshore Areas

Nearshore land management and activities have the potential to impact phosphorus loads to surface water. Within the Upper Spokane River ID subbasin, these activities apply to areas nearshore to Blanchard, Hauser, Hayden, and Twin Lakes, as well as the Spokane River. These lakes discharge to (via infiltration) and are important sources of recharge to the SVRP Aquifer. As such, water quality within these lakes has to potential to directly impact this sole source aquifer.

Nearshore sources transport phosphorus loads via surface water, stormwater runoff, interflow, and groundwater. Unlike activities and BMPs implemented upstream, there is little to no attenuation of phosphorus loads associated with nearshore sources before the receiving surface water body is impacted. DEQ (2000) identified and prioritized critical areas (defined as nearshore agricultural areas that contribute excessive pollutants to water bodies and where treatment is considered necessary to address resource concerns affecting water quality) contributing phosphorus to lakes and creeks draining to the Rathdrum Prairie. DEQ (2000) identified the following types of critical areas inventoried within the areas draining to these surface water bodies:

- Unstable and eroding stream banks primarily caused by grazing.
- Pastures adjacent to stream corridors, where grazing has not been excluded from the riparian area.
- Haylands adjacent to stream corridors that lack adequate buffering from harvest and fertilizer application.

DEQ (2000) also recommended BMPs and associated costs appropriate for implementation adjacent to lakes and creek draining to the Rathdrum Prairie. These BMPs included riparian fencing, riparian vegetation, riparian forest buffers, nutrient management, prescribed grazing, streambank protection, and watering facilities.

Reduction of loads from nearshore areas is important and should be considered as part of the overall nonpoint source phosphorus load reduction strategy. Nearshore areas should be inventoried to identify areas where BMPs should be implemented. BMPs that should be considered for nearshore areas include, but are not limited to:

- Erosion control and bank stabilization.
- Filter strips.
- Septic tank elimination.
- Inspection and pumping of septic systems.
- Phosphate lawn fertilizer ban.
- Riparian fencing, riparian zones and buffer strips.
- Education and outreach to nearshore property owners.

Additional detail regarding these BMPs is provided in Chapter 8.

Activity: Evaluate nearshore areas of the lakes and Spokane River within the Upper Spokane River, ID subbasin and implement activities and BMPs to reduce nonpoint source phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

14.5.9 Support Existing and Planned Activities

The NPS Reduction Plan supports existing water resources and water quality studies and planning. Protection of these resources also supports the reduction phosphorus nonpoint sources. Critical planned activities specific to the NPS Reduction Plan are identified below.

USI-EP-1 Support and Supplement Avista Utilities WQAP Implementation

Avista Utilities is developing a WQAP to identify how they will mitigate for impacts to dissolved oxygen in Lake Spokane caused by the Long Lake Dam (Ecology, 2010). The WQAP should be completed in 2012. Avista's efforts to implement the plan elements should be supported. In addition, other organizations in the Upper Spokane River, ID subbasin should look for ways to collaborate with and complement Avista's efforts to advance and expand success in reducing nonpoint source phosphorus loads.

Activity: Support and supplement Avista Utilities WQAP implementation to achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-EP-2 Support and Enforce Ordinances that Protect Shorelines and Prevent Erosion

Kootenai County and some of the cities within the Upper Spokane River, ID subbasin have local requirements that regulate shoreline use and modification activities. Each set of requirements are unique. For example:

- Kootenai County's Site Disturbance Ordinance purpose is to protect property, surface water, and ground water against significant adverse effects from excavation, filling, clearing, unstable earthworks, soil erosion, sedimentation, and stormwater runoff.
- City of Coeur d'Alene City Code Shoreline Regulations (Article IIA) prohibits construction within 40 feet of the shoreline (with some exceptions).
- City of Post Falls City Code Flood Damage Prevention (Chapter 15.44) identifies flood hazard areas and in these areas: 1) restricts or prohibits uses that create water or erosion hazards; 2) controls filling, grading, dredging and other development which may increase flood damage or erosion; 3) prevents or regulates construction of flood barriers; and 4) preserves and restores natural floodplains, stream channels, and natural protective barriers.

These requirements relate to nonpoint source phosphorus reduction by protecting and enhancing shorelines and preventing erosion.

Activity: Support and enforce city and county ordinances that achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-EP-3 Review and Enhance Policies regarding Removal of Sunken Logs

Abandoned sunken logs located in navigable waters can only be salvaged by a sale bidder after an encroachment permit has been obtained. The Navigable Waters Regulatory Program issues the permit with the concurrence of Fish & Game, DEQ and EPA. Removal operations have the potential to disturb sediments and release phosphorus. Other states have placed moratoriums on removing sunken logs until the potential impacts are understood. These prized logs are of high value and quality since the water significantly slows the decay process and preserves the old growth timber. Policy for the permits should restrict the conditions when removal is allowed to minimize water quality impacts and require monitoring of water quality conditions.

Activity: Maintain or restrict permits for removing sunken logs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-EP-4 Support, Compliment and Enforce Permits, Ordinances, Plans and Activities Relating to Nonpoint Source Phosphorus Reduction

There are a variety of permits, ordinances, plans and activities within the Upper Spokane River ID subbasin that relate to nonpoint source phosphorus reduction, including:

- City of Coeur d'Alene and City of Post Falls NPDES Phase II Stormwater Permit Requirements.
- Lake management plans for Hauser, Hayden, Spirit and Twin Lakes (Clean Lakes Coordinating Council, 1990; Panhandle Health District, 1994; Panhandle Health District, 1993; Clean Lakes Coordinating Council, 1991).
- Nutrient (total phosphorus) TMDLs for Hauser, Hayden and Twin Lakes (which addresses Fish and Rathdrum Creeks as well).
- Spokane River Forum education efforts.

When taking actions and implementing BMPs to reduce nonpoint source phosphorus, consider these and other related plans, goals, requirements and efforts to optimize reduction potential. Review that erosion control BMPs are followed at land development projects and construction sites.

Activity: Support, compliment and enforce permits, ordinances, plans and activities to achieve nonpoint source phosphorus reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

USI-EP-5 Support Existing TMDLs and Management Plans

Support existing TMDLs and management plans in the Upper Spokane River, ID subbasin including Lakes and Streams Located on or draining to the Rathdrum Prairie (DEQ, 2000). This TMDL identifies lake management plans for implementation:

- Hauser Lake Management Plan.
- Hayden Lake Watershed Management Plan.
- Twin Lakes Management Plan.
- Spirit Lake Watershed Management Plan.

Since these plans appear to have been completed more than a decade ago, an evaluation of their effectiveness and potential for updates should be completed. Additionally some of the plans are not readily accessible on the internet and available to the public. Coordination between the cities, counties, Panhandle Health District, watershed associations and coalitions and other special districts is suggested to clarify responsibilities for taking actions and implementing BMPs for nonpoint source reduction.

Key issues identified are similar to the recommended actions in the NPS Reduction Plan (Idaho Clean Lakes, 1994, HLWA, 2005 and Hofman, 2007). These issues and related actions (listed by section) include:

- Increase public awareness and education (14.5.2).
- Protect streamside zones (14.5.1).
- Control erosion including stream bank and lake shore, roads and private driveways (14.5.1).
- Exclude livestock from streams and riparian zones (14.5.3).
- Minimize sediments from forestry activities, including logging and roads (14.5.4).
- Minimize leaching from septic systems especially near shorelines (14.5.8).
- Perform septic system maintenance (14.5.6).
- Protect water quality in the aquifer (14.5.6).
- Proper management of wastes from pets and livestock (14.5.3).
- Appropriate use of fertilizers, test soil conditions. (14.5.3).
- Enact and enforce construction and development requirements (14.5.9).

Activity: Support existing TMDLs and Management Plans including evaluation of management actions, updating plans, and coordination of recommended activities.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

Chapter 15

Coeur d'Alene Lake Subbasin - Nonpoint Source Phosphorus Management Strategy and Actions

15.1 Introduction

An objective of this NPS Reduction Plan is to formulate nonpoint source control strategies that contribute to long-term reductions of phosphorus loads. It provides guidance on selecting 'what' strategies and actions to take and 'where' to apply them. Chapter 9 provides an introduction to the subbasin actions and strategies, background of the NPS Study objectives, how the subbasin chapters support the overall NPS Reduction Plan, and regional phosphorus control strategies that should be considered in all subbasins in the Spokane River Watershed.

This chapter identifies specific actions to for entities located in the Coeur d'Alene Lake subbasin and stakeholders supporting these entities to reduce nonpoint source phosphorus. Identified are strategies and actions and areas to target within the subbasin. The guidance identifies potential organization leads and potential timelines for initial and long-term reductions of nonpoint source phosphorus pollution.

The following sections of this chapter describe:

- The identification and relationship of entities and stakeholders in the watershed and associated acres of land ownership.
- An overview of reduction strategies, actions, and schedule for the subbasin.
- An overview of the nonpoint source reduction opportunities and guidance on 'what' BMPs to implement and 'where' to take these actions.
- The specific actions by category identified to be undertaken, including those identified by specific entities and stakeholders.

Estimates of the potential BMP phosphorus reductions and cost per pound are provided in Chapter 8. The overall phosphorus reduction potential is discussed in Chapter 9.

15.2 Entities and Stakeholders

As discussed in Chapter 9, accomplishing nonpoint source reductions will require engaging local, state, and federal agencies and land managers, as well as private land owners. The principal organizations involved with securing funding, identifying priority locations, selecting BMPs, and taking actions in the Coeur d'Alene Lake subbasin include those shown in Table 15-1. These organizations are subdivided into entities and stakeholders as shown in Table 15-2, along with the area of land owned and miles of streams in the Coeur d'Alene Lake subbasin.

Much of the land in the Coeur d'Alene Lake subbasin lies within the boundaries of the Coeur d'Alene Indian Reservation. Coordination with tribal departments will be an important element for successful nonpoint source reduction. The Tribe's Lake Management Department oversees

programs that include: lake improvement, recreation, water resources, and hazardous waste. The Tribe's Natural Resources Department oversees programs that include: fisheries, pesticides, forestry, and wildlife. Land ownership for the subbasin is shown in Figure 15-1.

The Coeur d'Alene Lake Management Plan, being implemented by DEQ and the Coeur d'Alene Tribe, has a similar goal as this plan to reduce nutrient inputs to Coeur d'Alene Lake. Work to reduce nutrient loading, outlined in both plans will likely help water quality in the Coeur d'Alene Lake and the Spokane River downstream.

Table 15-1. Organizations and Nonpoint Source Phosphorus

Organization
Local Governments
Benewah County
Kootenai County
Shoshone County
Spokane County
Benewah County Soil and Water Conservation District
Kootenai-Shoshone Soil and Water Conservation District
Spokane County Conservation District
Idaho Panhandle Health District 1
Spokane Regional Health District
Municipalities
Fernan Lake
Harrison
Utilities
Avista Utilities
Municipal water service providers
Tribal Governments
Coeur d'Alene Tribe
State Agencies
Idaho Department of Environmental Quality
Idaho Department of Lands
Idaho Department of Parks and Recreation
Idaho Fish and Game
Idaho Forest Products Commission
Idaho Rangeland Resource Commission
Idaho Soil Conservation Commission & Idaho Soil and Water Conservation Commission
Idaho State Department of Agriculture
Idaho Transportation Department
Washington Department of Fish and Wildlife
Washington Forest Practices Board
Washington Land Use Study Commission
Washington State Conservation Commission
Washington State Department of Agriculture
Washington State Department of Ecology
Washington State Department of Natural Resources
Washington State Department of Transportation
Washington State Parks and Recreation Commission
Federal Agencies
Coeur d'Alene National Forest
U.S. Bureau of Indian Affairs
U.S. Bureau of Land Management
U.S. Department of Agriculture – Natural Resource Conservation Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service

Table 15-2. Organizations and Land Area

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Private				
In Coeur d'Alene	2,483	Coeur d'Alene	Kootenai-Shoshone Soil and Water Conservation District	n/a
In Fernan Lake	46	Fernan Lake		
In Harrison	2,273	Harrison		
In Kootenai County	229,969	Kootenai County		761.0
In Shoshone County	10,118	Shoshone County		39.6
In Benewah County	2,367	Benewah County	Benewah County Soil and Water Conservation District	8.0
In Spokane County	4,863	Spokane County	Spokane County Conservation District	52.0
Coeur d'Alene Tribe	58,505	Coeur d'Alene Tribe	Various Federal Agencies	209.6
In Coeur d'Alene National Forest	17,516	U.S. Forest Service	USDA – Natural Resource Conservation Service	74.3
In Crystal Lake Wilderness Study Area	303	U.S. Environmental Protection Agency		0.1
In Public Domain Bureau of Land Management	1,537			3.5
Tribal Governments[2]				
Coeur d'Alene Tribe	*70,378*	U.S. Environmental Protection Agency	Benewah County Soil and Water Conservation District, USDA - Natural Resource Conservation Service	249.2
Incorporated Municipalities[2]				
Coeur d'Alene	*2,805*	Idaho Department of Environmental Quality, U.S. Environmental Protection Agency	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	1.3
Fernan Lake	*46*			0
Harrison	*2,706*			7.4
Local Governments				
Benewah County	*7,656*	Idaho Department of Environmental	Idaho Department of Agriculture, Idaho Forest	20.2

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Kootenai County	*387,964*	Quality, U.S. Environmental Protection Agency, Idaho Fish and Game, U.S. Fish and Wildlife Service	Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	1,295.3
Shoshone County	*11,051*			44.7
Spokane County	*5,572*	Washington Department of Ecology, U.S. Environmental Protection Agency, Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service	Washington State Department of Agriculture, Washington State Conservation Commission, Washington Land Use Study Commission	59.8
State Agencies				
Idaho Department of Fish and Game	5,078	Idaho Department of Environmental Quality, Idaho Fish and Game, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	14.9
Idaho Department of Lands	18,714			54.7
Idaho Department of Parks and Recreation	541			0.8
Idaho Transportation Department	1,170			n/a
Washington State Parks and Recreation Commission	226	Washington Department of Ecology, Forest Practices Board, Washington Department of Fish and Wildlife, U.S. Environmental Protection Agency	Washington State Department of Agriculture, Washington State Conservation Commission, Washington Land Use Study Commission	1.4
Washington State Department of Natural Resources	481			6.4
Washington State Department of Transportation	0			n/a

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Federal Agencies				
U.S. Bureau of Indian Affairs	6,237	U.S. Environmental Protection Agency	USDA – Natural Resource Conservation Service	16.0
U.S. Bureau of Land Management	13,187			32.4
U.S. Forest Service	89,456			297.2
Additional Land Areas				
Roads	1,453 miles		1,235 stream crossings	

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation, road miles include primary, secondary, local and forest service roads.

[2] Tribal governments, incorporated municipalities and local governments is total land area within boundaries, not land ownership.

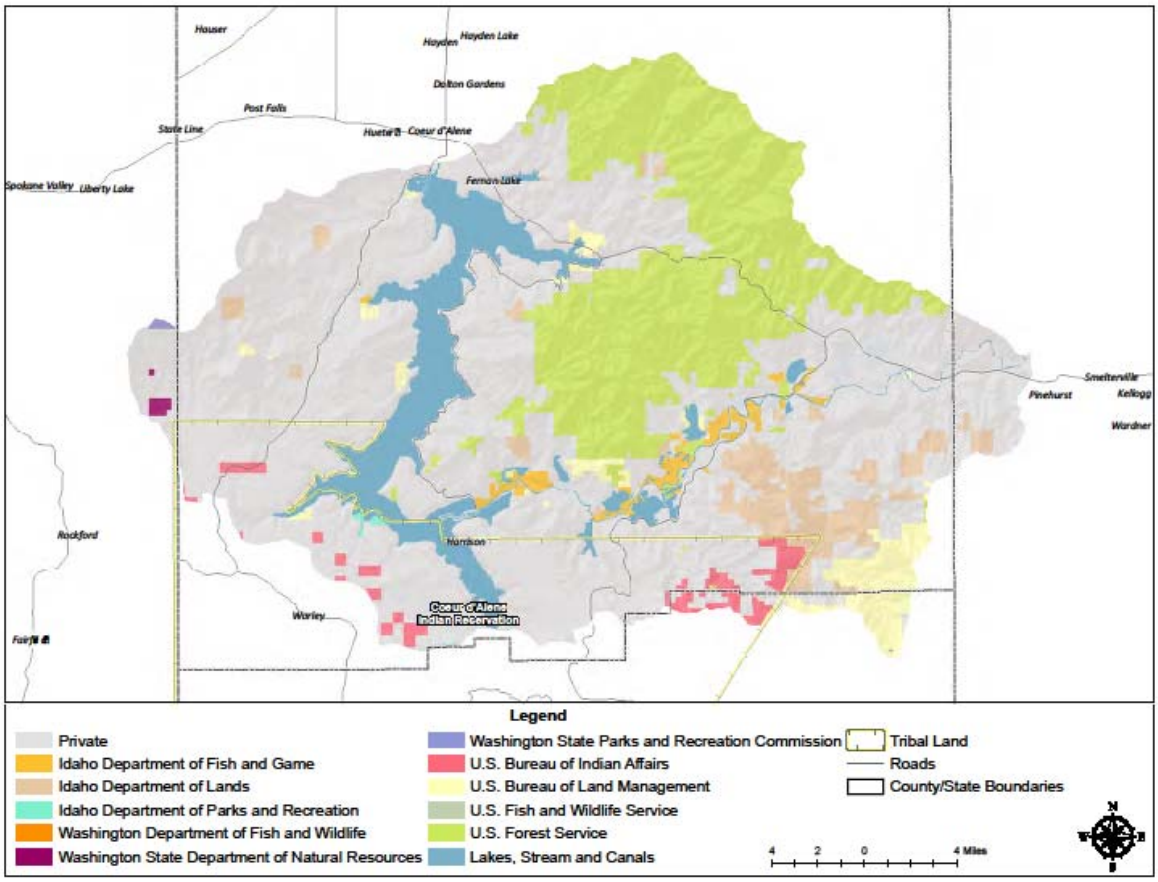

Figure 15-1. Coeur d'Alene Lake Subbasin and Land Owners

15.3 Overview of Reduction Strategy, Actions, and Schedule

Identifying strategies for reducing nonpoint source phosphorus in the Coeur d'Alene Lake subbasin is an important step to protect and restore water quality in the Coeur d'Alene Lake and the Spokane River. A successful strategy will also ultimately support improving dissolved oxygen concentrations downstream in Lake Spokane. The extent of water quality improvements will depend on fate and transport processes which were not addressed in the NPS Study. Nonpoint source phosphorus reductions will have both local and watershed benefits.

15.3.1 Strategy

The strategy for addressing nonpoint sources of phosphorus includes taking actions throughout the subbasin. Nonpoint source reduction actions include addressing obvious problems and undertaking actions that can be readily completed. The strategy emphasizes reducing nonpoint source phosphorus from land uses that generate large phosphorus loads and cover large areas of the subbasin. A subbasin scale assessment of these land uses revealed that evergreen forest and shrub and brush rangeland are dominant throughout the subbasin (Chapter 3).

15.3.2 Actions

Actions are the measures or steps from planning through achievement of nonpoint source phosphorus reduction. Actions include sufficient description and specificity for a responsible party to decide to take the action. The actions also help the responsible party determine where, what, when, and how to achieve the potential suggested outcome.

BMPs are the core of the action; whereas, actions encompass the entire process from the identification of the area, selection and implementation of the BMP through post monitoring. BMPs for addressing nonpoint sources of phosphorus include structural (i.e., physical) and non-structural (i.e., educational) measures.

BMPs referenced in the actions in Section 15.5 were identified based on the dominant land uses and the associated loading potential of the land uses. BMP phosphorus percent reduction efficiency, costs, estimated longevity and implementation effectiveness were also key indicators for identifying high priority BMPs for the subbasin. See Chapter 8 Nonpoint Source Phosphorus Control Measures for information about BMPs and the prioritization process.

15.3.3 Schedule

The schedule for nonpoint source actions for this plan is based on meeting the schedule in the Spokane River DO TMDL (Ecology, 2010). The schedule targets expeditious management actions to reduce nonpoint source phosphorus over the next two decades. From the Spokane River DO TMDL approval (May 2010), progress will be evaluated every 5 years, with extensive assessments after 10 and 20 years. The results from the first 10 years will be used to guide actions during the second 10-year period. Actions initiated in the first 10 years and determined to be beneficial should be continued, including successful nonpoint source control.

15.3.4 Summary of Approach

DEQ has not developed a TMDL and load allocation for the Coeur d'Alene Lake subbasin to match with the Spokane River DO TMDL (Ecology, 2010). Ecology assigned load allocations for the Little Spokane River and Hangman Creek subbasins and provided seasonal estimates for the percent reduction in nonpoint source phosphorus loads. These seasonal estimates were converted to average annual equivalents. Based on the reductions for the Little Spokane and Hangman Creek subbasins, a target reduction of approximately 25 percent within upstream subbasins is estimated to be necessary to meet downstream targets. Additionally, implementation of the Coeur d'Alene Lake Management Plan is investigating nutrient loads within tributaries to the lake and may provide additional guidance for reductions (DEQ and Coeur d'Alene Tribe, 2009). Using an average efficiency of 54 percent for the priority BMPs (Chapter 8), approximately 71 percent of the major land uses (evergreen forest and rangeland) would need BMPs applied to achieve the target. Based on the average cost for the priority BMPs of about $320/pound (Chapter 8), the total cost for the target reduction would be approximately $2,670,000. Achieving the target reduction over a 20-year period will require that approximately $135,000 is spent annually on BMPs in the subbasin.

15.4 Overview of Opportunities

Opportunities for organizations to undertake nonpoint source phosphorus reductions are available throughout the subbasin. This overview includes a description of what BMPs are the most relevant and where the BMPs should be implemented. Where the BMPs should be implemented is specific to land uses.

15.4.1 Control Measures and BMPs

BMPs specific to land use type and source are described in detail in Chapter 8. The background included in Chapter 8 narrowed the list of BMPs from 108 to 22 based on phosphorus percent reduction efficiency, cost, estimated longevity, and implementation effectiveness. This list of BMPs, if implemented for the appropriate land uses, could result in substantial net nonpoint source reduction of phosphorus.

There are several organizations throughout the Coeur d'Alene Lake subbasin that can mitigate nonpoint source loads by incorporating BMPs. The agencies and organizations are encouraged to review the land and nonpoint phosphorus sources in their jurisdiction to further identify BMPs that are specific to their situation.

Organizations should examine areas within their influence to identify opportunities where these BMPs can be implemented to reduce nonpoint source phosphorus. These organizations should also examine their stormwater management practices and look for opportunities to implement BMPs since stormwater is a primary transport mechanism for nonpoint source phosphorus. Organizations identified in Tables 15-1 and 15-2 include private, municipal, state and federal entities. Associated opportunities for nonpoint source phosphorus reduction include:

- Private land owners may protect and restore riparian corridors; minimize stormwater runoff; and consider education, land evaluation, and/or aide available from the conservation organizations.
- Municipalities may install BMPs to treat and/or reduce stormwater discharge to water bodies; evaluate where stormwater is being discharged; and/or evaluate the pollutant loading by collecting samples for analysis.
- State and federal agencies should review activities occurring on the land, identify potential impacts, and implement applicable BMPs.

15.4.2 Land Uses and Source Potential

The NPS Reduction Plan is meant to provide guidance on where to take action, as actions are voluntary and not mandatory. The NPS Study was conducted at the watershed and subbasin scales and is limited in its guidance to actions at those scales. Actions by organizations are limited by their jurisdictions and authority. Organizations will need to examine local conditions to determine specifically where they choose to take action.

The PS Reduction Plan analyses (Chapters 6 and 7) evaluated the dominant land uses and the phosphorus load potential for each subbasin. In some cases, the largest land use did not match

the largest phosphorus load reduction potential. The following land uses have the highest priority for the Coeur d'Alene Lake subbasin with respect to nonpoint source phosphorus loading:

- Evergreen Forest.
- Rangeland.

The analytical evaluation results indicated that the southwest portion of the subbasin has the highest nonpoint source phosphorus loading rates in the Coeur d'Alene Lake subbasin (see Chapter 7). These two sub-subbasins with the highest estimated loadings are Southwest Face (0.153 lbs/ac/yr) and Rockford Creek (0.146 lbs/ac/yr). These subareas should be considered as priority areas for action.

The Coeur d'Alene Lake subbasin is dominated by evergreen forest (63 percent) and shrub and brush rangeland (17 percent). These land uses also have the greatest phosphorus removal potential. Organizations are encouraged to take action in these high priority land use areas. These particular land uses represent the priority areas where nonpoint source phosphorus actions are necessary to achieve a significant net reduction. Organizations should examine areas they own or are within their influence, and look for opportunities to reduce nonpoint source phosphorus from the prioritized land uses. Organizations should also examine areas within their jurisdiction that are obvious areas for nonpoint source reduction opportunities.

15.4.3 Summary of Reduction Opportunities

BMPs have been prioritized first by their ability to remove nonpoint source phosphorus loads and then by land use type. The acres of land use by organization were computed and are tabulated in Table 15-3. The acres in Table 15-3 demonstrate how the land uses are distributed among the land owners and where the opportunities for reductions may exist.

The export coefficients summarized in Chapter 7, along with the land uses and areas, can be used to estimate potential nonpoint source phosphorus loads by organization. There is an associated range of reduction opportunities based on the potential to reduce phosphorus loads. These opportunities are presented in Table 15-4 by assigning a load reduction potential that ranges from low to high. The range is based on total phosphorus load; therefore, higher potential may be due to a greater export coefficient, the total land area, or a combination of both. Table 15-4 is intended to provide further guidance for considering and selecting BMPs for implementation.

Figure 15-2 shows land ownership with stream segments highlighted in areas of high potential for nonpoint source phosphorus reduction based on the land use and export coefficients. Stream segments are shown since the highest priority BMPs in this subbasin generally relate to stream or riparian corridors.

Table 15-3. Organizations Land Area by Land Use

Land Owners	Agriculture[1] (acres)	Forested[1] (acres)	Rangeland[1] (acres)	Urban / Suburban[1] (acres)	Other[1] (acres)
Private					
Private	15,435	146,814	69,926	7,482	7,854
Tribal Governments					
Coeur d'Alene Tribe	13,898	28,702	21,505	1,549	4,807
Incorporated Municipalities[2]					
Coeur d'Alene	0	470	140	1,838	37
Fernan Lake	0	2	0	43	1
Harrison	215	749	1,092	94	125
Local Governments[2]					
Benewah County	0.1	6,192	1,463	0	6
Kootenai County	16,645	244,809	77,079	7,904	41,830
Shoshone County	0	5,859	4,207	500	493
Spokane County	72	4,443	972	83	6
State Agencies					
Idaho Department of Fish and Game	27	907	858	36	3,254
Idaho Department of Lands	1	15,381	2,768	15	562
Idaho Department of Parks and Recreation	0.4	394	64	10	73
Washington State Department of Natural Resources	1	406	54	14	6
Washington State Parks and Recreation Commission	0	226	1	0	0
Federal Agencies					
U.S. Bureau of Indian Affairs	1,203	3,893	965	169	12
U.S. Bureau of Land Management	36	9,815	2,731	112	504
U.S. Forest Service	0	82,568	5,891	440	627

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation.

[2] Tribal governments, incorporated municipalities and local governments is the total land area within boundaries.

Table 15-4. Organizations and Potential for Nonpoint Source Phosphorus Reduction

Land Owners	Agriculture[1]	Forested[1]	Rangeland[1]	Urban / Suburban[1]	Other[1]
Private					
Private	High	High	High	High	High-Mod.
Tribal Governments					
Coeur d'Alene Tribe	High	High	High	High-Mod.	Low-Mod.
Incorporated Municipalities					
Coeur d'Alene	n/a	Moderate	Low-Mod.	High-Mod.	Low
Fernan Lake	n/a	Low	n/a	Low-Mod.	Low
Harrison	High-Mod.	High-Mod.	Moderate	Low-Mod.	Low-Mod.
Local Governments					
Benewah County	Low	High	High-Mod.	n/a	n/a
Kootenai County	High	High	High	High	High-Mod.
Shoshone County	n/a	High-Mod.	High-Mod.	Moderate	Low-Mod.
Spokane County	Moderate	High-Mod.	Moderate	Low-Mod.	Low
State Agencies					
Idaho Department of Fish and Game	Low-Mod.	Moderate	Moderate	Low-Mod.	Moderate
Idaho Department of Lands	Low	High	High-Mod.	Low	Low-Mod.
Idaho Department of Parks and Recreation	Low	Moderate	Low-Mod.	Low	Low
Washington State Department of Natural Resources	Low	Moderate	Low-Mod.	Low-Mod.	Low
Washington State Parks and Recreation Commission	n/a	Moderate	Low	n/a	n/a
Federal Agencies					
U.S. Bureau of Indian Affairs	High-Mod.	High-Mod.	Moderate	Moderate	Low
U.S. Bureau of Land Management	Moderate	High	High-Mod	Low-Mod.	Low
U.S. Forest Service	n/a	High	High-Mod	Moderate	Low-Mod.

[1] NPS load potential based on area and export classified into five categories, low, low-moderate, moderate, high-moderate, and high.

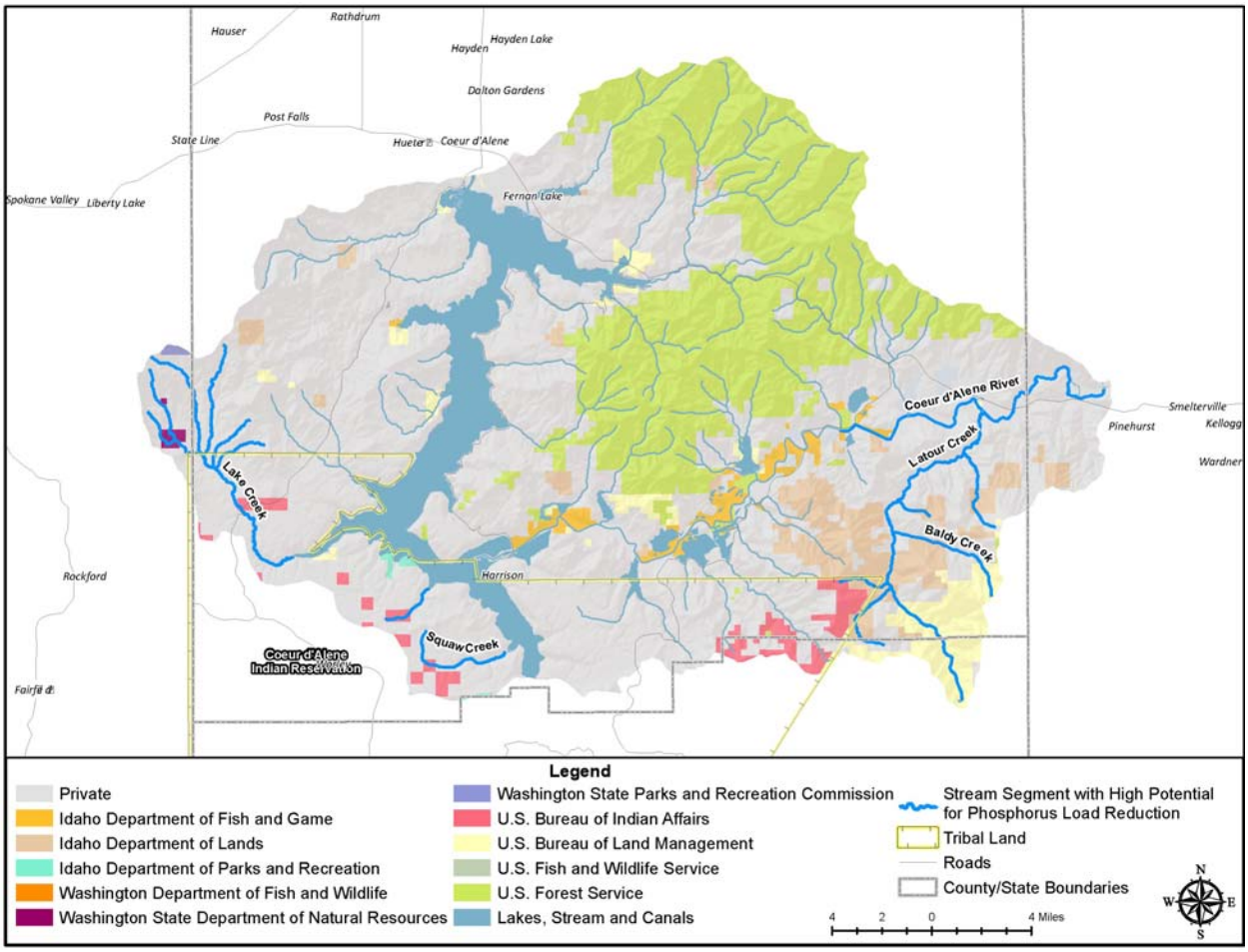

Figure 15-2. Coeur d'Alene Lake Subbasin High Potential Reduction Opportunities

15.5 Specific Actions by Category

This section includes a list of specific actions to reduce nonpoint source phosphorus loads and ultimately contribute to meeting water quality standards. A general description of each action, an activity summary, potential phosphorus load reduction, a range of costs, potential timelines, and the potential lead entity are provided for each action. Although it was not a primary objective of the NPS Study to specify "who" implements phosphorus control measures, potential lead organizations are identified for some actions to help provide linkage to the "what" and "where" objectives of the NPS Study. The lead organization will need to assist local entities in developing detailed plans for the activities, as well as a schedule and plan for monitoring progress. When the information was available, the action also includes a description of the roles of the organization with responsibility to improve water quality, and the means through which the organization will address the water quality issues.

15.5.1 High Priority BMPs

The analysis provided in Chapter 8 described the following BMPs as having the highest priority for the Coeur d'Alene Lake subbasin:

- Streamside Management Zones.
- Riparian Zones and Buffer Strips.
- Stream Bank Stabilization.
- Erosion Control.

Specific details regarding implementation of these high priority BMPs are provided in Chapter 9. These BMPs are appropriate for implementation for land uses in the subbasin. The following sections summarize actions appropriate for the specific land uses within the Coeur d'Alene Lake subbasin.

15.5.2 Regional Phosphorus Management

Regional phosphorus control strategies are not specific to any one land use type or organization, and may contribute to the reduction of nonpoint source phosphorus loadings in the subbasin. Descriptions of the regional or watershed-scale phosphorus management actions intended to facilitate load reductions and/or establish the technical foundation for further phosphorus control activities are described in Chapter 9.

15.5.3 Agriculture Related Activities

BMPs related to agricultural practices can have substantial impacts on nonpoint source phosphorus loading since agricultural land uses tend to be phosphorus intensive. BMPs under this category are typically associated with crop land uses, crop till management, and livestock grazing practices.

CDA-AR-1 Fertilizer Application Location and Timing

Managing the location and timing of fertilizer application can minimize the loss of phosphorus from the field and maximize plant uptake. Assistance may be obtained from the Benewah, Kootenai, Shoshone or Spokane county extension offices or Benewah or Kootenai-Shoshone soil and water conservation districts or Spokane County Conservation District. These agencies could also provide free seminars and literature about implementing such BMPs.

Optimizing fertilizer application and timing can be achieved through the following actions:

- Incorporate or inject fertilizers with phosphorus below the soil surface to reduce the total and soluble phosphorus losses (Fawecett, unknown). "Subsurface injection of fertilizer, as compared to surface application, reduced losses by 39 percent for no-till and by 35 percent for conventional tillage" (Mostaghimi, et al., 1988).
- Establish fertilizer management areas and apply at agronomic rates for those areas with phosphorus deficits, see CDA-AR-2 (Waskom and Bauder, unknown). "Maintain a buffer strip (where fertilizer and manure is not applied) a safe distance from surface water and drainage channels" (Waskom and Bauder, unknown). BMPs that buffer riparian zones were rated as high priority (Chapters 7 and 8).

- Avoid fertilizer and manure application to frozen and wet soils (Fawecett, unknown). For example, the earliest and latest spring freeze dates are April 4 and June 18 in Coeur d'Alene and April 6 and July 30 in Saint Maries, respectively (WRCC, 2011).

Activity: Provide support to growers with information on fertilizer management.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

CDA-AR-2 Fertilizer Application Rates

Sample the tillage layer of soil in each field on a regular basis and have soil analyzed to determine available soil phosphorus levels prior to applying fertilizers with phosphorus. Use crop and soil guides to determine agronomic application rates such as the University of Idaho Northern Idaho Fertilizer Guide or Washington State University Fertilizer Guides and Summary. The most common crops in this subbasin are grass seed, grass pasture, wheat and lentils. Grass seed and pasture may need phosphorus fertilizer every 2 to 3 years and should be done in the fall as spring, as fertilization is less effective in the spring and winter when it is more susceptible to runoff. Wheat has a relatively low demand for phosphorus. Lentils are especially dependent on the soil conditions and application method.

Activity: Provide support to growers about soil phosphorus testing and fertilizer application rates.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

CDA-AR-3 Runoff Management and Treatment

Manage runoff, from stormwater and irrigation if irrigating, to minimize runoff and treat runoff before entering waterbodies. Employ contouring or other techniques to reduce runoff potential. Maintain grass filter strips on the downhill perimeter of erosive crop fields to catch and filter phosphorus in runoff. These types of BMPs were rated as high priority (Chapters 7 and 8). Manage irrigation water to minimize runoff and erosion with irrigation BMPs or NRCS irrigation water management practices.

Slope is one factor that affects runoff. In this subbasin, the percentage of agricultural land use by slope classes are generally 12 percent has 0 to 5 percent slope; 28 percent 5 to 10 percent slope; 1 percent 10 to 15 percent slope; 29 percent 15 to 20 percent slope; and 30 percent greater than 20 percent slope. These slopes in combination with the soil types and other factors result in 73 percent of agricultural land use in the subbasin having a capability description of "very severe limitations that restrict the choice of plants, require very careful management, or both." This matches with implementing the recommended BMPs for managing and treating runoff. About 87 percent of the agricultural land use in the subbasin is rated as "good" relative to herbaceous habitat for wildlife such as in buffer zones.

Activity: Provide support to growers about runoff management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

CDA-AR-4 Crop Management

Crop management is related to many agricultural BMPs, including tillage type (conservation tillage/no-till/direct drill seeding), contouring (contour plowing and terracing and contour strip crop), crop rotation and erosion management (see Chapter 8). Crop management is related to the typical crops grown in the subbasin. Crops grown in the subbasin include: alfalfa, barley, canola, dry beans, herbs, lentils, oats, pasture grass, pasture hay, peas, rape seed, grass seed, and spring and winter wheat. Support economic crop management practices that also provide environmental benefits. This may require transformation in agency policies, new legislation, or other adjustments from historical practices that result in economic disincentives for implementing actions.

Activity: Provide support to growers about crop management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

CDA-AR-5 Animal Management

Animal management is related to many agricultural BMPs, including water supply, riparian zone exclusion, and feed, grazing and waste management (see Chapter 8). For example fencing riparian corridors limits livestock access to streams and ultimately protects water quality. Animal management is related to the head of animals raised in the subbasin. However, operations with large numbers of animals including cattle, dairy cows, turkeys, broilers and laying hens, may fall under confined animal feeding operation requirements instead. Smaller operations can also result in intense pressure on the land such as disturbance to drainages and streambanks, soil erosion, and animal wastes. Recommended priority BMPs such as buffers and riparian zones are beneficial to reducing or eliminating these pressures.

Activity: Provide support to producers about animal management and BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

15.5.4 Forestry Related Activities

BMPs related to forestry practices can reduce nonpoint source phosphorus. While phosphorus export forestry in general is low, local areas of intensive use can have higher phosphorus export rates. Since the Coeur d'Alene Lake subbasin is mostly forested, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this

category are typically associated with minimizing erosion, reducing sediment transport, protecting and maintaining riparian corridors and streamside management zones.

CDA-FR-1 Evaluate Forestry Practices

Idaho's forest practices regulations will be relied upon to reduce nonpoint source phosphorus loads from private and state forestlands. Ongoing practices should be reviewed by or as directed by the lead organization for compliance. If compliance with the existing regulations is not resulting in sufficient reduction, then more effective methods need to be promoted. Poorly performing practices need to be researched for the causes and potentially modified to improve the outcomes.

With large quantities of adjacent forested land, tributary water quality is likely affected by forest management practices. Logging and road building practices that have been common throughout the intermountain region from the late nineteenth century through most of the twentieth century have likely contributed to the degradation of water quality. In more recent times, implementation of more environmentally sound forest management practices has occurred. These practices may have reduced forestry-related phosphorus loading within the subbasin but additional reductions are still possible.

The Idaho Forest Practices Act (IDAPA 20.02.01) defines the minimum level of best management practices (BMPs) required to be implemented for commercial timber lands in Idaho. It is anticipated that the new road maintenance and abandonment plans required by the current forest practices rules will slowly reduce phosphorus export from harvested forests.

The agencies have data on forest health, ecology, harvest areas, vegetation types, soil conditions and more. This information can be useful for identifying areas of greater nonpoint source phosphorus loading. However, much of this data is not readily available or in a format that can be interpreted by water quality managers. Coordination between forest and water quality managers is necessary to understand the data and select management activities.

Activity: Enforce existing regulations, evaluate existing practices, discourage poorly performing practices, and encourage best performing practices and improve coordination of sharing information.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

CDA-FR-2 Quantify Sediment-Phosphorus Relationship in Forested Areas

Quantifying phosphorus loading associated with forest management practices may provide additional information that support selection of successful BMPs. The construction and use of roadways represent a major source of sediment from timber harvest activities (DEQ, 2000). A study to quantify the relationship between sediment associated with phosphorus in runoff from these roads can help determine whether additional measures should be undertaken.

Activity: Quantify relationship between sediment and phosphorus in forested areas.

Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

CDA-FR-3 Subbasin Scale Road Planning and Rehabilitation

Conduct a subbasin-scale management survey to inventory ownership and identify and prioritize the total miles of erodible roads and road banks. Specific BMPs may then be developed based on survey results to reduce miles of erodible roads associated with road construction, road conversions, and maintenance. A database of roads with tracking of BMP implementation is essential for determining success and accountability. Reduction plans should identify opportunities to abandon non-essential roads or restore roads on non-industrial forest lands and other county roads that contribute obvious erosion problems.

Activity: Quantify relationship between roads and phosphorus in forested areas
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

CDA-FR-4 Fire Rehabilitation Areas

Wild fires can significantly impact the landscape. Research has shown increased concentrations of suspended sediments, phosphorus, and potassium in streams below burned areas (Stednick, et al., 1982). Stream monitoring indicated an immediate flush of phosphorus in the runoff, followed by a slower release. Rehabilitation of burn areas, especially the riparian corridors to protect streams, will be important to reducing nonpoint source phosphorus in forested areas. The fire history from 2001 through 2010 suggests approximately 4,500 acres in the subbasin to have been burned and should be evaluated.

Activity: Identify and assist with rehabilitation of burned areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

CDA-FR-5 Land Use Planning on Federal Lands

The US Forest Service is currently in the process of developing a planning rule related to changes in land use planning. “The proposed rule would provide a framework to guide the collaborative and science-based development, amendment and revision of land management plans that promote healthy, resilient, diverse and productive national forests and grasslands” (USFS, 2011). Objectives of include encouraging sustainable ecosystem development. Development of the plan should include nonpoint source pollution and fit with the objectives of the NPS Reduction Plan.

Activity: Complete land use planning in accordance with the planning rule revision.

Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

15.5.5 Range Related Activities

BMPs related to rangeland practices can reduce nonpoint source phosphorus. Since range, shrub and brush land is the second largest percentage of land uses in the Coeur d'Alene Lake subbasin, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing disturbance of range land, protecting and maintaining riparian zones and maintaining or stabilizing stream banks.

CDA-RR-1 Evaluate Rangeland Practices

The state's regulations will be relied upon to reduce nonpoint source phosphorus loads from rangelands. Evaluate past and present impacts and review ongoing practices for compliance. The goal of evaluating past and present activities is to manage rangeland to maintain optimum soil and water quality. If compliance with the existing regulations is not resulting in sufficient nonpoint source phosphorus reduction, then more effective methods should be identified and promoted.

Activity: Evaluate existing practices, enforce existing regulations, and encourage BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

15.5.6 Urban/Suburban Related Activities

Urban/suburban areas can have the most variable impacts on nonpoint source phosphorus loading due to the diversity of development, uses, and control of stormwater runoff. BMPs under this category are typically associated with minimization of pollution sources and the management of stormwater.

CDA-UR-1 Business Practices to Prevent Stormwater and other Pollution

The Coeur d'Alene Lake subbasin contains much of the commercial area associated with the City of Coeur d'Alene. Volume 5 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ 2005) provides a list and descriptions of BMPs geared toward contaminant loading reduction for commercial and industrial facilities. These practices include the following:

- Loading dock and equipment yard design elements.
- Material loading and storage practices.
- Restaurant control practices.
- Surface cleaning control practices.

- Spill prevention, control, and cleanup.
- Employee training.

Volume 2 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ 2005) provides a list and descriptions of BMPs geared toward contaminant loading reduction for construction practices. These largely deal with erosion and sediment controls and include the following:

- Construction timing.
- Temporary road construction practices.
- Stockpile and waste management.
- Slope protection and stabilization.
- Construction stormwater collection and handling.

Activity: Review existing practices, encourage BMP implementation, provide adequate resources and information to businesses.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

CDA-UR-2 Evaluate and Analyze Impervious Surfaces and Implement Stormwater BMPs

Impervious surfaces throughout the Coeur d'Alene Lake subbasin are the source of substantial stormwater runoff. Within the subbasin, stormwater runoff enters both surface water and groundwater via infiltration. An understanding of the area and location of the impervious surfaces in the subbasin will guide the need and responsibility for implementation.

Dye tracing of stormwater from drains to outfalls can be helpful to determine where the flows discharge and potential additional BMPs at the discharge location. Around Liberty Lake, Washington, for example, two drains were dye tested, found to discharge to the lake, and subsequently modified with the installation of bio-infiltration systems to provide treatment (Hamlin, 2010).

Activity: Evaluate and quantify existing impervious surfaces, identify areas where vegetated buffer/filter strips or other applicable stormwater BMPs (see Chapter 8) could be installed, and encourage installation.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

CDA-UR-3 Evaluate and Revise Stormwater Policies

Only about 1 percent of the subbasin is within municipal boundaries. However, this urban/residential area generally is within close proximity to Coeur d'Alene Lake and stormwater

runoff from these areas impacts surface water quality with little to no attenuation. This action consists of a review of stormwater regulations of municipalities for water quality requirements. Municipalities have unique policies; however, working towards incorporating at least some minimum water quality requirements that address nonpoint source pollution including phosphorus across the watershed will provide some reduction in loads. Resources to consider include the following:

- DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ 2005).
- Idaho Department of Transportation's Erosion & Sediment Control—Best Management Practices Manual (Idaho DOT, 2011).
- DEQ's Compendium of Best Management Practices To Control Polluted Runoff, A Source Book (Metl and Maquire, 2003).
- The Spokane Regional Stormwater Manual (Spokane County et. al, 2008).

Consider holding a subbasin or watershed summit to evaluate and identify policies, and evaluate and determine areas throughout the Coeur d'Alene Lake subbasin for implementation and enforcement of the requirements. Keep in mind that some developed areas outside municipal jurisdictions should be considered.

Activity: Coordinate on minimum water quality stormwater treatment policies and requirements.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

CDA-UR-4 Strengthen Requirements for Stormwater Treatment BMPs in Key Areas

Stormwater treatment BMPs, such as bio-infiltration swales, bio-infiltration channels, vegetated buffer strips and infiltration basins are important within the Coeur d'Alene Lake subbasin because development frequently occurs above bedrock with limited treatment capacity and in close proximity to Coeur d'Alene Lake. Volume 4 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005) provides a list and description of permanent stormwater BMPs designed to control stormwater based contaminant loading. These include BMPs that treat stormwater through filtration, infiltration and/or detention.

The Coeur d'Alene Lake subbasin contains commercial and industrial land uses within the City of Coeur d'Alene. More stringent requirements could be considered for implementation of BMPs intended to reduce industrial discharges of phosphorus. This could include installation of sand filters at or near stormwater discharges, installation of catch basin filtration systems, installation of flocculation systems, and/or multi-chambered treatment trains (DEQ, 2005; DEQ, 2001).

Implementation of this action would strengthen requirements regarding implementation of the stormwater treatment BMPs listed in this section. These requirements could include developed and redeveloped commercial, industrial and residential properties within 1,000 feet of Fernan Lake, Coeur d'Alene Lake, the Coeur d'Alene River, and associated off-channel (chain) lakes.

This action also could include guidelines regarding BMP maintenance. Stormwater systems that are properly operated and maintained function better and reduce maintenance costs and liability problems. Volume 4 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ 2005) provides information on properly operating and maintaining stormwater systems for residential, commercial, or industrial developments. DEQ (2005) also include inspection and maintenance forms that prompt the user to identify problems that commonly occur with various stormwater control BMPs and provide recommendations for maintenance.

BMPs are also described below in the subactivities 'Install BMP' (see CDA-UR-4a through 4d).

Activity: Implement rigorous stormwater BMP requirements in key portions of subbasin.
Potential Phosphorus Load Reduction: Varies depending on BMP – refer to CDA-UR-4a through CDA-UR-4d.
Range of Cost: Varies depending on BMP – refer to CDA-UR-4a through CDA-UR-4d.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County, City of Post Falls, City of Coeur d'Alene.

CDA-UR-4a Install Grassed Bio-Infiltration Swales

To implement this BMP, stormwater runoff is directed to a grassed swale where vegetative cover provides pretreatment of stormwater before infiltration to the subsurface. Infiltration occurs either through the swale or within drywells that receive stormwater once the swale is filled to a design overflow elevation. The area surrounding the drywell and underlying the swale should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone.

Specific details regarding bio-infiltration swale design and construction within the Coeur d'Alene Lake subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: Grassed swales have a wide range of potential phosphorus removal efficiencies from 20 to 61 percent (Miller, 1987) to 29 to 99 percent (Yu et al., 2001).
Range of Cost: No specific quantitative information regarding the cost of grassed bio-infiltration swales was found during the project review. However, based on BMP characteristics, costs are expected to be moderate to high with respect to the other BMPs described in this plan.

CDA-UR-4b Install Bio-Infiltration Channels

To implement this stormwater treatment BMP, stormwater runoff is directed to a bio-infiltration channel underlain by an unsaturated zone that has an appropriate balance of treatment capacity

and infiltration capacity (EPA, 1999). A bio-infiltration channel is a sloped, vegetated channel or ditch that both conveys and treats stormwater runoff. It does not provide flow control but can convey runoff to facilities designed for that purpose (Spokane County et al., 2008). A bio-infiltration channel provides treatment as stormwater flows through vegetative cover and/or infiltrates. Channel flow can be directed to a pond or other facility. Infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Specific details regarding bio-infiltration channel and construction (also termed infiltration channels) within the Coeur d'Alene Lake subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of bio-infiltration channels was found during planning. However, infiltration trenches and basins have a wide range of potential phosphorus removal efficiencies of 10 to 80 percent (EPA, 1999).
Range of Cost: No specific quantitative information regarding the cost of bio-infiltration channels was found during planning.

CDA-UR-4c Install Vegetated Buffer Strips

Stormwater runoff is directed via sheet flow to a vegetated buffer strip situated adjacent to a rural roadway or parking lot. Vegetative cover within the buffer strip provides pretreatment of stormwater before infiltration to the subsurface, and/or evaporation. Vegetated buffer strips are used to intercept overland sheet flow runoff from adjacent impervious areas. They slow runoff velocities, filter out sediment and other pollutants, and provide infiltration into underlying soils. When buffer strips are used for infiltration, the area underlying the buffer strip should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone. Specific details regarding vegetated buffer strip design and construction within the Coeur d'Alene Lake subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness or cost of vegetated buffer strips was found during the project review. However, vegetated filter strips have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Grass filter strips have low phosphorus removal costs of $190 to $250 per pound (Sera-17, 2010).

CDA-UR-4d Infiltration Areas/Bio-retention Basins

Stormwater runoff is directed to an infiltration area underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). The infiltration area can be equipped with a drainfield constructed of perforated pipe to facilitate infiltration. A suitable site requires soils with a sufficiently high permeability to allow for relatively rapid infiltration, but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Spokane County and the City of Spokane have recently constructed/enhanced a number of regional stormwater infiltration facilities for the purpose of managing stormwater runoff in areas with difficult infiltration conditions on a site-specific level. When these facilities are located over relatively thick glaciofluvial sand and gravel sequences, benefit of water quality treatment may be limited. Examples include: Hazel's Creek Drainage and Conservation Facility (City of Spokane), Browne's Mountain Regional Stormwater Facility (Spokane County), and Price and Wall Regional Stormwater Facility (Spokane County).

DEQ (2005) provides guidance regarding bio-infiltration basins, which have similar design and operational elements.

Potential Phosphorus Load Reduction: Infiltration basins have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Infiltration structures generally have high phosphorus removal costs of $2,500 to $3,000 per pound (Corrozi, 2009).

CDA-UR-5 Evaluate Phosphorus Load from Septic Tanks along Coeur d'Alene Lake and Other Densely Developed Areas

While there is historical literature that suggests septic systems and subsequent treatment in the unsaturated zone provides phosphorus removal from effluent, recent and emerging evidence indicates the contrary in many locations. Both the current science and measured groundwater concentrations of phosphorus clearly indicate that septic systems release significant phosphorus loads into underlying groundwater and that phosphorus loading can increase with time as a result of the loading of sorption sites in the unsaturated zone. Moreover, the shallow hydrostratigraphy of many areas within the Coeur d'Alene Lake subbasin consists of shallow bedrock with little to no overlying fine-grained soil and therefore, has little phosphorus removal capacity.

Septic system density within the Coeur d'Alene Lake subbasin is summarized in Figure 4-6. The areas that should be considered include but are not limited to areas within 1,000 feet of Fernan Lake, Coeur d'Alene Lake, the Coeur d'Alene River, and associated off-channel (chain) lakes.

Activity: Evaluate phosphorus load from septic tanks within densely developed areas as a basis for future management decisions.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.

Potential Lead: Kootenai County or other municipalities.

CDA-UR-6 Septic Tank Elimination within Key Areas

Removal of septic systems by connecting to sewer systems eliminates a source of pollution to surface and groundwater. Wastes are treated more thoroughly and phosphorus removal is more complete at a wastewater treatment facility designed for phosphorus removal than is possible with a septic system. For these reasons, septic tank elimination is an important long-term management approach to controlling nonpoint source phosphorus loading.

Septic tank elimination programs should be based on results of CDA-UR-5, which will assist in identification of specific areas where infrastructure investment will lead to relatively large phosphorus loading reductions. It is likely that septic tanks are sufficiently dispersed within most of the subbasin to preclude sewering. However, review of septic tank distribution (Figure 4-6) suggests there are anomalous areas of high septic tank density directly east of the City of Coeur d'Alene, which could be considered for septic tank elimination.

Activity: Remove septic systems and replace with sanitary sewer east of the current City of Coeur d'Alene Lake service area.
Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of septic tank elimination was found during planning. However, based on the phosphorus removal characteristics of area wastewater facilities and that septic tank discharges are completely eliminated during removal, the expected effectiveness is very high.
Range of Cost: No specific quantitative information regarding the cost of septic tank elimination was found during planning. Potential costs may range from low to high with respect to the other BMPs described in this plan.
Potential Timeline: TBD by Potential Lead.
Potential Lead: City of Coeur d'Alene and/or Kootenai County.

CDA-UR-7 Inspection and Pumping of Septic Systems within Key Areas

Regular inspection and pumping of septic systems prolongs the life of the system, reduces maintenance costs and contamination around the drain field, and slows the breakthrough of phosphorus to groundwater. The priority systems to target are older systems and systems near streams and areas with a high groundwater table. The septic tank should be pumped by a licensed septage waste-hauler on a regular basis and septage properly disposed of in an approved site or wastewater treatment facility.

Septic system inspection and pumping can be performed throughout the subbasin to achieve nonpoint source loading reduction to area surface water. However, it will have greatest positive impact within nearshore areas and with septic system overlying coarse soil and/or bedrock with minimal phosphorus treatment capacity. Areas to consider include those within 1,000 feet of Fernan Lake, Coeur d'Alene Lake, the Coeur d'Alene River, and associated off-channel (chain) lakes

Activity: Require regular inspection and pumping of septic systems on a standard interval. The interval should vary as a function of septic tank size and persons per household to achieve acceptable retention times. Standard matrices are available for these requirements.
Potential Phosphorus Load Reduction: Inspection and pumping of septic systems has low to moderate phosphorus removal efficiencies of 40 to 55 percent (DDNR, 2010).
Range of Cost: Inspection and pumping of septic systems has very low phosphorus removal costs of $7 to $25 per pound (DDNR, 2010).
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County.

CDA-UR-8 Develop a Small Community Program for Phosphorus Loading Reduction

Small communities within the Coeur d'Alene Lake subbasin include Harrison, Medimont, Rose Lake, Cataldo, Fernan Lake Village, and others. These communities have a unique set of associated phosphorus loading mechanisms that, in many cases, are not specifically targeted by existing guidelines and regulation. A number of the small communities within the Coeur d'Alene Lake subbasin are in close proximity, and likely runoff directly to Coeur d'Alene Lake and its tributaries. Because of this, phosphorus loading from these areas could impact subbasin surface water.

The intent of this action is to develop a program to assist smaller communities to develop the tools they need to reduce phosphorus loading. This program could include generation of guidance documents and/or ordinances. Components of the program could include the following:

- Community outreach and education.
- Training programs targeted at local government officials and managers.
- Retrofit of existing stormwater management structures to comply with guidelines described in Action CDA-UR-4.
- Management and education intended to reduce of impact of pet waste on water quality.
- Septic system elimination (if applicable) per Action CDA-UR-6 and inspection/pumping per Action CDA-UR-7.
- Recommendation or requirement for use of phosphorus-free fertilizer, per Action CDA-AA-2.
- Recommendation to retain grass clippings/leaves on lawns or as properly-disposed of solid waste, rather than within runoff.

This action will also include guidance and/or requirements for LID practices in construction and stormwater management. LID practices that could be applicable to the Coeur d'Alene Lake subbasin are presented in detail in Volume 3 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ 2005). Described LID practices include:

- Clearing and grading practices.
- Use of aquatic buffers and preservation of natural hydrologic function.
- Impervious area practices.

- Green roofs and parking lots.
- Pervious pavement.
- Soil amendments and restoration.
- Rainwater harvesting and reuse.
- Created wetlands.

Activity: Develop a Small Community Program for Phosphorus Loading Reduction to assist smaller communities in developing the tools they need to reduce phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County or other municipalities.

CDA-UR-9 Marina Practices to Prevent Stormwater and other Pollution

Numerous marinas and other facilities are situated within the Coeur d'Alene Lake subbasin, particularly along Coeur d'Alene Lake extending from the City of Coeur d'Alene in the north to the City of Harrison and Conkling Park in the south. In addition, numerous house boat facilities occupy various coves and bays within Coeur d'Alene Lake. Each of these facilities deals with septic and other wastes and are potential sources of phosphorus directly to the Lake. BMP information specific to marina operations, which are of particular importance within the Coeur d'Alene Lake subbasin, is provided in DEQ's Compendium of Best Management Practices to Control Polluted Runoff (Meitl and Maguire, 2003) and Volume 2 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ 2005). Types of BMPs that pertain to marinas and boating operations include the following:

- Marina siting and design practices.
- Shoreline stabilization.
- Stormwater management.
- Sewage and solid waste management.
- Boat cleaning practices.
- Establishment of no wake zones and other boat management practices.
- Public education.

Activity: Review existing practices, encourage BMP implementation, provide adequate resources and information to marinas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

15.5.7 Supporting Phosphorus Reduction Activities

Supporting activities to be undertaken as part of this NPS Reduction Plan will provide valuable information for long-term success, in addition to the subbasin-specific actions and BMPs designed to provide direct phosphorus reduction. These activities are described in Chapter 9.

15.5.8 Additional Activities

Additional activities include indirect actions that either lead to overall improvements in ecological functions and thus water quality or provide additional insights into the overall health and conditions of the watershed. Activities are described in Chapter 9. Additional activities in the Coeur d'Alene Lake subbasin include the coordination of activities on Lake Spokane, nearshore, and upstream activities.

CDA-AA-1 Research Processes and Coordination of Restoration near Rose Lake

Data from the area downstream of Cataldo, ID, near Rose Lake indicate high values of phosphorus. The cause of these high values is unknown. Potential reasons include errors in the data, historical practices in the area, modifications to the channel banks, area lakes and/or wetlands. "Backwater conditions exist during May through September on the Coeur d'Alene River from Cataldo to the mouth due to control of surface elevation of Coeur d'Alene Lake at Post Falls Dam" (KSSWCD, unknown). Erosional processes include bank erosion due to fluctuating water levels and boat wake, deforestation caused by timber harvest, wildfires (primarily the 1910 fire), land use conversion resulting in increased discharge rate of runoff, channelization of streams by development, and decreased wetlands due to agricultural land conversion and development (KSSWCD, unknown).

"Numerous wetlands (with depths up to 5 feet) and 11 lateral lakes (with depths exceeding 20 feet) are located throughout the floodplain and are frequently connected by surface or subsurface flow from the mainstem channel" (Berenbrock and Tranmer, 2008). An increased understanding of the flow dynamics and interconnectivity of surface and groundwater systems may be useful for understanding the potential delivery of nonpoint sources. "Floodplain inundation occurs frequently throughout the Lower Basin via lateral connecting channels and overbank flow" (EPA, 2010a). This could be a delivery mechanism of nonpoint source phosphorus from agricultural and other land uses.

"Human activities have altered the movement of water in the Lower Basin for more than 100 years. These actions include those that restrict the flow of water, such as the construction of Post Falls Dam, levees and dikes (and improvements made to existing natural levees), causeways for rail and highways, and bridge crossings. Other actions include construction of culverts and artificial and improved channels between the river and lateral lakes" (EPA, 2010a). Coordination with wetlands restoration and metals remediation projects could be adapted to also reduce nonpoint sources. Projects that reduce the movement of sediment would also be beneficial for reducing nonpoint source phosphorus.

Activity: Research the source of high phosphorus data in the Rose Lake area and coordinate with other restoration projects.
Potential Phosphorus Load Reduction: TBD by Potential Lead.

Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

CDA-AA-2 Consider Phosphorus Free Fertilizer Ordinances

Municipalities across the U.S. have adopted phosphorus free fertilizer ordinances, such as a phosphate lawn fertilizer ban. Retailers and fertilizer producers have appropriate fertilizers products available that meet these ordinances. Some ordinances allow the use of fertilizer with phosphorus under specific circumstances such as if soil testing showing a phosphorus deficiency or for establishing new lawns or plants. A USGS study found that "runoff from lawn sites with non-phosphorus fertilizer applications had a median total phosphorus concentration that was similar to that of unfertilized sites, an indication that non-phosphorus fertilizer use may be an effective, low-cost practice for reducing phosphorus in runoff" (USGS, 2002).

Activity: Adopt ordinances that ban the use of fertilizer containing phosphorus.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.

CDA-AA-3 Evaluate, Protect and Enhance Nearshore Areas

Nearshore land management and activities have the potential to impact phosphorus loads to surface water. Within the Coeur d'Alene Lake subbasin, these activities apply to areas nearshore to Coeur d'Alene Lake, the Coeur d'Alene River, Wolf Lodge Creek and numerous tributaries within the subbasin. Nearshore sources may transport phosphorus loads via surface water, stormwater runoff, interflow, and groundwater. Unlike activities and BMPs implemented upstream, there is no attenuation of phosphorus loads associated with nearshore sources. Therefore, reduction of loads from nearshore areas is important and should be considered as part of the overall nonpoint source phosphorus load reduction strategy. Nearshore areas should be inventoried to identify areas where BMPs should be implemented. BMPs that should be considered for nearshore areas include, but are not limited to:

- Erosion control and bank stabilization.
- Filter strips.
- Septic tank elimination.
- Inspection and pumping of septic systems.
- Phosphate lawn fertilizer ban.
- Riparian fencing, riparian zones and buffer strips.
- Education and outreach to nearshore property owners.

Additional detail regarding these BMPs is provided in Chapter 8.

Activity: Evaluate nearshore areas of Fernan Lake, Coeur d'Alene Lake, Coeur d'Alene River and tributaries within the Coeur d'Alene Lake subbasin and implement activities and BMPs to reduce nonpoint source phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

15.5.9 Support Existing and Planned Activities

The NPS Reduction Plan supports existing water resources and water quality studies and planning. Protection of these resources also supports the reduction phosphorus nonpoint sources. Critical planned activities specific to the NPS Reduction Plan are identified below.

CDA-EP-1 Support and Supplement Avista Utilities WQAP Implementation

Avista Utilities is developing a WQAP to identify how they will mitigate for impacts to dissolved oxygen in Lake Spokane caused by the Long Lake Dam (Ecology, 2010). The WQAP should be completed in 2012. Avista's efforts to implement the plan elements should be supported. In addition, other organizations in the Coeur d'Alene Lake subbasin should look for ways to collaborate with and complement Avista's efforts to advance and expand success in reducing nonpoint source phosphorus loads.

Activity: Support and supplement Avista Utilities WQAP to achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

CDA-EP-2 Support and Enforce Ordinances that Protect Shorelines and Prevent Erosion

Kootenai County and the City of Coeur d'Alene have local requirements that regulate shoreline use and modification activities. Each set of requirements are unique. For example:

- Kootenai County's Site Disturbance Ordinance purpose is to protect property, surface water, and ground water against significant adverse effects from excavation, filling, clearing, unstable earthworks, soil erosion, sedimentation, and stormwater runoff.
- City of Coeur d'Alene City Code Shoreline Regulations (Article IIA) prohibits construction within 40 feet of the shoreline (with some exceptions).

These requirements relate to nonpoint source phosphorus reduction by protecting and enhancing shorelines and preventing erosion which transports phosphorus.

Activity: Support and enforce city and county ordinances that achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.

Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

CDA-EP-3 Implement, Support and Compliment Coeur d'Alene Lake Management Plan

Water quality in Coeur d'Alene Lake has generally improved since the mid-1970s as large-scale mining-related activities upstream of the lake tapered off and environmental cleanup activities got underway in the Silver Valley. The primary environmental concern in Coeur d'Alene Lake is the potential for release of metal contaminants contained in lake bottom sediments into the water column. The 2009 Coeur d'Alene Lake Management Plan (LMP) goal is *to protect and improve lake water quality by limiting basin-wide nutrient inputs that impair lake water quality conditions, which in turn influence the solubility of mining-related metals contamination contained in lake sediments.* (DEQ and Coeur d'Alene Tribe, 2009)

A USGS study suggested that Coeur d'Alene Lake may retain about half of total phosphorus inflow load due to high iron concentrations and high adsorption as particulate phosphorus (Woods, 2004). A comparison of historically reported inflow and outflow loads of total phosphorus suggested a similar deposition rate in the range of 50 to 60 percent. However, as concentrations of metals decrease the retention rate may decrease as well.

The 2009 LMP comprehensively identifies the actions and substantial resources that will be required to effectively manage Coeur d'Alene Lake and the large quantities of mining associated hazardous substances in its waters and lakebed sediments. It is intended to serve as a framework for watershed-based lake management through a public-private partnership model. Tier I of the plan includes monitoring and modeling, nutrient source inventory, coordination of existing partner programs, and education and outreach. Tier II includes nutrient reduction projects, special studies, and coordination with TMDL program implementation. (DEQ and Coeur d'Alene Tribe, 2009)

Activity: Implement, support and compliment Coeur d'Alene Lake Management Plan to achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: DEQ and Coeur d'Alene Tribe.

CDA-EP-4 Support, Compliment and Enforce Permits, Ordinances, Plans and Activities Relating to Nonpoint Source Phosphorus Reduction

There are a variety of permits, ordinances, plans and activities within the Coeur d'Alene Lake subbasin that relate to nonpoint source phosphorus reduction, including:

- City of Coeur d'Alene NPDES Phase II Stormwater Permit Requirements.
- 2002 Coeur d'Alene Lake and River TMDL Implementation Plan for Cougar, Kidd, Latour, Mica and Wolf Lodge Creeks relating to sediment load reduction.
- Spokane River Forum education efforts.

- TMDL for Dissolved Cadmium, Dissolved Lead and Dissolved Zinc in Surface Waters of the Coeur d'Alene River Basin (EPA, 2000).
- TMDL for Sediments in the Waters of Lake Creek in Coeur d'Alene Lake Subbasin, Idaho (EPA, 2005).

When taking actions and implementing BMPs to reduce nonpoint source phosphorus, consider these and other related plans, goals, requirements and efforts to optimize reduction potential. Review that erosion control BMPs are followed at land development projects and construction sites.

Activity: Support, compliment and enforce permits, ordinances, plans and activities to achieve nonpoint source phosphorus reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

Chapter 16

Upper Coeur d'Alene River Subbasin - Nonpoint Source Phosphorus Management Strategy and Actions

16.1 Introduction

An objective of this NPS Reduction Plan is to formulate nonpoint source control strategies that contribute to long-term reductions of phosphorus loads. It provides guidance on selecting 'what' strategies and actions to take and 'where' to apply them. Chapter 9 provides an introduction to the subbasin actions and strategies, background of the NPS Study objectives, how the subbasin chapters support the overall NPS Reduction Plan, and regional phosphorus control strategies that should be considered in all subbasins in the Spokane River Watershed.

This chapter identifies specific actions for entities located in the Upper Coeur d'Alene River subbasin and stakeholders supporting these entities to reduce nonpoint source phosphorus. Identified are strategies and actions and areas to target within the subbasin. This NPS Reduction Plan provides guidance on selecting 'what' strategies and actions to take and 'where' to apply them. The guidance identifies potential organization leads and potential timelines for initial and long-term reductions of nonpoint source phosphorus pollution.

The following sections of this chapter describe:

- The identification and relationship of entities and stakeholders in the watershed and associated acres of land ownership.
- An overview of reduction strategies, actions, and schedule for the subbasin.
- An overview of the nonpoint source reduction opportunities and guidance on 'what' BMPs to implement and 'where' to take these actions.
- The specific actions by category identified to be undertaken, including those identified by specific entities and stakeholders.

Estimates of the potential BMP phosphorus reductions and cost per pound are provided in Chapter 8. The overall phosphorus reduction potential is discussed in Chapter 9.

16.2 Entities and Stakeholders

As discussed in Chapter 9, accomplishing nonpoint source reductions will require engaging local, state, and federal agencies and land managers, as well as private land owners. The principal organizations involved with securing funding, identifying priority locations, selecting BMPs, and taking actions in the Upper Coeur d'Alene River subbasin include those shown in Table 16-1. These organizations are subdivided into entities and stakeholders as shown in Table 16-2, along with the area of land owned and miles of streams in the Upper Coeur d'Alene River subbasin. Land ownership for the subbasin is shown in Figure 16-1.

Table 16-1. Organizations and Nonpoint Source Phosphorus

Organization
Local Governments
Kootenai County
Shoshone County
Kootenai-Shoshone Soil and Water Conservation District
Idaho Panhandle Health District 1
Municipalities
None identified
Utilities
Municipal water service providers
Tribal Governments
None identified
State Agencies
Idaho Department of Environmental Quality
Idaho Department of Lands
Idaho Fish and Game
Idaho Forest Products Commission
Idaho Rangeland Resource Commission
Idaho Soil and Water Conservation Commission
Idaho Soil Conservation Commission
Idaho State Department of Agriculture
Idaho Transportation Department
Federal Agencies
U.S. Bureau of Land Management
U.S. Department of Agriculture – Natural Resource Conservation Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service

Table 16-2. Organizations and Land Area

Land Owners	Land Area (acres)	Regulatory[1]	Assistance	Stream Distance[1] (Miles)
Private				
In Bonner County	82	Bonner County	Bonner County Soil and Water Conservation District	0.5
In Kootenai County	538	Kootenai County		4.0
In Shoshone County	21,600	Shoshone County	Kootenai-Shoshone Soil and Water Conservation District	124.9
In Coeur d'Alene National Forest	19,114	U.S. Forest Service	USDA – Natural Resource Conservation Service	114.0
In Public Domain Bureau of Land Management	980	U.S. Environ. Protection Agency		8.9
Local Governments[2]				
Bonner County	*14,472*	Idaho Department of Environmental Quality, Idaho Fish and Game, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	47.8
Kootenai County	*116,879*			430.4
Shoshone County	*442,559*			1,669.0
State Agencies				
Idaho Department of Lands	7,495	Idaho Department of Environmental Quality, Idaho Fish and Game, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	21.2
Idaho Transportation Department	0			n/a
Federal Agencies				
U.S. Bureau of Land Management	3,208	U.S. Environmental Protection Agency	Natural Resource Conservation Service	9.8
U.S. Forest Service	539,863			1,975.4
Additional Land Areas				
Roads	1,615 miles		1,367 stream crossings	

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation, road miles include primary, secondary, local and forest service roads.

[2] Incorporated municipalities and local governments is total land area within boundaries, not land ownership.

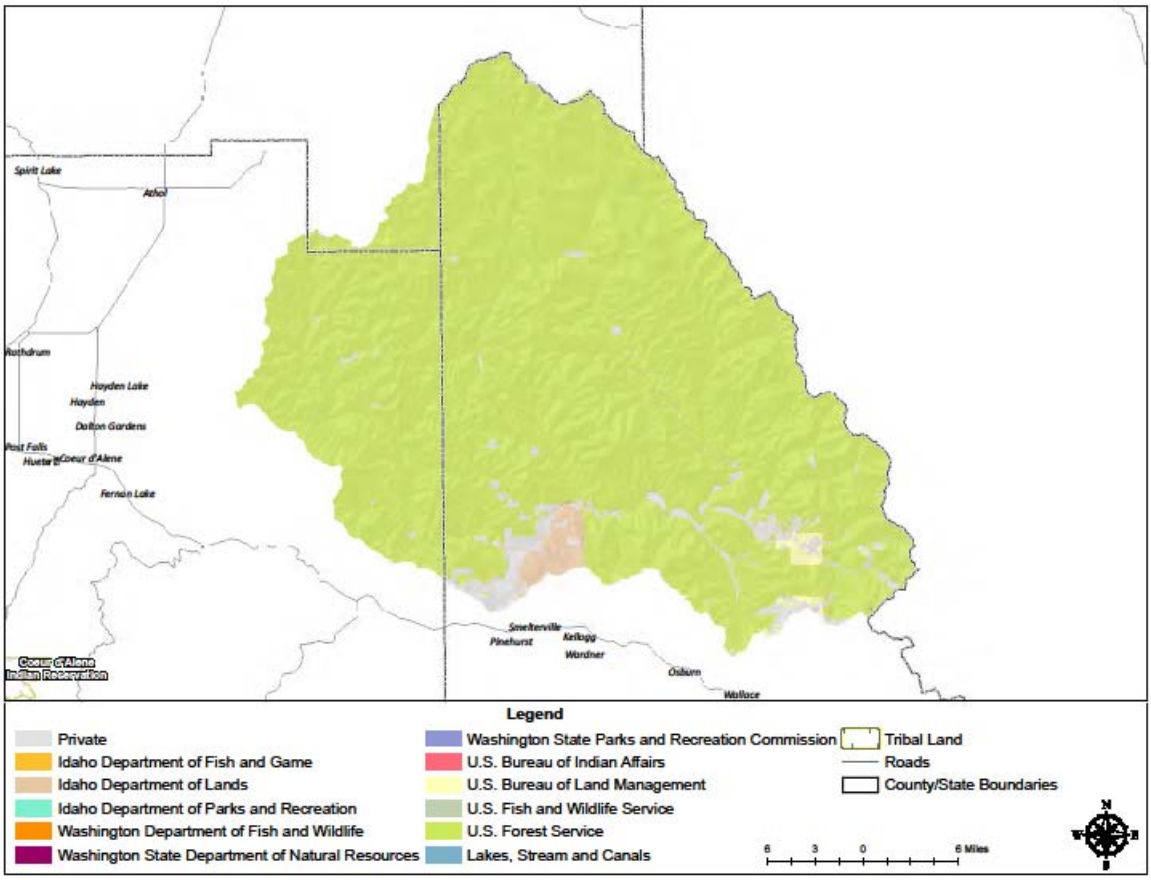

Figure 16-1. Upper Coeur d'Alene River Subbasin and Land Owners

16.3 Overview of Reduction Strategy, Actions, and Schedule

Identifying strategies for reducing nonpoint source phosphorus in the Upper Coeur d'Alene River subbasin is an important step to protect and restore water quality in the North Fork and main Coeur d'Alene Rivers, Coeur d'Alene Lake and the Spokane River. A successful strategy will also ultimately support improving dissolved oxygen concentrations in Lake Spokane. The extent of water quality improvements will depend on fate and transport processes which were not addressed in the NPS Study. Nonpoint source phosphorus reductions will have both local and watershed benefits.

16.3.1 Strategy

The strategy for addressing nonpoint sources of phosphorus includes taking actions throughout the subbasin. Nonpoint source reduction actions include addressing obvious problems and undertaking actions that can be readily completed. The strategy emphasizes reducing nonpoint source phosphorus from land uses that generate large phosphorus loads and cover large areas of the subbasin. A subbasin scale assessment of these land uses revealed that evergreen forest and rangeland are dominant throughout the subbasin.

16.3.2 Actions

Actions are the measures or steps from planning through achievement of nonpoint source phosphorus reduction. Actions include sufficient description and specificity for a responsible party to decide to take the action. The actions also help the responsible party determine where, what, when, and how to achieve the potential suggested outcome.

BMPs are the core of the action; whereas, actions encompass the entire process from the identification of the area, selection and implementation of the BMP through post monitoring. BMPs for addressing nonpoint sources of phosphorus include structural (i.e., physical) and non-structural (i.e., educational) measures.

BMPs referenced in the actions in Section 16.5 were identified based on the dominant land uses and the associated loading potential of the land uses. BMP phosphorus percent reduction efficiency, costs, estimated longevity and implementation effectiveness were also key indicators for identifying high priority BMPs for the subbasin. See Chapter 8 Nonpoint Source Phosphorus Control Measures for information about BMPs and the prioritization process.

16.3.3 Schedule

The schedule for nonpoint source actions for this plan is based on meeting the schedule in the Spokane River DO TMDL (Ecology, 2010). The schedule targets expeditious management actions to reduce nonpoint source phosphorus over the next two decades. From the Spokane River DO TMDL approval (May 2010), progress will be evaluated every five years, with extensive assessments after 10- and 20-years. The results from the first 10-years will be used to guide actions during the second ten year period. Actions initiated in the first ten years and determined to be beneficial should be continued, including successful nonpoint source control.

16.3.4 Summary of Approach

DEQ has not developed a TMDL and load allocation for the Upper Coeur d'Alene River subbasin to match with the Spokane River DO TMDL (Ecology, 2010). Ecology assigned load allocations for the Little Spokane River and Hangman Creek subbasins and provided seasonal estimates for the percent reduction in nonpoint source phosphorus loads. These seasonal estimates were converted to average annual equivalents. Based on the reductions for the Little Spokane and Hangman Creek subbasins, a target reduction of approximately 25 percent within upstream subbasins is estimated to be necessary to meet downstream targets. Additionally, implementation of the Coeur d'Alene Lake Management Plan is investigating nutrient loads within tributaries to the lake and may provide additional guidance for reductions (DEQ and Coeur d'Alene Tribe, 2009). Using an average efficiency of 54 percent for the priority BMPs (Chapter 8), approximately 63 percent of the major land uses (evergreen forest and rangeland) would need BMPs applied to achieve the target. Based on the average cost for the priority BMPs of about $320/pound (Chapter 8), the total cost for the target reduction would be approximately $3,800,000. Achieving the target reduction over a 20-yr period will require that approximately $190,000 is spent annually on BMPs in the subbasin.

16.4 Overview of Opportunities

Opportunities for organizations to undertake nonpoint source phosphorus reductions are available throughout the subbasin. This overview includes a description of what BMPs are the most relevant and where the BMPs should be implemented. Where the BMPs should be implemented is specific to land uses.

16.4.1 Control Measures and BMPs

BMPs specific to land use type and source are described in detail in Chapter 8. The background included in Chapter 8 narrowed the list of BMPs from 108 to 22 based on phosphorus percent reduction efficiency, cost, estimated longevity, and implementation effectiveness. This list of BMPs, if implemented for the appropriate land uses, could result in substantial net nonpoint source reduction of phosphorus.

There are several organizations throughout the Upper Coeur d'Alene River subbasin that can mitigate nonpoint source loads by incorporating BMPs. The agencies and organizations are encouraged to review the land and nonpoint phosphorus sources in their jurisdiction to further identify BMPs that are specific to their situation.

Organizations should examine areas within their influence to identify opportunities where these BMPs can be implemented to reduce nonpoint source phosphorus. These organizations should also examine their stormwater management practices and look for opportunities to implement BMPs since stormwater is a primary transport mechanism for nonpoint source phosphorus. Organizations identified in Tables 16-1 and 16-2 include private, municipal, state and federal entities. Associated opportunities for nonpoint source phosphorus reduction include:

- Private land owners may protect and restore riparian corridors; minimize stormwater runoff; and consider education, land evaluation, and/or aide available from the conservation organizations.
- Municipalities may install BMPs to treat and/or reduce stormwater discharge to water bodies; evaluate where stormwater is being discharged; and/or evaluate the pollutant loading by collecting samples for analysis.
- State and federal agencies should review activities occurring on the land, identify potential impacts, and implement applicable BMPs.

16.4.2 Land Uses and Source Potential

The NPS Reduction Plan is meant to provide guidance on where to take action, as actions are voluntary and not mandatory. The NPS Study was conducted at the watershed and subbasin scales and is limited in its guidance to actions at those scales. Actions by organizations are limited by their jurisdictions and authority. Organizations will need to examine local conditions to determine specifically where they choose to take action.

The NPS Reduction Plan analyses (Chapters 6 and 7) evaluated the dominant land uses and the phosphorus load potential for each subbasin. In some cases, the largest land use did not match

the largest phosphorus load reduction potential. The following land uses have the highest priority for the Upper Coeur d'Alene River subbasin with respect to nonpoint source phosphorus loading:

- Evergreen Forest.
- Range.

The analytical evaluation results indicated that the western portion of the subbasin has the highest nonpoint source phosphorus loading rates in the Upper Coeur d'Alene River subbasin (see Chapter 7). These two sub-subbasins with the highest estimated loadings are Burnt Cabin Creek (0.084 lbs/ac/yr) and Iron Creek (0.084 lbs/ac/yr). These subareas should be considered as priority areas for action.

The Upper Coeur d'Alene River subbasin is dominated by evergreen forest land (94 percent) with minor shrub and brush rangeland (5 percent). These land uses also have the greatest phosphorus removal potential. Organizations are encouraged to take action in these high priority land use areas. These particular land uses represent the priority areas where nonpoint source phosphorus actions are necessary to achieve a significant net reduction. Organizations should examine areas they own or are within their influence, and look for opportunities to reduce nonpoint source phosphorus from the prioritized land uses. Organizations should also examine areas within their jurisdiction that are obvious areas for nonpoint source reduction opportunities.

16.4.3 Summary of Reduction Opportunities

BMPs have been prioritized first by their ability to remove nonpoint source phosphorus loads and then by land use type. The acres of land use by organization were computed and are tabulated in Table 16-3. The acres in Table 16-3 demonstrates how the land uses are distributed among the land owners and where the opportunities for reductions may exist.

The export coefficients summarized in Chapter 7, along with the land uses and areas, can be used to estimate potential nonpoint source phosphorus loads by organization. There is an associated range of reduction opportunities based on the potential to reduce phosphorus loads. These opportunities are presented in Table 16-4 by assigning a load reduction potential that ranges from low to high. The range is based on total phosphorus load; therefore, higher potential may be due to a greater export coefficient, the total land area, or a combination of both. Table 16-4 is intended to provide further guidance for considering and selecting BMPs for implementation.

Figure 16-2 shows land ownership with stream segments highlighted in areas of high potential for nonpoint source phosphorus reduction based on the land use and export coefficients. Stream segments are shown since the highest priority BMPs in this subbasin generally relate to stream or riparian corridors.

Table 16-3. Organizations Land Area by Land Use

Land Owners	Agriculture[1] (acres)	Forested[1] (acres)	Rangeland[1] (acres)	Urban / Suburban[1] (acres)	Other[1] (acres)
Private					
Private	31	16,733	3,295	338	1,837
Local Governments[2]					
Bonner County	2	13,770	652	0	23
Kootenai County	5	112,945	3,347	3	665
Shoshone County	211	410,887	26,547	747	4,414
State Agencies					
Idaho Department of Fish and Game	0	6	2	4	9
Idaho Department of Lands	0.3	6,752	655	45	27
Federal Agencies					
U.S. Bureau of Land Management	0	3,080	130	<1	<1
U.S. Forest Service	181	510,515	26,359	314	2,782

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation.

[2] Incorporated municipalities and local governments is the total land area within boundaries.

Table 16-4. Organizations and Potential for Nonpoint Source Phosphorus Reduction

Land Owners	Agriculture[1]	Forested[1]	Rangeland[1]	Urban / Suburban[1]	Other[1]
Private					
Private	Moderate	High	High-Mod.	Moderate	Moderate
Local Governments					
Bonner County	Low-Mod.	High	Moderate	n/a	Low-Mod.
Kootenai County	Low-Mod.	High	High-Mod.	Low-Mod.	Low-Mod.
Shoshone County	High-Mod.	High	High	High-Mod.	Moderate
State Agencies					
Idaho Department of Fish and Game	n/a	Low	Low	Low-Mod.	Low
Idaho Department of Lands	Low	High-Mod.	Moderate	Low-Mod.	Low
Federal Agencies					
U.S. Bureau of Land Management	n/a	High-Mod.	Low-Mod.	Low	Low
U.S. Forest Service	High-Mod.	High	High	High-Mod.	Moderate

[1] NPS load potential based on area and export classified into five categories, low, low-moderate, moderate, high-moderate, and high.

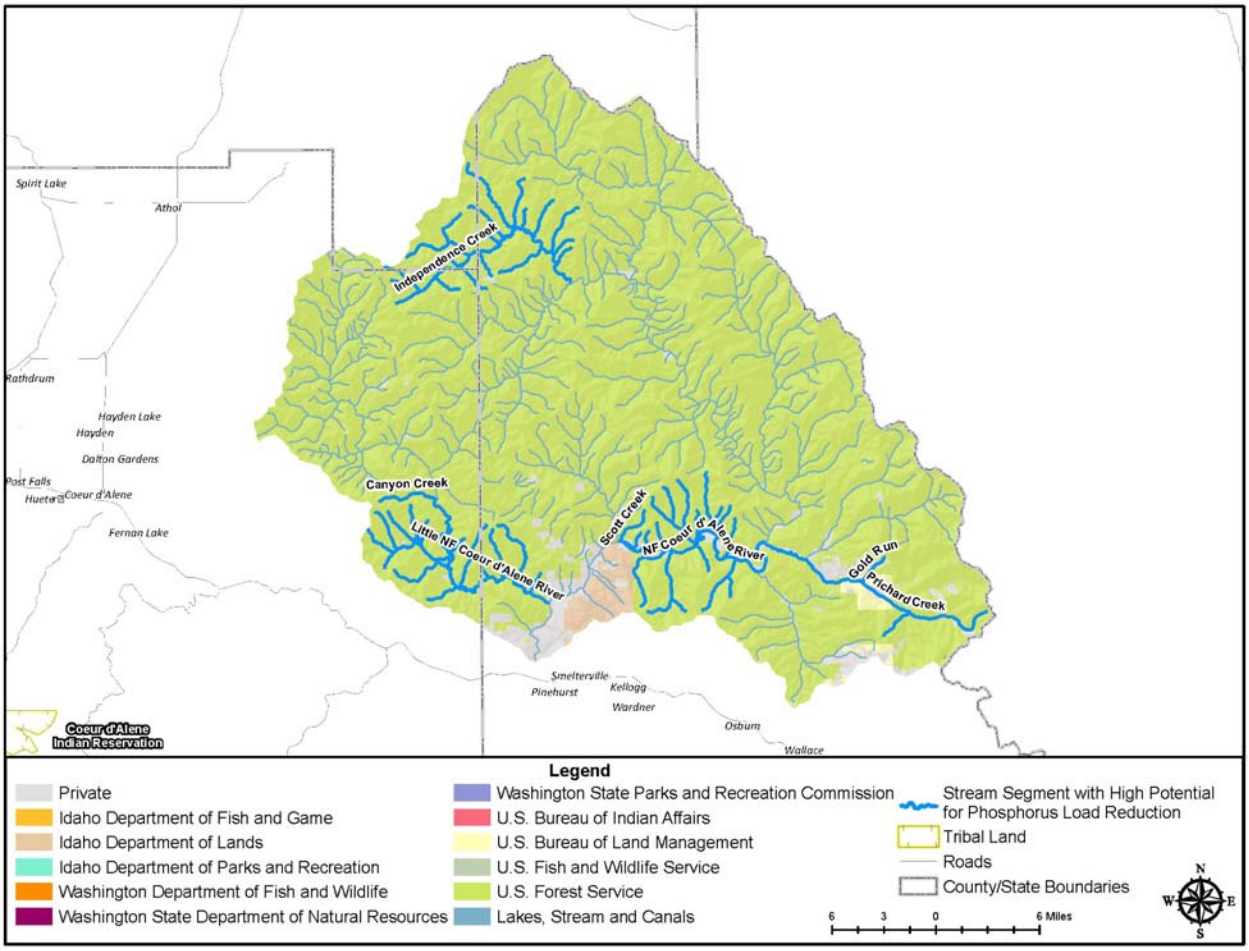

Figure 16-2. Upper Coeur d'Alene River Subbasin High Potential Reduction Opportunities

16.5 Specific Actions by Category

This section includes a list of specific actions to reduce nonpoint source phosphorus loads and ultimately contribute to meeting water quality standards. A general description of each action, an activity summary, potential phosphorus load reduction, a range of costs, potential timelines, and the potential lead entity are provided for each action. Although it was not a primary objective of the NPS Study to specify "who" implements phosphorus control measures, potential lead organizations are identified for some actions to help provide linkage to the "what" and "where" objectives of the NPS Study. The lead organization will need to assist local entities in developing detailed plans for the activities, as well as a schedule and plan for monitoring progress. When the information was available, the action also includes a description of the roles of the organization with responsibility to improve water quality, and the means through which the organization will address the water quality issues.

16.5.1 High Priority BMPs

The analysis provided in Chapter 8 described the following BMPs as having the highest priority for the Upper Coeur d'Alene River subbasin:

- Streamside Management Zones.
- Riparian Zones and Buffer Strips.
- Stream Bank Stabilization.
- Erosion Control.

Specific details regarding implementation of these high priority BMPs are provided in Chapter 9. These BMPs are appropriate for implementation for land uses in the subbasin. The following sections summarize actions appropriate for the specific land uses within the Upper Coeur d'Alene River subbasin.

16.5.2 Regional Phosphorus Management

Regional phosphorus control strategies are not specific to any one land use type or organization, and may contribute to the reduction of nonpoint source phosphorus loadings in the subbasin. Descriptions of the regional or watershed-scale phosphorus management actions intended to facilitate load reductions and/or establish the technical foundation for further phosphorus control activities are described in Chapter 9.

16.5.3 Agriculture Related Activities

Since less than 1 percent of the subbasin land use is being used for agriculture, opportunities for phosphorus loading reduction within subbasin agricultural lands are minor. As such, no specific agriculture actions are presented. Public education and outreach programs under the regional phosphorus management strategy will likely support agriculture BMPs throughout the subbasin.

16.5.4 Forestry Related Activities

Since the subbasin is more than 90 percent forested, a number of forestry-related phosphorus control strategies should be considered to reduce nonpoint source phosphorus loadings. BMPs under this category are typically associated with minimizing erosion, reducing sediment transport, protecting and maintaining riparian corridors and streamside management zones. The following sections provide brief descriptions of potential forestry-related phosphorus management actions.

UCR-FR-1 Evaluate Forestry Practices

Idaho's forest practices regulations will be relied upon to reduce nonpoint source phosphorus loads from private and state forestlands. Ongoing practices should be reviewed by or as directed by the lead organization for compliance. If compliance with the existing regulations is not resulting in sufficient reduction, then more effective methods need to be promoted. Poorly performing practices need to be researched for the causes and potentially modified to improve the outcomes.

With large quantities of adjacent forested land, tributary water quality is likely affected by forest management practices. Logging and road building practices that have been common throughout the intermountain region from the late nineteenth century through most of the twentieth century have likely contributed to the degradation of water quality. In more recent times, implementation of more environmentally sound forest management practices has occurred. These practices may

have reduced forestry-related phosphorus loading within the subbasin but additional reductions are still possible.

The Idaho Forest Practices Act (IDAPA 20.02.01) defines the minimum level of best management practices (BMPs) required to be implemented for commercial timber lands in Idaho. It is anticipated that the new road maintenance and abandonment plans required by the current forest practices rules will slowly reduce phosphorus export from harvested forests.

The agencies have data on forest health, ecology, harvest areas, vegetation types, soil conditions and more. This information can be useful for identifying areas of greater nonpoint source phosphorus loading. However, much of this data is not readily available or in a format that can be interpreted by water quality managers. Coordination between forest and water quality managers is necessary to understand the data and select management activities.

Activity: Enforce existing regulations, evaluate existing practices, discourage poorly performing practices, and encourage best performing practices and improve coordination of sharing information.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

UCR-FR-2 Quantify Sediment-Phosphorus Relationship in Forested Areas

Quantifying phosphorus loading associated with forest management practices may provide additional information that support selection of successful BMPs. The construction and use of roadways represent a major source of sediment from timber harvest activities (DEQ, 2000). A study to quantify the relationship between sediment associated with phosphorus in runoff from these roads can help determine whether additional measures should be undertaken.

Activity: Quantify relationship between sediment and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

UCR-FR-3 Subbasin Scale Road Planning and Rehabilitation

Conduct a subbasin-scale management survey to inventory ownership and identify and prioritize the total miles of erodible roads and road banks. Specific BMPs may then be developed based on survey results to reduce miles of erodible roads associated with road construction, road conversions, and maintenance. A database of roads with tracking of BMP implementation is essential for determining success and accountability. Reduction plans should identify opportunities to abandon non-essential roads or restore roads on non-industrial forest lands and other county roads that contribute obvious erosion problems.

Activity: Quantify relationship between roads and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.

Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

UCR-FR-4 Fire Rehabilitation Areas

Wild fires can significantly impact the landscape. Research has shown increased concentrations of suspended sediments, phosphorus, and potassium in streams below burned areas (Stednick, et al., 1982). Stream monitoring indicated an immediate flush of phosphorus in the runoff, followed by a slower release. Rehabilitation of burn areas, especially the riparian corridors to protect streams, will be important to reducing nonpoint source phosphorus in forested areas. The fire history from 2001 through 2010 suggests approximately 300 acres in the subbasin to have been burned and should be evaluated.

Activity: Identify and assist with rehabilitation of burned areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

UCR-FR-5 Land Use Planning on Federal Lands

The US Forest Service is currently in the process of developing a planning rule related to changes in land use planning. "The proposed rule would provide a framework to guide the collaborative and science-based development, amendment and revision of land management plans that promote healthy, resilient, diverse and productive national forests and grasslands" (USFS, 2011). Objectives of include encouraging sustainable ecosystem development. Development of the plan should include nonpoint source pollution and fit with the objectives of the NPS Reduction Plan.

Activity: Complete land use planning in accordance with the planning rule revision.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

16.5.5 Range Related Activities

About 5 percent of the subbasin is rangeland. Because rangeland is the second largest land use in the subbasin, phosphorus control strategies will likely be necessary to reduce nonpoint source phosphorus loadings. The following sections provide brief descriptions of some of the phosphorus management actions for load reductions in rangeland areas.

UCR-RR-1 Evaluate Rangeland Practices

The state's regulations will be relied upon to reduce nonpoint source phosphorus loads from rangelands. Evaluate past and present impacts and review ongoing practices for compliance. The goal of evaluating past and present activities is to manage rangeland to maintain optimum soil and water quality. If compliance with the existing regulations is not resulting in sufficient

nonpoint source phosphorus reduction, then more effective methods should be identified and promoted.

Activity: Evaluate existing practices, enforce existing regulations, and encourage BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

16.5.6 Urban/Suburban Related Activities

Since less than 1 percent of the land use is urban/suburban, no specific urban/suburban actions are identified. Public education and outreach programs under the regional phosphorus management strategy could support urban/suburban BMPs throughout the subbasin.

16.5.7 Supporting Phosphorus Reduction Activities

Supporting activities to be undertaken as part of this NPS Reduction Plan will provide valuable information for long-term success, in addition to the subbasin-specific actions and BMPs designed to provide direct phosphorus reduction. These activities are described in Chapter 9.

16.5.8 Additional Activities

Additional activities include indirect actions that either lead to overall improvements in ecological functions and thus water quality or provide additional insights into the overall health and conditions of the watershed. Activities are described in Chapter 9. Additional activities in the Upper Coeur d'Alene River subbasin include the coordination of activities nearshore and upstream and downstream activities.

UCR-AA-1 Evaluate, Protect and Enhance Nearshore Areas

Nearshore land management and activities have the potential to impact phosphorus loads to surface water. Within the Upper Coeur d'Alene River subbasin, these activities apply to areas nearshore to the North Fork, the South Fork, the Coeur d'Alene River reach downstream of the two forks, and their numerous tributaries. Nearshore sources may transport phosphorus loads via surface water, stormwater runoff, interflow, and groundwater. Unlike activities and BMPs implemented upstream, there is little to no attenuation of phosphorus loads associated with nearshore sources. Therefore, reduction of loads from nearshore areas is important and should be considered as part of the overall nonpoint source phosphorus load reduction strategy. Nearshore areas should be inventoried to identify areas where BMPs should be implemented. Additional detail regarding these BMPs is provided in Chapter 8. BMPs that should be considered for nearshore areas include, but are not limited to:

- Erosion control and bank stabilization.
- Filter strips.
- Inspection and pumping of septic systems.
- Riparian fencing, riparian zones and buffer strips.

- Education and outreach to nearshore property owners.

Activity: Evaluate nearshore areas of the North Fork, the South Fork, the Coeur d'Alene River reach downstream of the two forks, and their numerous tributaries within the Upper Coeur d'Alene River subbasin and implement activities and BMPs to reduce nonpoint source phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

16.5.9 Support Existing and Planned Activities

The NPS Reduction Plan supports existing water resources and water quality studies and planning. Protection of these resources also supports the reduction phosphorus nonpoint sources. Critical planned activities specific to the NPS Reduction Plan are identified below.

UCR-EP-1 Support, Compliment and Enforce Permits, Ordinances, Plans and Activities Relating to Nonpoint Source Phosphorus Reduction

There are a variety of permits, ordinances, plans and activities within the Upper Coeur d'Alene River subbasin that relate to nonpoint source phosphorus reduction, including:

- 2001 Subbasin Assessment and TMDL of the North Fork Coeur d'Alene River and subbasin-wide sediment TMDLs for the entire North Coeur d'Alene River.
- Spokane River Forum education efforts.
- Various plans and actions related to reduction of sediment loading associated with historic mining activities.

When taking actions and implementing BMPs to reduce nonpoint source phosphorus, consider these and other related plans, goals, requirements and efforts to optimize reduction potential. Review that erosion control BMPs are followed at land development projects and construction sites.

Activity: Support, compliment and enforce permits, ordinances, plans and activities to achieve nonpoint source phosphorus reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

UCR-EP-2 Implement, Support and Compliment Coeur d'Alene Lake Management Plan

Water quality in Coeur d'Alene Lake has generally improved since the mid-1970s as large-scale mining-related activities upstream of the lake tapered off and environmental cleanup activities got underway in the Silver Valley. The primary environmental concern in Coeur d'Alene Lake is the potential for release of metal contaminants contained in lake bottom sediments into the water column. The 2009 Coeur d'Alene Lake LMP goal is *to protect and improve lake water quality by*

limiting basin-wide nutrient inputs that impair lake water quality conditions, which in turn influence the solubility of mining-related metals contamination contained in lake sediments. (DEQ and Coeur d'Alene Tribe, 2009)

A USGS study suggested that Coeur d'Alene Lake may retain about half of total phosphorus inflow load due to high iron concentrations and high adsorption as particulate phosphorus (Woods, 2004). A comparison of historically reported inflow and outflow loads of total phosphorus suggested a similar deposition rate in the range of 50 to 60 percent. However, as concentrations of metals decrease the retention rate may decrease as well.

The 2009 LMP comprehensively identifies the actions and substantial resources that will be required to effectively manage Coeur d'Alene Lake and the large quantities of mining associated hazardous substances in its waters and lakebed sediments. It is intended to serve as a framework for watershed-based lake management through a public-private partnership model. Tier I of the plan includes monitoring and modeling, nutrient source inventory, coordination of existing partner programs, and education and outreach. Tier II includes nutrient reduction projects, special studies, and coordination with TMDL program implementation. (DEQ and Coeur d'Alene Tribe, 2009)

Activity: Implement, support and compliment Coeur d'Alene Lake Management Plan to achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: DEQ and Coeur d'Alene Tribe.

Chapter 17

South Fork Coeur d'Alene River Subbasin - Nonpoint Source Phosphorus Management Strategy and Actions

17.1 Introduction

An objective of this NPS Reduction Plan is to formulate nonpoint source control strategies that contribute to long-term reductions of phosphorus loads. It provides guidance on selecting 'what' strategies and actions to take and 'where' to apply them. Chapter 9 provides an introduction to the subbasin actions and strategies, background of the NPS Study objectives, how the subbasin chapters support the overall NPS Reduction Plan, and regional phosphorus control strategies that should be considered in all subbasins in the Spokane River Watershed.

This chapter identifies specific actions for entities located in the South Fork Coeur d'Alene River subbasin and stakeholders supporting these entities to reduce nonpoint source phosphorus. Identified are strategies and actions and areas to target within the subbasin. The guidance identifies potential organization leads and potential timelines for initial and long-term reductions of nonpoint source phosphorus pollution.

The following sections of this chapter describe:

- The identification and relationship of entities and stakeholders in the watershed and associated acres of land ownership.
- An overview of reduction strategies, actions, and schedule for the subbasin.
- An overview of the nonpoint source reduction opportunities and guidance on 'what' BMPs to implement and 'where' to take these actions.
- The specific actions by category identified to be undertaken, including those identified by specific entities and stakeholders.

Estimates of the potential BMP phosphorus reductions and cost per pound are provided in Chapter 8. The overall phosphorus reduction potential is discussed in Chapter 9.

17.2 Entities and Stakeholders

As discussed in Chapter 9, accomplishing nonpoint source reductions will require engaging local, state, and federal agencies and land managers, as well as private land owners. The principal organizations involved with securing funding, identifying priority locations, selecting BMPs, and taking actions in the South Fork Coeur d'Alene River subbasin include those shown in Table 17-1. These organizations are subdivided into entities and stakeholders as shown in Table 17-2, along with the area of land owned and miles of streams in the South Fork Coeur d'Alene River subbasin. Land ownership for the subbasin is shown in Figure 17-1.

Table 17-1. Organizations and Nonpoint Source Phosphorus

Organization
Local Governments
Benewah County
Kootenai County
Shoshone County
Benewah Soil and Water Conservation District
Kootenai-Shoshone Soil and Water Conservation District
Idaho Panhandle Health District 1
Municipalities
Kellogg, Mullan, Osburn, Pinehurst, Smelterville, Wallace, Wardner
Utilities
Municipal water service providers
Tribal Governments
None identified
State Agencies
Idaho Department of Environmental Quality
Idaho Department of Lands
Idaho Department of Parks and Recreation
Idaho Fish and Game
Idaho Forest Products Commission
Idaho Rangeland Resource Commission
Idaho Soil Conservation Commission & Idaho Soil and Water Conservation Commission
Idaho State Department of Agriculture
Idaho Transportation Department
Federal Agencies
Coeur d'Alene National Forest
U.S. Bureau of Land Management
U.S. Department of Agriculture – Natural Resource Conservation Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service

Table 17-2. Organizations and Land Area

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Private				
In Kellogg	2,531	Kellogg	Kootenai-Shoshone Soil and Water Conservation District	n/a
In Mullan	498	Mullan		
In Osburn	833	Osburn		
In Pinehurst	639	Pinehurst		
In Smelterville	211	Smelterville		
In Wallace	536	Wallace		
In Wardner	523	Wardner		
In Kootenai County	852	Kootenai County		1.2
In Shoshone County	82,488	Shoshone County		311.1
In Benewah County	525	Benewah County	Benewah Soil and Water Conservation District	2.7
In Coeur d'Alene National Forest	19,473	U.S. Forest Service	USDA – Natural Resource Conservation Service	71.1
In Crystal Lake Wilderness Area	89	U.S. Environmental Protection Agency		0.5
In Public Domain Bureau of Land Management	8,382			36.4
Incorporated Municipalities[2]				
Kellogg	*2,563*	Idaho Department of Environmental Quality, U.S. Environmental Protection Agency	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	10.6
Mullan	*506*			1.7
Osburn	*856*			5.4
Pinehurst	*639*			2.2
Smelterville	*221*			0.7
Wallace	*575*			3.0
Wardner	*558*			2.3

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Local Governments[2]				
Benewah County	*1,449*	Idaho Department of Environmental Quality, U.S. Environmental Protection Agency, Idaho Fish and Game, U.S. Fish and Wildlife Service	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	4.3
Kootenai County	*3,311*			5.0
Shoshone County	*185,184*			631.8
State Agencies				
Idaho Department of Lands	5,556	Idaho Department of Environmental Quality, Idaho Fish and Game, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	16.6
Idaho Department of Parks and Recreation	130			0.3
Idaho Transportation Department	613			n/a
Federal Agencies				
U.S. Bureau of Land Management	39,056	U.S. Environmental Protection Agency	USDA – Natural Resource Conservation Service	111.3
U.S. Forest Service	61,207			197.0
Additional Land Areas				
Roads	682 miles		601 stream crossings	

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation, road miles include primary, secondary, local and forest service roads.

[2] Incorporated municipalities and local governments is total land area within boundaries, not land ownership.

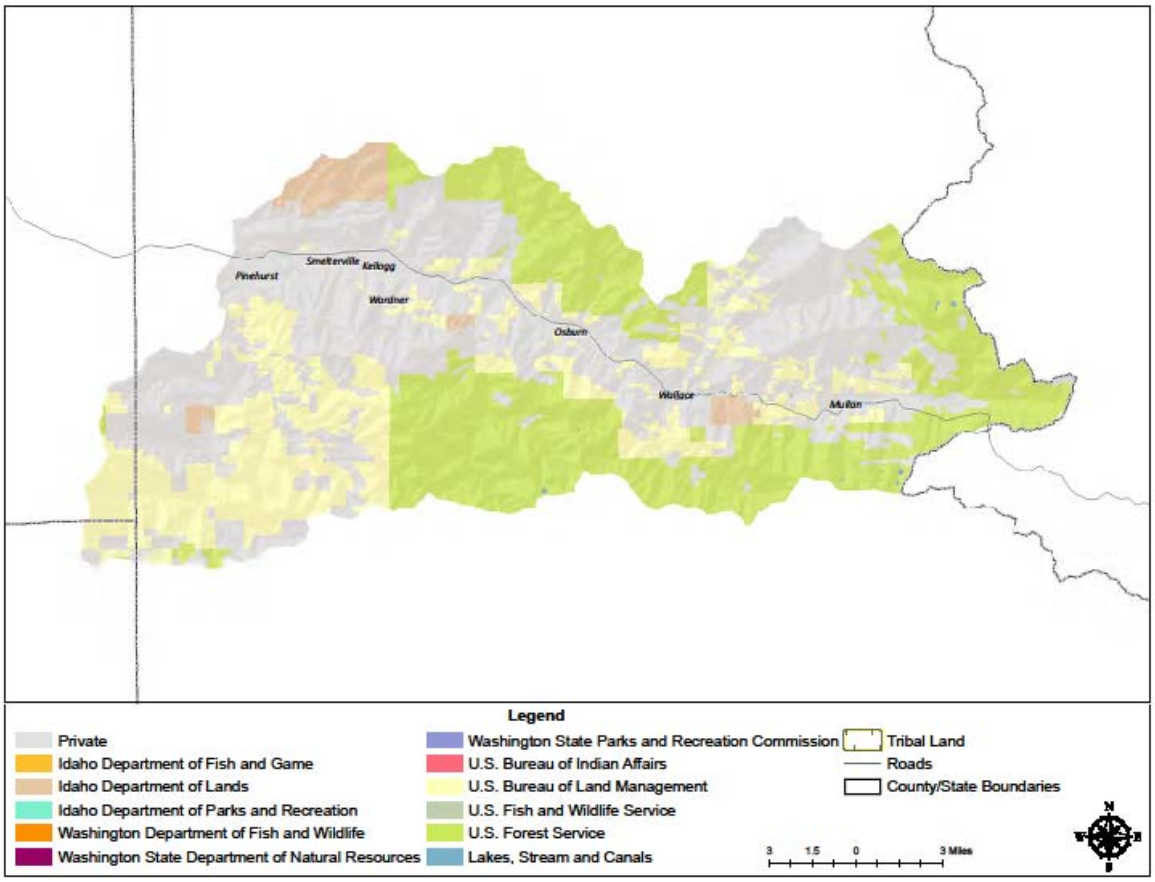

Figure 17-1. South Fork Coeur d'Alene River Subbasin and Land Owners

17.3 Overview of Reduction Strategy, Actions, and Schedule

Identifying strategies for reducing nonpoint source phosphorus in the South Fork Coeur d'Alene River subbasin is an important step to protect and restore water quality in the South Fork Coeur d'Alene River, Coeur d'Alene Lake and the Spokane River. A successful strategy will also ultimately support improving dissolved oxygen concentrations in Lake Spokane. The extent of water quality improvements will depend on fate and transport processes which were not addressed in the NPS Study. Nonpoint source phosphorus reductions will have both local and watershed benefits.

17.3.1 Strategy

The strategy for addressing nonpoint sources of phosphorus includes taking actions throughout the subbasin. Nonpoint source reduction actions include addressing obvious problems and undertaking actions that can be readily completed. The strategy emphasizes reducing nonpoint source phosphorus from land uses that generate large phosphorus loads and cover large areas of the subbasin. A subbasin scale assessment of these land uses revealed that evergreen forest and shrub and brush rangeland are dominant throughout the subbasin (Chapter 3).

17.3.2 Actions

Actions are the measures or steps from planning through achievement of nonpoint source phosphorus reduction. Actions include sufficient description and specificity for a responsible party to decide to take the action. The actions also help the responsible party determine where, what, when, and how to achieve the potential suggested outcome.

BMPs are the core of the action; whereas, actions encompass the entire process from the identification of the area, selection and implementation of the BMP through post monitoring. BMPs for addressing nonpoint sources of phosphorus include structural (i.e., physical) and non-structural (i.e., educational) measures.

BMPs referenced in the actions in Section 17.5 were identified based on the dominant land uses and the associated loading potential of the land uses. BMP phosphorus percent reduction efficiency, costs, estimated longevity and implementation effectiveness were also key indicators for identifying high priority BMPs for the subbasin. See Chapter 8 Nonpoint Source Phosphorus Control Measures for information about BMPs and the prioritization process.

17.3.3 Schedule

The schedule for nonpoint source actions for this plan is based on meeting the schedule in the Spokane River DO TMDL (Ecology, 2010). The schedule targets expeditious management actions to reduce nonpoint source phosphorus over the next two decades. From the Spokane River DO TMDL approval (May 2010), progress will be evaluated every five years, with extensive assessments after 10- and 20-years. The results from the first 10-years will be used to guide actions during the second ten year period. Actions initiated in the first ten years and determined to be beneficial should be continued, including successful nonpoint source control.

17.3.4 Summary of Approach

DEQ has not developed a TMDL and load allocation for the South Fork Coeur d'Alene River subbasin to match with the Spokane River DO TMDL (Ecology, 2010). Ecology assigned load allocations for the Little Spokane River and Hangman Creek subbasins and provided seasonal estimates for the percent reduction in nonpoint source phosphorus loads. These seasonal estimates were converted to average annual equivalents. Based on the reductions for the Little Spokane and Hangman Creek subbasins, a target reduction of approximately 25 percent within upstream subbasins is estimated to be necessary to meet downstream targets. Additionally, implementation of the Coeur d'Alene Lake Management Plan is investigating nutrient loads within tributaries to the lake and may provide additional guidance for reductions (DEQ and Coeur d'Alene Tribe, 2009). Using an average efficiency of 54 percent for the priority BMPs (Chapter 8), approximately 59 percent of the major land uses (evergreen forest and rangeland) would need BMPs applied to achieve the target. Based on the average cost for the priority BMPs of about $320/pound (Chapter 8), the total cost for the target reduction would be approximately $1,197,000. Achieving the target reduction over a 20-year period will require that approximately $60,000 is spent annually on BMPs in the subbasin.

17.4 Overview of Opportunities

Opportunities for organizations to undertake nonpoint source phosphorus reductions are available throughout the subbasin. This overview includes a description of what BMPs are the most relevant and where the BMPs should be implemented. Where the BMPs should be implemented is specific to land uses.

17.4.1 Control Measures and BMPs

BMPs specific to land use type and source are described in detail in Chapter 8. The background included in Chapter 8 narrowed the list of BMPs from 108 to 22 based on phosphorus percent reduction efficiency, cost, estimated longevity, and implementation effectiveness. This list of BMPs, if implemented for the appropriate land uses, could result in substantial net nonpoint source reduction of phosphorus.

There are several organizations throughout the South Fork Coeur d'Alene River subbasin that can mitigate nonpoint source loads by incorporating BMPs. The agencies and organizations are encouraged to review the land and nonpoint phosphorus sources in their jurisdiction to further identify BMPs that are specific to their situation.

Organizations should examine areas within their influence to identify opportunities where these BMPs can be implemented to reduce nonpoint source phosphorus. These organizations should also examine their stormwater management practices and look for opportunities to implement BMPs since stormwater is a primary transport mechanism for nonpoint source phosphorus. Organizations identified in Tables 17-1 and 17-2 include private, municipal, state and federal entities. Associated opportunities for nonpoint source phosphorus reduction include:

- Private land owners may protect and restore riparian corridors; minimize stormwater runoff; and consider education, land evaluation, and/or aide available from the conservation organizations.
- Municipalities may install BMPs to treat and/or reduce stormwater discharge to water bodies; evaluate where stormwater is being discharged; and/or evaluate the pollutant loading by collecting samples for analysis.
- State and federal agencies should review activities occurring on the land, identify potential impacts, and implement applicable BMPs.

17.4.2 Land Uses and Source Potential

The NPS Reduction Plan is meant to provide guidance on where to take action, as actions are voluntary and not mandatory. The NPS Study was conducted at the watershed and subbasin scales and is limited in its guidance to actions at those scales. Actions by organizations are limited by their jurisdictions and authority. Organizations will need to examine local conditions to determine specifically where they choose to take action.

The NPS Reduction Plan analyses (Chapters 6 and 7) evaluated the dominant land uses and the phosphorus load potential for each subbasin. In some cases, the largest land use did not match the largest phosphorus load reduction potential. The following land uses have the highest priority

for the South Fork Coeur d'Alene River subbasin with respect to nonpoint source phosphorus loading:

- Evergreen Forest.
- Range.

The analytical evaluation results indicated that the north-northeastern portion of the subbasin has the highest nonpoint source phosphorus loading rates in the South Fork Coeur d'Alene River subbasin (see Chapter 7). These two sub-subbasins with the highest estimated loadings are Bear Creek (0.088 lbs/ac/yr) and Canyon Creek (0.080 lbs/ac/yr). These subareas should be considered as priority areas for action.

The South Fork Coeur d'Alene River subbasin is dominated by evergreen forest land (74 percent) and shrub and brush rangeland (22 percent). These land uses also have the greatest phosphorus removal potential. Organizations are encouraged to take action in these high priority land use areas. These particular land uses represent the priority areas where nonpoint source phosphorus actions are necessary to achieve a significant net reduction. Organizations should examine areas they own or are within their influence, and look for opportunities to reduce nonpoint source phosphorus from the prioritized land uses. Organizations should also examine areas within their jurisdiction that are obvious areas for nonpoint source reduction opportunities.

17.4.3 Summary of Reduction Opportunities

BMPs have been prioritized first by their ability to remove nonpoint source phosphorus loads and then by land use type. The acres of land use by organization were computed and are tabulated in Table 17-3. The acres in Table 17-3 demonstrate how the land uses are distributed among the land owners and where the opportunities for reductions may exist.

The export coefficients summarized in Chapter 7, along with the land uses and areas, can be used to estimate potential nonpoint source phosphorus loads by organization. There is an associated range of reduction opportunities based on the potential to reduce phosphorus loads. These opportunities are presented in Table 17-4 by assigning a load reduction potential that ranges from low to high. The range is based on total phosphorus load; therefore, higher potential may be due to a greater export coefficient, the total land area, or a combination of both. Table 17-4 is intended to provide further guidance for considering and selecting BMPs for implementation.

Figure 17-2 shows land ownership with stream segments highlighted in areas of high potential for nonpoint source phosphorus reduction based on the land use and export coefficients. Stream segments are shown since the highest priority BMPs in this subbasin generally relate to stream or riparian corridors.

Table 17-3. Organizations Land Area by Land Use

Land Owners	Agriculture[1] (acres)	Forested[1] (acres)	Rangeland[1] (acres)	Urban / Suburban[1] (acres)	Other[1] (acres)
Private					
Private	106	53,500	24,614	4,005	1,697
Incorporated Municipalities[2]					
Kellogg	0	148	1,084	705	595
Mullan	2	195	97	200	4
Osburn	10	24	155	624	20
Pinehurst	6	103	79	429	21
Smelterville	0	3	37	133	38
Wallace	3	186	144	203	0
Wardner	0	184	293	47	0
Local Governments[2]					
Benewah County	0	828	622	0	0
Kootenai County	0	2,190	1,124	0	0
Shoshone County	109	139,220	39,598	4,477	1,891
State Agencies					
Idaho Department of Lands	1	4,998	544	12	6
Idaho Department of Parks and Recreation	0.2	4	40	66	20
Federal Agencies					
U.S. Bureau of Land Management	0.1	29,621	9,219	175	68
U.S. Forest Service	2	54,056	6,909	218	52

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation.

[2] Incorporated municipalities and local governments is the total land area within boundaries.

Table 17-4. Organizations and Potential for Nonpoint Source Phosphorus Reduction

Land Owners	Agriculture[1]	Forested[1]	Rangeland[1]	Urban / Suburban[1]	Other[1]
Private					
Private	High-Mod.	High	High	High-Mod.	High
Incorporated Municipalities					
Kellogg	n/a	Moderate	High-Mod.	High-Mod.	High-Mod.
Mullan	Low	Moderate	Low-Mod.	Moderate	Low
Osburn	Low-Mod.	Low-Mod.	Low-Mod.	High-Mod.	Low
Pinehurst	Low-Mod.	Moderate	Low-Mod.	High-Mod.	Low
Smelterville	n/a	Low	Low-Mod.	Low-Mod.	Moderate
Wallace	Low	Moderate	Low-Mod.	Moderate	n/a
Wardner	n/a	Moderate	Moderate	Low-Mod.	n/a
Local Governments					
Benewah County	n/a	High-Mod.	High-Mod.	n/a	n/a
Kootenai County	n/a	High-Mod.	High-Mod.	n/a	n/a
Shoshone County	High-Mod.	High	High	High	High
State Agencies					
Idaho Department of Lands	Low	High	Moderate	Low	Low
Idaho Department of Parks and Recreation	Low	Low	Low-Mod.	Low-Mod.	Moderate
Federal Agencies					
U.S. Bureau of Land Management	Low	High	High	Moderate	Moderate
U.S. Forest Service	Low	High	High	High-Mod.	Low-Mod.

[1] NPS load potential based on area and export classified into five categories, low, low-moderate, moderate, high-moderate, and high.

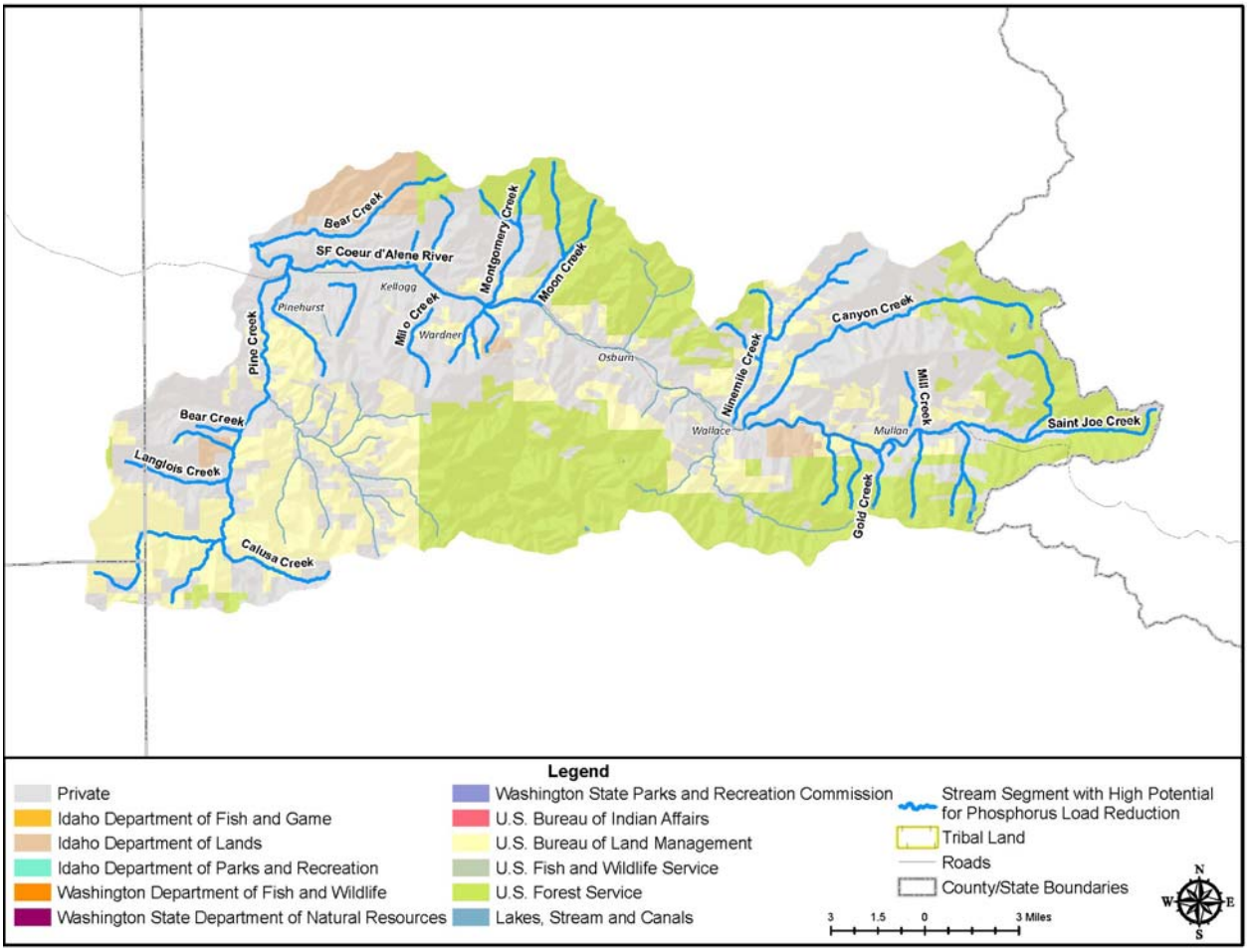

Figure 17-2. South Fork Coeur d'Alene River Subbasin High Potential Reduction Opportunities

17.5 Specific Actions by Category

This section includes a list of specific actions to reduce nonpoint source phosphorus loads and ultimately contribute to meeting water quality standards. A general description of each action, an activity summary, potential phosphorus load reduction, a range of costs, potential timelines, and the potential lead entity are provided for each action. Although it was not a primary objective of the NPS Study to specify "who" implements phosphorus control measures, potential lead organizations are identified for some actions to help provide linkage to the "what" and "where" objectives of the NPS Study. The lead organization will need to assist local entities in developing detailed plans for the activities, as well as a schedule and plan for monitoring progress. When the information was available, the action also includes a description of the roles of the organization with responsibility to improve water quality, and the means through which the organization will address the water quality issues.

17.5.1 High Priority BMPs

The analysis provided in Chapter 8 described the following BMPs as having the highest priority for the South Fork Coeur d'Alene River subbasin:

- Streamside Management Zones.
- Riparian Zones and Buffer Strips.
- Stream Bank Stabilization.
- Erosion Control.

Specific details regarding implementation of these high priority BMPs are provided in Chapter 9. These BMPs are appropriate for implementation for land uses in the subbasin. The following sections summarize actions appropriate for the specific land uses within the South Fork Coeur d'Alene River subbasin.

17.5.2 Regional Phosphorus Management

Regional phosphorus control strategies are not specific to any one land use type or organization, and may contribute to the reduction of nonpoint source phosphorus loadings in the subbasin. Descriptions of the regional or watershed-scale phosphorus management actions intended to facilitate load reductions and/or establish the technical foundation for further phosphorus control activities are described in Chapter 9.

17.5.3 Agriculture Related Activities

Since less than 1 percent of the subbasin land use is being used for agriculture, opportunities for phosphorus loading reduction within subbasin agricultural lands are minor. As such, no specific agriculture actions are presented. Public education and outreach programs under the regional phosphorus management strategy will likely support agriculture BMPs throughout the subbasin.

17.5.4 Forestry Related Activities

BMPs related to forestry practices can reduce nonpoint source phosphorus. While phosphorus export related to forestry in general is low, local areas of intensive use can have higher phosphorus export rates. Since the South Fork Coeur d'Alene River subbasin is mostly forested, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing erosion, reducing sediment transport, protecting and maintaining riparian corridors and streamside management zones.

SFC-FR-1 Evaluate Forestry Practices

Idaho's forest practices regulations will be relied upon to reduce nonpoint source phosphorus loads from private and state forestlands. Ongoing practices should be reviewed by or as directed by the lead organization for compliance. If compliance with the existing regulations is not resulting in sufficient reduction, then more effective methods need to be promoted. Poorly performing practices need to be researched for the causes and potentially modified to improve the outcomes.

With large quantities of adjacent forested land, tributary water quality is likely affected by forest management practices. Logging and road building practices that have been common throughout the intermountain region from the late nineteenth century through most of the twentieth century have likely contributed to the degradation of water quality. In more recent times, implementation of more environmentally sound forest management practices has occurred. These practices may

have reduced forestry-related phosphorus loading within the subbasin but additional reductions are still possible.

The Idaho Forest Practices Act (IDAPA 20.02.01) defines the minimum level of best management practices (BMPs) required to be implemented for commercial timber lands in Idaho. It is anticipated that the new road maintenance and abandonment plans required by the current forest practices rules will slowly reduce phosphorus export from harvested forests.

The agencies have data on forest health, ecology, harvest areas, vegetation types, soil conditions and more. This information can be useful for identifying areas of greater nonpoint source phosphorus loading. However, much of this data is not readily available or in a format that can be interpreted by water quality managers. Coordination between forest and water quality managers is necessary to understand the data and select management activities.

Activity: Enforce existing regulations, evaluate existing practices, discourage poorly performing practices, and encourage best performing practices and improve coordination of sharing information.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SFC-FR-2 Quantify Sediment-Phosphorus Relationship in Forested Areas

Quantifying phosphorus loading associated with forest management practices may provide additional information that support selection of successful BMPs. The construction and use of roadways represent a major source of sediment from timber harvest activities (DEQ, 2000). A study to quantify the relationship between sediment associated with phosphorus in runoff from these roads can help determine whether additional measures should be undertaken.

Activity: Quantify relationship between sediment and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SFC-FR-3 Subbasin Scale Road Planning and Rehabilitation

Conduct a subbasin-scale management survey to inventory ownership and identify and prioritize the total miles of erodible roads and road banks. Specific BMPs may then be developed based on survey results to reduce miles of erodible roads associated with road construction, road conversions, and maintenance. A database of roads with tracking of BMP implementation is essential for determining success and accountability. Reduction plans should identify opportunities to abandon non-essential roads or restore roads on non-industrial forest lands and other county roads that contribute obvious erosion problems.

Activity: Quantify relationship between roads and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.

Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SFC-FR-4 Fire Rehabilitation Areas

Wild fires can significantly impact the landscape. Research has shown increased concentrations of suspended sediments, phosphorus, and potassium in streams below burned areas (Stednick, et al., 1982). Stream monitoring indicated an immediate flush of phosphorus in the runoff, followed by a slower release. Rehabilitation of burn areas, especially the riparian corridors to protect streams, will be important to reducing nonpoint source phosphorus in forested areas. The fire history from 2001 through 2010 suggests approximately 200 acres in the subbasin to have been burned and should be evaluated.

Activity: Identify and assist with rehabilitation of burned areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

17.5.5 Range Related Activities

BMPs related to rangeland practices can reduce nonpoint source phosphorus. Since range, shrub and brush land is the second largest percentage of land uses in the South Fork Coeur d'Alene River subbasin, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing disturbance of range land, protecting and maintaining riparian zones and maintaining or stabilizing stream banks.

SFC-RR-1 Evaluate Rangeland Practices

The state's regulations will be relied upon to reduce nonpoint source phosphorus loads from rangelands. Evaluate past and present impacts and review ongoing practices for compliance. The goal of evaluating past and present activities is to manage rangeland to maintain optimum soil and water quality. If compliance with the existing regulations is not resulting in sufficient nonpoint source phosphorus reduction, then more effective methods should be identified and promoted.

Activity: Evaluate existing practices, enforce existing regulations, and encourage BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

17.5.6 Urban/Suburban Related Activities

Urban/suburban areas can have the most variable impacts on nonpoint source phosphorus loading due to the diversity of development, uses, and control of stormwater runoff. BMPs under this category are typically associated with minimization of pollution sources and the management of stormwater.

SFR-UR-1 Business Practices to Prevent Stormwater and other Pollution

The South Fork Coeur d'Alene River subbasin contains commercial and industrial activity within the series of municipalities located along Interstate 90, such as Pinehurst, Smelterville, Kellogg, Osburn, Wallace, and Mullan. Volume 5 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005) provides a list and descriptions of BMPs geared toward contaminant loading reduction for commercial and industrial facilities. These practices include the following:

- Loading dock and equipment yard design elements.
- Material loading and storage practices.
- Restaurant control practices.
- Surface cleaning control practices.
- Spill prevention, control, and cleanup.
- Employee training.

Volume 2 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005) provides a list and descriptions of BMPs geared toward contaminant loading reduction for construction practices. These largely deal with erosion and sediment controls and include the following:

- Construction timing.
- Temporary road construction practices.
- Stockpile and waste management.
- Slope protection and stabilization.
- Construction stormwater collection and handling.

Activity: Review existing practices, encourage BMP implementation, provide adequate resources and information to businesses.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SFR-UR-2 Evaluate and Analyze Impervious Surfaces and Implement Stormwater BMPs

Impervious surfaces throughout the South Fork Coeur d'Alene River subbasin are a source of stormwater runoff. Within the subbasin, stormwater runoff enters both surface water and groundwater via infiltration. An understanding of the area and location of the impervious surfaces in the subbasin will guide the need and responsibility for implementation.

Dye tracing of stormwater from drains to outfalls can be helpful to determine where the flows discharge and potential additional BMPs at the discharge location. Around Liberty Lake, Washington, for example, two drains were dye tested, found to discharge to the lake, and

subsequently modified with the installation of bio-infiltration systems to provide treatment (Hamlin, 2010).

Activity: Evaluate and quantify existing impervious surfaces, identify areas where vegetated buffer/filter strips or other applicable stormwater BMPs (see Chapter 8) could be installed, and encourage installation.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SFR-UR-3 Evaluate and Revise Stormwater Policies

Approximately 3 percent of the subbasin is within municipal boundaries. This urban/residential area generally is within close proximity to subbasin surface water, such as the South Fork Coeur d'Alene River, and stormwater runoff from these areas impacts surface water quality with little to no contaminant attenuation.

This action consists of a review of stormwater regulations of municipalities for water quality requirements. Municipalities have unique policies; however, working towards incorporating at least some minimum water quality requirements that address nonpoint source pollution including phosphorus across the watershed will provide some reduction in loads. Resources to consider include the following:

- DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005).
- Idaho Department of Transportation's Erosion & Sediment Control—Best Management Practices Manual (Idaho DOT, 2011).
- DEQ's Compendium of Best Management Practices To Control Polluted Runoff, A Source Book (Metl and Maquire, 2003).
- The Spokane Regional Stormwater Manual (Spokane County et. al, 2008).

Consider holding a subbasin or watershed summit to evaluate and identify policies, and evaluate and determine areas throughout the South Fork Coeur d'Alene River subbasin for implementation and enforcement of the requirements. Keep in mind that some developed areas outside municipal jurisdictions should be considered.

Activity: Coordinate on minimum water quality stormwater treatment policies and requirements.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SFR-UR-4 Strengthen Requirements for Stormwater Treatment BMPs in Key Areas

Stormwater treatment BMPs, such as bio-infiltration swales, bio-infiltration channels, vegetated buffer strips and infiltration basins are important within the South Fork Coeur d'Alene River subbasin because development frequently occurs above bedrock with limited treatment capacity

and in close proximity to the South Fork Coeur d'Alene River and its tributaries. Volume 4 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005) provides a list and description of permanent stormwater BMPs designed to control stormwater based contaminant loading. These include BMPs that treat stormwater through filtration, infiltration and/or detention.

The South Fork Coeur d'Alene River subbasin contains commercial and industrial land uses within and near the series of municipalities located along Interstate 90. More stringent requirements could be considered for implementation of BMPs intended to reduce industrial discharges of phosphorus. This could include installation of sand filters at or near stormwater discharges, installation of catch basin filtration systems, installation of flocculation systems, and/or multi-chambered treatment trains (DEQ, 2005; Oregon DEQ, 2001).

This action also could include guidelines regarding BMP maintenance. Stormwater systems that are properly operated and maintained function better and reduce maintenance costs and liability problems. Volume 4 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005) provides information on properly operating and maintaining stormwater systems for residential, commercial, or industrial developments. DEQ also includes inspection and maintenance forms that prompt the user to identify problems that commonly occur with various stormwater control BMPs and provide recommendations for maintenance (DEQ, 2005).

BMPs are also described below in the subactivities 'Install BMP' (see SFR -UR-4a through 4d).

Activity: Implement rigorous stormwater BMP requirements in key portions of subbasin.
Potential Phosphorus Load Reduction: Varies depending on BMP – refer to SFR-UR-4a through SFR-UR-4d.
Range of Cost: Varies depending on BMP – refer to SFR-UR-4a through SFR-UR-4d.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Shoshone County.

SFR-UR-4a Install Grassed Bio-Infiltration Swales

To implement this BMP, stormwater runoff is directed to a grassed swale where vegetative cover provides pretreatment of stormwater before infiltration to the subsurface. Infiltration occurs either through the swale or within drywells that receive stormwater once the swale is filled to a design overflow elevation. The area surrounding the drywell and underlying the swale should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone.

Specific details regarding bio-infiltration swale design and construction within the South Fork Coeur d'Alene River subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: Grassed swales have a wide range of potential phosphorus removal efficiencies from 20 to 61 percent (Miller, 1987) to 29 to 99 percent (Yu et al., 2001).
Range of Cost: No specific quantitative information regarding the cost of grassed bio-infiltration swales was found during the project review. However, based on BMP characteristics, costs are expected to be moderate to high with respect to the other BMPs described in this plan.

SFR-UR-4b Install Bio-Infiltration Channels

To implement this stormwater treatment BMP, stormwater runoff is directed to a bio-infiltration channel underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). A bio-infiltration channel is a sloped, vegetated channel or ditch that both conveys and treats stormwater runoff. It does not provide flow control but can convey runoff to facilities designed for that purpose (Spokane County et al., 2008). A bio-infiltration channel provides treatment as stormwater flows through vegetative cover and/or infiltrates. Channel flow can be directed to a pond or other facility. Infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Specific details regarding bio-infiltration channel and construction (also termed infiltration channels) within the South Fork Coeur d'Alene River subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of bio-infiltration channels was found during planning. However, infiltration trenches and basins have a wide range of potential phosphorus removal efficiencies of 10 to 80 percent (EPA, 1999).
Range of Cost: No specific quantitative information regarding the cost of bio-infiltration channels was found during planning.

SFR-UR-4c Install Vegetated Buffer Strips

Stormwater runoff is directed via sheet flow to a vegetated buffer strip situated adjacent to a rural roadway or parking lot. Vegetative cover within the buffer strip provides pretreatment of stormwater before infiltration to the subsurface, and/or evaporation. Vegetated buffer strips are used to intercept overland sheet flow runoff from adjacent impervious areas. They slow runoff velocities, filter out sediment and other pollutants, and provide infiltration into underlying soils. When buffer strips are used for infiltration, the area underlying the buffer strip should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone. Specific details regarding vegetated buffer strip design and construction within the South Fork Coeur d'Alene River subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness or cost of vegetated buffer strips was found during the project review. However, vegetated filter strips have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Grass filter strips have low phosphorus removal costs of $190 to $250 per pound (Sera-17, 2010).

SFR-UR-4d Infiltration Areas/Bioretention Basins

Stormwater runoff is directed to an infiltration area underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). The infiltration area can be equipped with a drainfield constructed of perforated pipe to facilitate infiltration. A suitable site requires soils with a sufficiently high permeability to allow for relatively rapid infiltration, but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Spokane County and the City of Spokane have recently constructed/enhanced a number of regional stormwater infiltration facilities for the purpose of managing stormwater runoff in areas with difficult infiltration conditions on a site-specific level. When these facilities are located over relatively thick glaciofluvial sand and gravel sequences, benefit of water quality treatment may be limited. Examples include: Hazel's Creek Drainage and Conservation Facility (City of Spokane), Browne's Mountain Regional Stormwater Facility (Spokane County), and Price and Wall Regional Stormwater Facility (Spokane County).

DEQ (2005) provides guidance regarding bio-infiltration basins, which have similar design and operational elements.

Potential Phosphorus Load Reduction: Infiltration basins have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Infiltration structures generally have high phosphorus removal costs of $2,500 to $3,000 per pound (Corrozi, 2009).

SFR-UR-5 Evaluate Phosphorus Load from Septic Tanks along the South Fork Coeur d'Alene River and Other Densely Developed Areas

While there is historical literature that suggests septic systems and subsequent treatment in the unsaturated zone provides phosphorus removal from effluent, recent and emerging evidence indicates the contrary in many locations. Both the current science and measured groundwater concentrations of phosphorus clearly indicate that septic systems release significant phosphorus loads into underlying groundwater and that phosphorus loading can increase with time as a result of the loading of sorption sites in the unsaturated zone. Moreover, the shallow hydrostratigraphy of many areas within the South Fork Coeur d'Alene River subbasin consists of shallow bedrock with little to no overlying fine-grained soil and therefore, has little phosphorus removal capacity.

Septic-based phosphorus loading should be considered, at a minimum, within 1,000 feet of the South Fork Coeur d'Alene River and its tributaries.

Activity: Evaluate phosphorus load from septic tanks within densely developed areas as a basis for future management decisions.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County or other municipalities.

SFR-UR-6 Septic Tank Elimination within Key Areas

Removal of septic systems by connecting to sewer systems eliminates a source of pollution to surface and groundwater. Wastes are treated more thoroughly and phosphorus removal is more complete at a wastewater treatment facility designed for phosphorus removal than is possible with a septic system. For these reasons, septic tank elimination is an important long-term management approach to controlling nonpoint source phosphorus loading.

Septic tank elimination programs should be based on results of SFR-UR-5, which will assist in identification of specific areas where infrastructure investment will lead to relatively large phosphorus loading reductions. It is likely that septic tanks are sufficiently dispersed within most of the subbasin to preclude sewering. However, it is possible that there are relatively dense distributions of septic tanks adjacent to municipal service areas that could be considered for septic tank elimination.

Activity: Remove septic systems and replace with sanitary sewer in key areas adjacent to existing service areas.
Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of septic tank elimination was found during planning. However, based on the phosphorus removal characteristics of area wastewater facilities and that septic tank discharges are completely eliminated during removal, the expected effectiveness is very high.
Range of Cost: No specific quantitative information regarding the cost of septic tank elimination was found during planning. Potential costs may range from low to high with respect to the other BMPs described in this plan.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Shoshone County or other subbasin municipalities.

SFR-UR-7 Inspection and Pumping of Septic Systems within Key Areas

Regular inspection and pumping of septic systems prolongs the life of the system, reduces maintenance costs and contamination around the drain field, and slows the breakthrough of phosphorus to groundwater. The priority systems to target are older systems and systems near streams and areas with a high groundwater table. The septic tank should be pumped by a licensed septage waste-hauler on a regular basis and septage properly disposed of in an approved site or wastewater treatment facility.

Septic system inspection and pumping can be performed throughout the subbasin to achieve nonpoint source loading reduction to area surface water. However, it will have greatest positive impact within nearshore areas and with septic system overlying coarse soil and/or bedrock with minimal phosphorus treatment capacity. Areas to consider include those within 1,000 feet of South Fork Coeur d'Alene River and its tributaries.

Activity: Require regular inspection and pumping of septic systems on a standard interval. The interval should vary as a function of septic tank size and persons per household to achieve acceptable retention times. Standard matrices are available for these requirements.
Potential Phosphorus Load Reduction: Inspection and pumping of septic systems has low to moderate phosphorus removal efficiencies of 40 to 55 percent (DDNR, 2010).
Range of Cost: Inspection and pumping of septic systems has very low phosphorus removal costs of $7 to $25 per pound (DDNR, 2010).
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County.

SFR-UR-8 Develop a Small Community Program for Phosphorus Loading Reduction

Small communities within the South Fork Coeur d'Alene River subbasin include Pinehurst, Smelterville, Kellogg, Osburn, Wallace, and Mullan. These communities have a unique set of associated phosphorus loading mechanisms that, in many cases, are not specifically targeted by existing guidelines and regulation. A number of the small communities within the South Fork Coeur d'Alene River subbasin are in close proximity, and likely runoff directly to South Fork Coeur d'Alene River. Because of this, phosphorus loading from these areas could impact subbasin surface water.

The intent of this action is to develop a program to assist smaller communities to develop the tools they need to reduce phosphorus loading. This program could include generation of guidance documents and/or ordinances. Components of the program could include the following:

- Community outreach and education.
- Training programs targeted at local government officials and managers.
- Retrofit of existing stormwater management structures to comply with guidelines described in Action SFR-UR-4.
- Management and education intended to reduce of impact of pet waste on water quality.
- Septic system elimination (if applicable) per Action SFR-UR-6 and inspection/pumping per Action SFR-UR-7.
- Recommendation or requirement for use of phosphorus-free fertilizer, per Action SFR-AA-2.
- Recommendation to retain grass clippings/leaves on lawns or as properly-disposed of solid waste, rather than within runoff.

This action will also include guidance and/or requirements for LID practices in construction and stormwater management. LID practices that could be applicable to the South Fork Coeur d'Alene River subbasin are presented in detail in Volume 3 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005). Described LID practices include:

- Clearing and grading practices.
- Use of aquatic buffers and preservation of natural hydrologic function.
- Impervious area practices.

- Green roofs and parking lots.
- Pervious pavement.
- Soil amendments and restoration.
- Rainwater harvesting and reuse.
- Created wetlands.

Activity: Develop a Small Community Program for Phosphorus Loading Reduction to assist smaller communities in developing the tools they need to reduce phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County or other municipalities.

17.5.7 Supporting Phosphorus Reduction Activities

Supporting activities to be undertaken as part of this NPS Reduction Plan will provide valuable information for long-term success, in addition to the subbasin-specific actions and BMPs designed to provide direct phosphorus reduction. These activities are described in Chapter 9.

17.5.8 Additional Activities

Additional activities include indirect actions that either lead to overall improvements in ecological functions and thus water quality or provide additional insights into the overall health and conditions of the watershed. Activities are described in Chapter 9. Additional activities in the Upper Coeur d'Alene River subbasin include the coordination of activities on Lake Spokane, nearshore, and upstream activities.

SFC-AA-1 Evaluate, Protect and Enhance Nearshore Areas

Nearshore land management and activities have the potential to impact phosphorus loads to surface water. Within the South Fork Coeur d'Alene River subbasin, these activities apply to areas nearshore to the South Fork Coeur d'Alene River and the numerous small tributaries from the north (i.e., Canyon Creek, Ninemile Creek, and Moon Creek) and south (i.e., Placer Creek, Big Creek, and Pine Creek). Nearshore sources may transport phosphorus loads via surface water, stormwater runoff, interflow, and groundwater. Unlike activities and BMPs implemented upstream, there is little to no attenuation of phosphorus loads associated with nearshore sources. Therefore, reduction of loads from nearshore areas is important and should be considered as part of the overall nonpoint source phosphorus load reduction strategy. Nearshore areas should be inventoried to identify areas where BMPs should be implemented. BMPs that should be considered for nearshore areas include, but are not limited to:

- Erosion control and bank stabilization.
- Filter strips.
- Septic tank improvement and maintenance.
- Inspection and pumping of septic systems.
- Phosphate lawn fertilizer ban.

- Riparian fencing, riparian zones and buffer strips.
- Education and outreach to nearshore property owners.

Additional detail regarding these BMPs is provided in Chapter 8.

Activity: Evaluate nearshore areas of the North Fork, the South Fork, the Coeur d'Alene River reach downstream of the two forks, and their numerous tributaries within the Upper Coeur d'Alene River subbasin and implement activities and BMPs to reduce nonpoint source phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

17.5.9 Support Existing and Planned Activities

The NPS Reduction Plan supports existing water resources and water quality studies and planning. Protection of these resources also supports the reduction phosphorus nonpoint sources. Critical planned activities specific to the NPS Reduction Plan are identified below.

SFC-EP-1 Support, Compliment and Enforce Permits, Ordinances, Plans and Activities Relating to Nonpoint Source Phosphorus Reduction

There are a variety of permits, ordinances, plans and activities within the South Fork Coeur d'Alene River subbasin that relate to nonpoint source phosphorus reduction, including:

- 2002 South Fork Coeur d'Alene River Sediment Subbasin Assessment and TMDL and associated sediment TMDL that encompasses Canyon Creek, Ninemile Creek, East Fork Ninemile Creek, Government Gulch, Pine Creek, East Fork Pine Creek and the South Fork from the Canyon Creek confluence to the mouth.
- Various plans and actions related to reduction of sediment loading associated with historic mining activities.
- Spokane River Forum education efforts.

When taking actions and implementing BMPs to reduce nonpoint source phosphorus, consider these and other related plans, goals, requirements and efforts to optimize reduction potential. Review that erosion control BMPs are followed at land development projects and construction sites.

Activity: Support, compliment and enforce permits, ordinances, plans and activities to achieve nonpoint source phosphorus reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SFC-EP-2 Support and Compliment the Proposed Plan for Cleanup of the Upper Basin of the Coeur d'Alene River or Equivalent

Mining and associated smelting of ore material in the South Fork Coeur d'Alene River subbasin began more than 100 years ago, and the subbasin became one of the leading silver-, lead-, and zinc-producing areas in the world. However, legacy contamination resulted in widespread elevated concentrations of lead, zinc, cadmium, arsenic, and other metals. The Bunker Hill Superfund Site was placed on the National Priorities List in 1983. Assessment and cleanup activities targeted at surface water, groundwater, and soil contamination have been ongoing since that time.

The EPA (2010b) issued their Proposed Plan, Upper Basin of the Coeur d'Alene River, Bunker Hill Mining and Metallurgical Complex Superfund Site during July 2010. This proposed plan documents the decision for a final remedy for remedial actions within the Upper Basin to protect human health and the environment. Goals of the remedy are to:

- Aggressively address contaminant sources (such as mine tailings, waste rock, and contaminated floodplain sediments).
- Improve surface water quality in the South Fork Coeur d'Alene River and its tributaries.
- Protect existing human health remedies that are vulnerable to erosion and recontamination (EPA, 2010b).

Achievement of the goals expressed in this Proposed Plan (or subsequently agreed-to final plan) not only would have clear environmental and human health benefits with regard to metal contamination, but reduction in sediment loading would lead to phosphorus loading reduction as well.

Activity: Support and compliment plans to cleanup and reduce sediment loading associated with historic mining activities.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SFC-EP-3 Implement, Support and Compliment Coeur d'Alene Lake Management Plan

Water quality in Coeur d'Alene Lake has generally improved since the mid-1970s as large-scale mining-related activities upstream of the lake tapered off and environmental cleanup activities got underway in the Silver Valley. The primary environmental concern in Coeur d'Alene Lake is the potential for release of metal contaminants contained in lake bottom sediments into the water column. The 2009 Coeur d'Alene Lake LMP goal is *to protect and improve lake water quality by limiting basin-wide nutrient inputs that impair lake water quality conditions, which in turn influence the solubility of mining-related metals contamination contained in lake sediments.* (DEQ and Coeur d'Alene Tribe, 2009)

A USGS study suggested that Coeur d'Alene Lake may retain about half of total phosphorus inflow load due to high iron concentrations and high adsorption as particulate phosphorus (Woods, 2004). A comparison of historically reported inflow and outflow loads of total

phosphorus suggested a similar deposition rate in the range of 50 to 60 percent. However, as concentrations of metals decrease the retention rate may decrease as well.

The 2009 LMP comprehensively identifies the actions and substantial resources that will be required to effectively manage Coeur d'Alene Lake and the large quantities of mining associated hazardous substances in its waters and lakebed sediments. It is intended to serve as a framework for watershed-based lake management through a public-private partnership model. Tier I of the plan includes monitoring and modeling, nutrient source inventory, coordination of existing partner programs, and education and outreach. Tier II includes nutrient reduction projects, special studies, and coordination with TMDL program implementation. (DEQ and Coeur d'Alene Tribe, 2009)

Activity: Implement, support and compliment Coeur d'Alene Lake Management Plan to achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: DEQ and Coeur d'Alene Tribe.

Chapter 18

St. Joe River Subbasin - Nonpoint Source Phosphorus Management Strategy and Actions

18.1 Introduction

An objective of this NPS Reduction Plan is to formulate nonpoint source control strategies that contribute to long-term reductions of phosphorus loads. It provides guidance on selecting 'what' strategies and actions to take and 'where' to apply them. Chapter 9 provides an introduction to the subbasin actions and strategies, background of the NPS Study objectives, how the subbasin chapters support the overall NPS Reduction Plan, and regional phosphorus control strategies that should be considered in all subbasins in the Spokane River watershed.

This chapter identifies specific actions to for entities located in the St. Joe River subbasin and stakeholders supporting these entities reduce nonpoint source phosphorus. Identified are strategies and actions and areas to target within the subbasin. The guidance identifies potential organization leads and potential timelines for initial and long-term reductions of nonpoint source phosphorus pollution.

The following sections of this chapter describe:

- The identification and relationship of entities and stakeholders in the watershed and associated acres of land ownership.
- An overview of reduction strategies, actions, and schedule for the subbasin.
- An overview of the nonpoint source reduction opportunities and guidance on 'what' BMPs to implement and 'where' to take these actions.
- The specific actions by category identified to be undertaken, including those identified by specific entities and stakeholders.

Estimates of the potential BMP phosphorus reductions and cost per pound are provided in Chapter 8. The overall phosphorus reduction potential is discussed in Chapter 9.

18.2 Entities and Stakeholders

As discussed in Chapter 9, accomplishing nonpoint source reductions will require engaging local, state, and federal agencies and land managers, as well as private land owners. The principal organizations involved with securing funding, identifying priority locations, selecting BMPs, and taking actions in the St. Joe River subbasin include those shown in Table 18-1. These organizations are subdivided into entities and stakeholders as shown in Table 18-2, along with the area of land owned and miles of streams in the St. Joe River subbasin. Land ownership for the subbasin is shown in Figure 18-1.

Table 18-1. Organizations and Nonpoint Source Phosphorus

Organization
Local Governments
Benewah County
Clearwater County
Kootenai County
Latah County
Shoshone County
Benewah Soil and Water Conservation District
Kootenai-Shoshone Soil and Water Conservation District
Latah Soil and Water Conservation District
Idaho Panhandle Health District 1
Municipalities
Plummer
St. Maries
Utilities
Municipal water service providers
Tribal Governments
Coeur d'Alene Tribe
State Agencies
Idaho Department of Environmental Quality
Idaho Department of Lands
Idaho Department of Parks and Recreation
Idaho Fish and Game
Idaho Forest Products Commission
Idaho Rangeland Resource Commission
Idaho Soil Conservation Commission & Idaho Soil and Water Conservation Commission
Idaho State Department of Agriculture
Idaho Transportation Department
Federal Agencies
Clearwater National Forest
St. Joe National Forest
U.S. Bureau of Indian Affairs
U.S. Bureau of Land Management
U.S. Department of Agriculture – Natural Resource Conservation Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service

Table 18-2. Organizations and Land Area

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Private				
In Plummer	486	Plummer	Benewah Soil and Water Conservation District	n/a
In St. Maries	568	St. Maries		
In Benewah County	248,335	Benewah County		1,027.9
In Kootenai County	6,490	Kootenai County	Kootenai-Shoshone Soil and Water Conservation District	25.7
In Shoshone County	213,802	Shoshone County		848.9
In Latah County	5,668	Latah County	Latah Soil and Water Conservation District	34.8
In Clearwater County	5,223	Clearwater County	Clearwater County Soil & Water Conservation District	34.4
Coeur d'Alene Tribe	103,834	Coeur d'Alene Tribe	Various Federal Agencies	409.7
In St. Joe National Forest	89,288	U.S. Forest Service	USDA – Natural Resource Conservation Service	358.9
In Crystal Lake Wilderness Study Area	132	U.S. Environmental Protection Agency		0
In Grandmother Mountain Wilderness Study Area	272			0.6
In Public Domain Bureau of Land Management	7,640			23.0
Tribal Governments[2]				
Coeur d'Alene Tribe	*126,173*	U.S. Environmental Protection Agency	Benewah County Soil and Water Conservation District, USDA Natural Resource Conservation Service	494.4
Incorporated Municipalities[2]				
Plummer	*809*	Idaho Department of Environmental Quality, U.S. Environmental Protection Agency	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	3.9
St. Maries	*699*			1.1
Local Governments[2]				

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Benewah County	*352,225*	Idaho Department of Environmental Quality, U.S. Environmental Protection Agency, Idaho Fish and Game, U.S. Fish and Wildlife Service	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	1,465.1
Clearwater County	*6,662*			46.8
Kootenai County	*6,843*			27.1
Latah County	*20,087*			114.3
Shoshone County	*800,831*			3,295.3
State Agencies				
Idaho Department of Fish and Game	2,424	Idaho Department of Environmental Quality, Idaho Fish and Game, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	10.3
Idaho Dept. of Lands	74,701			328.9
Idaho Department of Parks and Recreation	6,739			22.0
Idaho Transportation Department	714			n/a
Federal Agencies				
U.S. Bureau of Indian Affairs	8,960	U.S. Environmental Protection Agency	USDA – Natural Resource Conservation Service	27.9
U.S. Bureau of Land Management	15,479			32.0
U.S. Forest Service	594,522			2,471.3
Additional Land Areas				
Roads	2,792 miles		2,967 stream crossings	

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation, road miles include primary, secondary, local and forest service roads.

[2] Tribal governments, incorporated municipalities and local governments is total land area within boundaries, not land ownership.

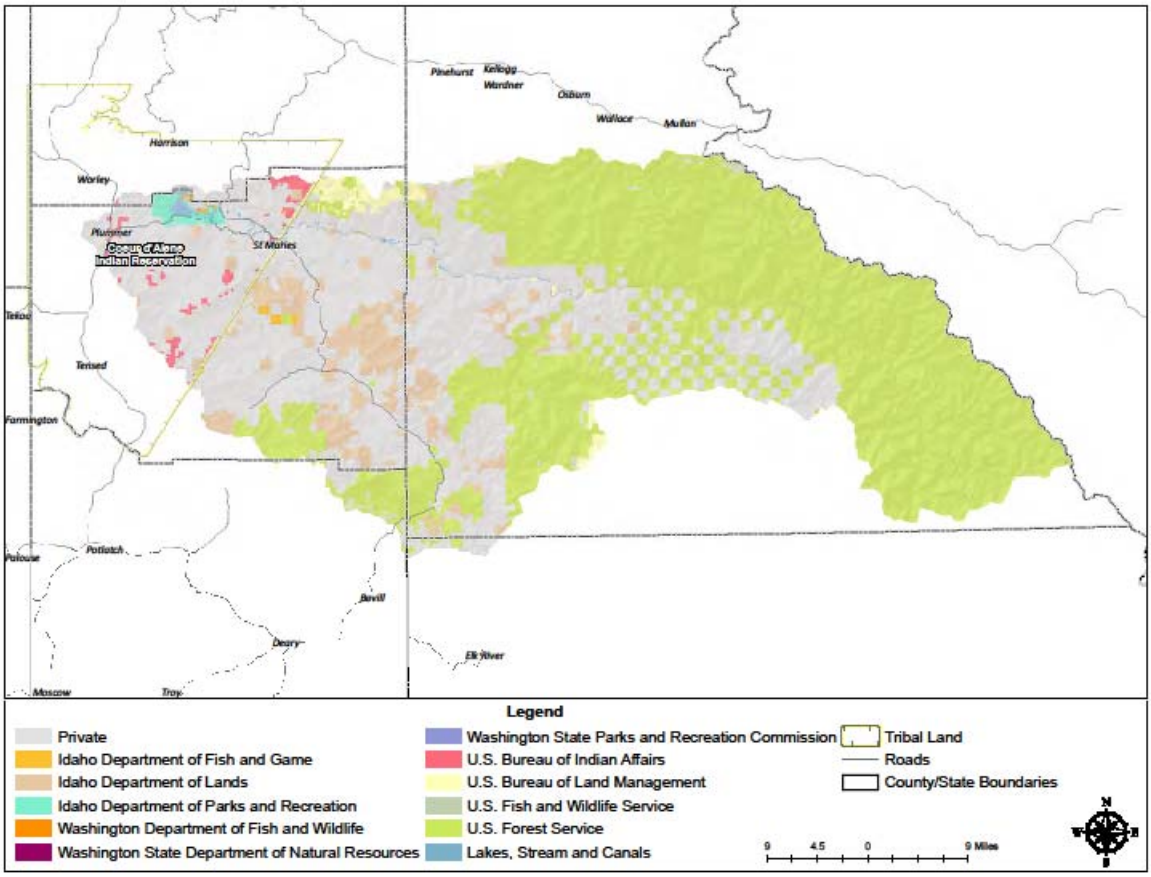

Figure 18-1. St. Joe River Subbasin and Land Owners

18.3 Overview of Reduction Strategy, Actions, and Schedule

Identifying strategies for reducing nonpoint source phosphorus in the St. Joe River subbasin is an important step to protect and restore water quality in the St. Joe River, Coeur d'Alene Lake and the Spokane River. A successful strategy will also ultimately support improving dissolved oxygen concentrations in Lake Spokane. The extent of water quality improvements will depend on fate and transport processes which were not addressed in the NPS Study. Nonpoint source phosphorus reductions will have both local and watershed benefits.

18.3.1 Strategy

The strategy for addressing nonpoint sources of phosphorus includes taking actions throughout the subbasin. Nonpoint source reduction actions include addressing obvious problems and undertaking actions that can be readily completed. The strategy emphasizes reducing nonpoint source phosphorus from land uses that generate large phosphorus loads and cover large areas of the subbasin. A subbasin scale assessment of these land uses revealed that evergreen forest and shrub and brush rangeland are dominant throughout the subbasin (Chapter 3).

18.3.2 Actions

Actions are the measures or steps from planning through achievement of nonpoint source phosphorus reduction. Actions include sufficient description and specificity for a responsible party to decide to take the action. The actions also help the responsible party determine where, what, when, and how to achieve the potential suggested outcome.

BMPs are the core of the action; whereas, actions encompass the entire process from the identification of the area, selection and implementation of the BMP through post monitoring. BMPs for addressing nonpoint sources of phosphorus include structural (i.e., physical) and non-structural (i.e., educational) measures.

BMPs referenced in the actions in Section 18.5 were identified based on the dominant land uses and the associated loading potential of the land uses. BMP phosphorus percent reduction efficiency, costs, estimated longevity and implementation effectiveness were also key indicators for identifying high priority BMPs for the subbasin. See Chapter 8 Nonpoint Source Phosphorus Control Measures for information about BMPs and the prioritization process.

18.3.3 Schedule

The schedule for nonpoint source actions for this plan is based on meeting the schedule in the Spokane River DO TMDL (Ecology, 2010). The schedule targets expeditious management actions to reduce nonpoint source phosphorus over the next two decades. From the Spokane River DO TMDL approval (May 2010), progress will be evaluated every 5 years, with extensive assessments after 10 and 20 years. The results from the first 10 years will be used to guide actions during the second 10-year period. Actions initiated in the first 10 years and determined to be beneficial should be continued, including successful nonpoint source control.

18.3.4 Summary of Approach

DEQ has not developed a TMDL and load allocation for the St. Joe River subbasin to match with the Spokane River DO TMDL (Ecology, 2010). Ecology assigned load allocations for the Little Spokane River and Hangman Creek subbasins and provided seasonal estimates for the percent reduction in nonpoint source phosphorus loads. These seasonal estimates were converted to average annual equivalents. Based on the reductions for the Little Spokane and Hangman Creek subbasins, a target reduction of approximately 25 percent within upstream subbasins is estimated to be necessary to meet downstream targets. Additionally, implementation of the Coeur d'Alene Lake Management Plan is investigating nutrient loads within tributaries to the lake and may provide additional guidance for reductions (DEQ and Coeur d'Alene Tribe, 2009). Using an average efficiency of 54 percent for the priority BMPs (Chapter 8), approximately 57 percent of the major land uses (evergreen forest and rangeland) would need BMPs applied to achieve the target. Based on the average cost for the priority BMPs of about $320/pound (Chapter 8), the total cost for the target reduction would be approximately $7,160,000. Achieving the target reduction over a 20-year period will require that approximately $358,000 is spent annually on BMPs in the subbasin.

18.4 Overview of Opportunities

Opportunities for organizations to undertake nonpoint source phosphorus reductions are available throughout the subbasin. This overview includes a description of what BMPs are the most relevant and where the BMPs should be implemented. Where the BMPs should be implemented is specific to land uses.

18.4.1 Control Measures and BMPs

BMPs specific to land use type and source are described in detail in Chapter 8. The background included in Chapter 8 narrowed the list of BMPs from 108 to 22 based on phosphorus percent reduction efficiency, cost, estimated longevity, and implementation effectiveness. This list of BMPs, if implemented for the appropriate land uses, could result in substantial net nonpoint source reduction of phosphorus.

There are several organizations throughout the St. Joe River subbasin that can mitigate nonpoint source loads by incorporating BMPs. The agencies and organizations are encouraged to review the land and nonpoint phosphorus sources in their jurisdiction to further identify BMPs that are specific to their situation.

Organizations should examine areas within their influence to identify opportunities where these BMPs can be implemented to reduce nonpoint source phosphorus. These organizations should also examine their stormwater management practices and look for opportunities to implement BMPs since stormwater is a primary transport mechanism for nonpoint source phosphorus. Organizations identified in Tables 18-1 and 18-2 include private, municipal, state and federal entities. Associated opportunities for nonpoint source phosphorus reduction include:

- Private land owners may protect and restore riparian corridors; minimize stormwater runoff; and consider education, land evaluation, and/or aide available from the conservation organizations.
- Municipalities may install BMPs to treat and/or reduce stormwater discharge to water bodies; evaluate where stormwater is being discharged; and/or evaluate the pollutant loading by collecting samples for analysis.
- State and federal agencies should review activities occurring on the land, identify potential impacts, and implement applicable BMPs.

18.4.2 Land Uses and Source Potential

The NPS Reduction Plan is meant to provide guidance on where to take action, as actions are voluntary and not mandatory. The NPS Study was conducted at the watershed and subbasin scales and is limited in its guidance to actions at those scales. Actions by organizations are limited by their jurisdictions and authority. Organizations will need to examine local conditions to determine specifically where they choose to take action.

The NPS Reduction Plan analyses (Chapters 6 and 7) evaluated the dominant land uses and the phosphorus load potential for each subbasin. In some cases, the largest land use did not match

the largest phosphorus load reduction potential. The following land uses have the highest priority for the Hangman Creek subbasin with respect to nonpoint source phosphorus loading:

- Evergreen Forest.
- Range.

The analytical evaluation results indicated that the central and western portion of the subbasin has the highest nonpoint source phosphorus loading rates in the St. Joe River subbasin (see Chapter 7). These two sub-subbasins with the highest estimated loadings are Mica Creek (0.112 lbs/ac/yr) and Plummer Creek (0.098 lbs/ac/yr). These subareas should be considered as priority areas for action.

The St. Joe River subbasin is dominated by evergreen forest land (73 percent) and shrub and brush rangeland (24 percent). These land uses also have the greatest phosphorus removal potential. Organizations are encouraged to take action in these high priority land use areas. These particular land uses represent the priority areas where nonpoint source phosphorus actions are necessary to achieve a significant net reduction. Organizations should examine areas they own or are within their influence, and look for opportunities to reduce nonpoint source phosphorus from the prioritized land uses. Organizations should also examine areas within their jurisdiction that are obvious areas for nonpoint source reduction opportunities.

18.4.3 Summary of Reduction Opportunities

BMPs have been prioritized first by their ability to remove nonpoint source phosphorus loads and then by land use type. The acres of land use by organization were computed and are tabulated in Table 18-3. The acres in Table 18-3 demonstrate how the land uses are distributed among the land owners and where the opportunities for reductions may exist.

The export coefficients summarized in Chapter 7, along with the land uses and areas, can be used to estimate potential nonpoint source phosphorus loads by organization. There is an associated range of reduction opportunities based on the potential to reduce phosphorus loads. These opportunities are presented in Table 18-4 by assigning a load reduction potential that ranges from low to high. The range is based on total phosphorus load; therefore, higher potential may be due to a greater export coefficient, the total land area, or a combination of both. Table 18-4 is intended to provide further guidance for considering and selecting BMPs for implementation.

Figure 18-2 shows land ownership with stream segments highlighted in areas of high potential for nonpoint source phosphorus reduction based on the land use and export coefficients. Stream segments are shown since the highest priority BMPs in this subbasin generally relate to stream or riparian corridors.

Table 18-3. Organizations Land Area by Land Use

Land Owners	Agriculture[1] (acres)	Forested[1] (acres)	Rangeland[1] (acres)	Urban / Suburban[1] (acres)	Other[1] (acres)
Private					
Private	3,342	315,890	146,025	4,488	10,083
Tribal Governments[2]					
Coeur d'Alene Tribe	3,334	80,262	33,212	2,120	7,335
Incorporated Municipalities[2]					
Plummer	10	71	256	143	6
St. Maries	0	71	62	417	19
Local Governments[2]					
Benewah County	2,528	247,906	85,637	4,239	12,173
Clearwater County	0	4,712	1,940	0	1
Kootenai County	883	1,916	3,722	141	187
Latah County	0	18,777	1,086	191	21
Shoshone County	189	587,257	207,624	2,156	3,922
State Agencies					
Idaho Department of Fish and Game	0	1,402	344	16	661
Idaho Department of Lands	1	63,931	10,435	99	286
Idaho Department of Parks and Recreation	<1	4,875	330	180	1,359
Federal Agencies					
U.S. Bureau of Indian Affairs	128	7,059	1,349	327	104
U.S. Bureau of Land Management	0	10,442	4,935	62	42
U.S. Forest Service	122	456,406	136,160	1,264	763

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation.

[2] Tribal governments, incorporated municipalities and local governments is the total land area within boundaries.

Table 18-4. Organizations and Potential for Nonpoint Source Phosphorus Reduction

Land Owners	Agriculture[1]	Forested[1]	Rangeland[1]	Urban / Suburban[1]	Other[1]
Private					
Private	High	High	High	High-Mod.	Moderate
Tribal Governments					
Coeur d'Alene Tribe	High-Mod.	High	High	High-Mod.	Low-Mod.
Incorporated Municipalities					
Plummer	Low	Low-Mod.	Low-Mod.	Low-Mod.	Low
St. Maries	n/a	Low-Mod.	Low	Low-Mod.	Low
Local Governments					
Benewah County	High-Mod.	High	High	High-Mod.	Moderate
Clearwater County	n/a	High-Mod.	Moderate	n/a	Low
Kootenai County	High-Mod.	Moderate	Moderate	Low-Mod.	Low
Latah County	n/a	High	Moderate	Low-Mod.	Low
Shoshone County	Moderate	High	High	High-Mod.	Moderate
State Agencies					
Idaho Department of Fish and Game	n/a	Moderate	Low-Mod.	Low	Low
Idaho Department of Lands	Low	High	High-Mod.	Low-Mod.	Low
Idaho Department of Parks and Recreation	Low	High-Mod.	Low-Mod.	Moderate	Low-Mod.
Federal Agencies					
U.S. Bureau of Indian Affairs	Moderate	High-Mod.	Moderate	Moderate	Low
U.S. Bureau of Land Management	n/a	High-Mod.	High-Mod.	Low-Mod.	Low
U.S. Forest Service	Moderate	High	High	High-Mod.	Low-Mod.

[1] NPS load potential based on area and export classified into five categories, low, low-moderate, moderate, high-moderate, and high.

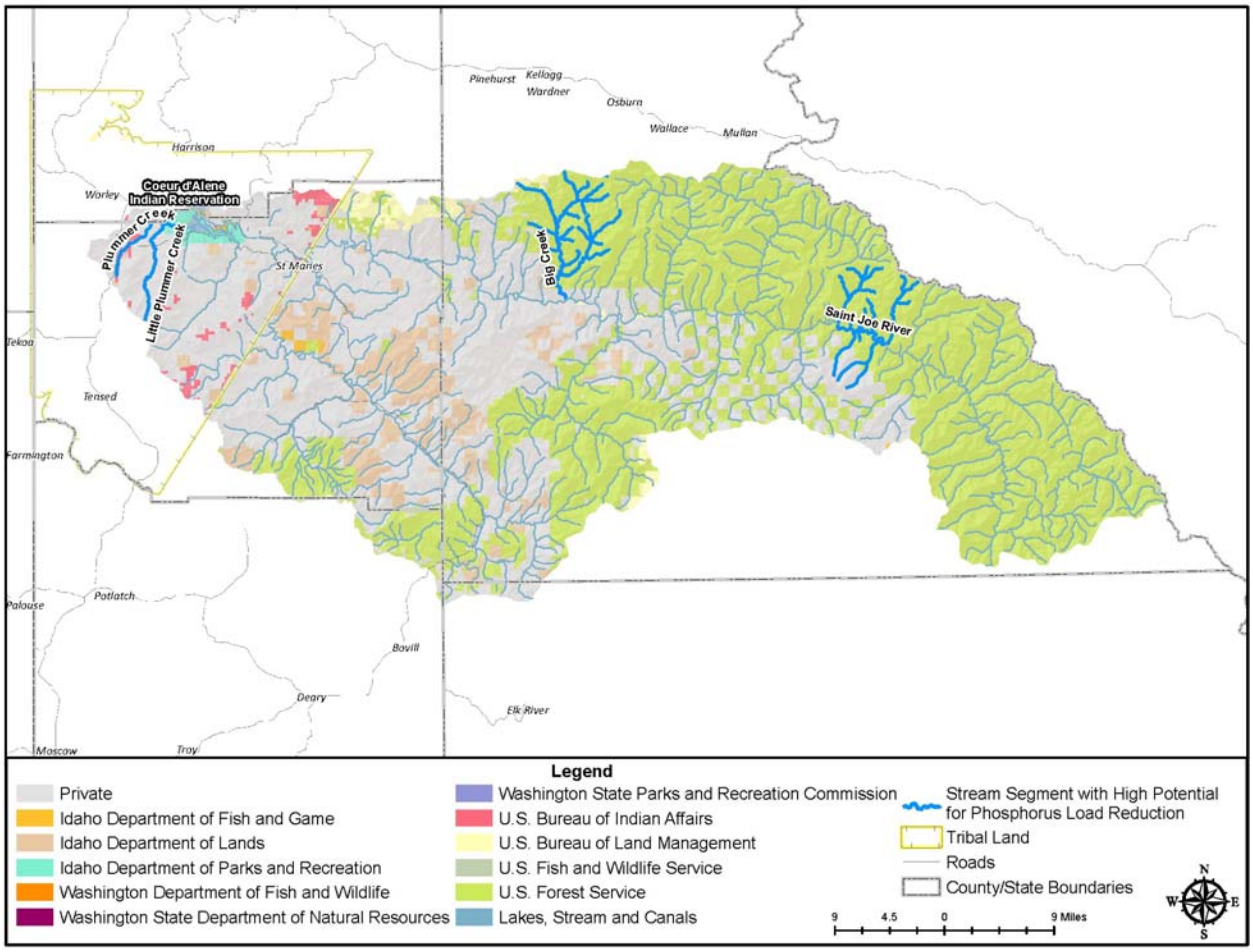

Figure 18-2. St. Joe River Subbasin High Potential Reduction Opportunities

18.5 Specific Actions by Category

This section includes a list of specific actions to reduce nonpoint source phosphorus loads and ultimately contribute to meeting water quality standards. A general description of each action, an activity summary, potential phosphorus load reduction, a range of costs, potential timelines, and the potential lead entity are provided for each action. Although it was not a primary objective of the NPS Study to specify "who" implements phosphorus control measures, potential lead organizations are identified for some actions to help provide linkage to the "what" and "where" objectives of the NPS Study. The lead organization will need to assist local entities in developing detailed plans for the activities, as well as a schedule and plan for monitoring progress. When the information was available, the action also includes a description of the roles of the organization with responsibility to improve water quality, and the means through which the organization will address the water quality issues.

18.5.1 High Priority BMPs

The analysis provided in Chapter 8 described the following BMPs as having the highest priority for the St. Joe River subbasin:

- Streamside Management Zones.
- Riparian Zones and Buffer Strips.
- Stream Bank Stabilization.
- Erosion Control.

Specific details regarding implementation of these high priority BMPs are provided in Chapter 9. These BMPs are appropriate for implementation for land uses in the subbasin. The following sections summarize actions appropriate for the specific land uses within the St. Joe River subbasin.

18.5.2 Regional Phosphorus Management

Regional phosphorus control strategies are not specific to any one land use type or organization, and may contribute to the reduction of nonpoint source phosphorus loadings in the subbasin. Descriptions of the regional or watershed-scale phosphorus management actions intended to facilitate load reductions and/or establish the technical foundation for further phosphorus control activities are described in Chapter 9.

18.5.3 Agriculture Related Activities

Since less than 1 percent of the subbasin land use is being used for agriculture, no specific agriculture actions are presented. However, since the St. Joe River subbasin is the largest subbasin there are still more than 7,000 acres of agricultural land use and potentially generating significant nonpoint source loads. Opportunities for phosphorus loading reduction on these agricultural lands may be present and should be addressed when identified. Public education and outreach programs under the regional phosphorus management strategy will likely support agriculture BMPs throughout the subbasin. For specific agricultural control activities, refer to the agriculture related activities in Chapter 13.

18.5.4 Forestry Related Activities

BMPs related to forestry practices can reduce nonpoint source phosphorus. While phosphorus export forestry in general is low, local areas of intensive use can have higher phosphorus export rates. Since a large percentage of the S. Joe River subbasin is mostly forested, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing erosion, reducing sediment transport, protecting and maintaining riparian corridors and streamside management zones.

SJR-FR-1 Evaluate Forestry Practices

Idaho's forest practices regulations will be relied upon to reduce nonpoint source phosphorus loads from private and state forestlands. Ongoing practices should be reviewed by or as directed by the lead organization for compliance. If compliance with the existing regulations is not resulting in sufficient reduction, then more effective methods need to be promoted. Poorly performing practices need to be researched for the causes and potentially modified to improve the outcomes.

With large quantities of adjacent forested land, tributary water quality is likely affected by forest management practices. Logging and road building practices that have been common throughout the intermountain region from the late nineteenth century through most of the twentieth century have likely contributed to the degradation of water quality. In more recent times, implementation of more environmentally sound forest management practices has occurred. These practices may have reduced forestry-related phosphorus loading within the subbasin but additional reductions are still possible.

The Idaho Forest Practices Act (IDAPA 20.02.01) defines the minimum level of best management practices (BMPs) required to be implemented for commercial timber lands in Idaho. It is anticipated that the new road maintenance and abandonment plans required by the current forest practices rules will slowly reduce phosphorus export from harvested forests.

The agencies have data on forest health, ecology, harvest areas, vegetation types, soil conditions and more. This information can be useful for identifying areas of greater nonpoint source phosphorus loading. However, much of this data is not readily available or in a format that can be interpreted by water quality managers. Coordination between forest and water quality managers is necessary to understand the data and select management activities.

Activity: Enforce existing regulations, evaluate existing practices, discourage poorly performing practices, and encourage best performing practices and improve coordination of sharing information.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SJR-FR-2 Quantify Sediment-Phosphorus Relationship in Forested Areas

Quantifying phosphorus loading associated with forest management practices may provide additional information that support selection of successful BMPs. The construction and use of roadways represent a major source of sediment from timber harvest activities (DEQ, 2000). A study to quantify the relationship between sediment associated with phosphorus in runoff from these roads can help determine whether additional measures should be undertaken.

Activity: Quantify relationship between sediment and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SJR-FR-3 Subbasin Scale Road Planning and Rehabilitation

Conduct a subbasin-scale management survey to inventory ownership and identify and prioritize the total miles of erodible roads and road banks. Specific BMPs may then be developed based on survey results to reduce miles of erodible roads associated with road construction, road conversions, and maintenance. A database of roads with tracking of BMP implementation is

essential for determining success and accountability. Reduction plans should identify opportunities to abandon non-essential roads or restore roads on non-industrial forest lands and other county roads that contribute obvious erosion problems.

Activity: Quantify relationship between roads and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SJR-FR-4 Fire Rehabilitation Areas

Wild fires can significantly impact the landscape. Research has shown increased concentrations of suspended sediments, phosphorus, and potassium in streams below burned areas (Stednick, et al., 1982). Stream monitoring indicated an immediate flush of phosphorus in the runoff, followed by a slower release. Rehabilitation of burn areas, especially the riparian corridors to protect streams, will be important to reducing nonpoint source phosphorus in forested areas. The fire history from 2001 through 2010 suggests approximately 1,800 acres in the subbasin to have been burned and should be evaluated.

Activity: Identify and assist with rehabilitation of burned areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

18.5.5 Range Related Activities

BMPs related to rangeland practices can reduce nonpoint source phosphorus. Since range, shrub and brush land is the second largest percentage of land uses in the St. Joe River subbasin, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing disturbance of range land, protecting and maintaining riparian zones and maintaining or stabilizing stream banks.

SJR-RR-1 Evaluate Rangeland Practices

The state's regulations will be relied upon to reduce nonpoint source phosphorus loads from rangelands. Evaluate past and present impacts and review ongoing practices for compliance. The goal of evaluating past and present activities is to manage rangeland to maintain optimum soil and water quality. If compliance with the existing regulations is not resulting in sufficient nonpoint source phosphorus reduction, then more effective methods should be identified and promoted.

Activity: Evaluate existing practices, enforce existing regulations, and encourage BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

18.5.6 Urban/Suburban Related Activities

Urban/suburban areas can have the most variable impacts on nonpoint source phosphorus loading due to the diversity of development, uses, and control of stormwater runoff. BMPs under this category are typically associated with minimization of pollution sources and the management of stormwater.

SJR-UR-1 Business Practices to Prevent Stormwater and other Pollution

The St. Joe River subbasin contains commercial activity associated with the Cities of St. Maries and Plummer. Volume 5 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005) provides a list and descriptions of BMPs geared toward contaminant loading reduction for commercial and industrial facilities. These practices include the following:

- Loading dock and equipment yard design elements.
- Material loading and storage practices.
- Restaurant control practices.
- Surface cleaning control practices.
- Spill prevention, control, and cleanup.
- Employee training.

Volume 2 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005) provides a list and descriptions of BMPs geared toward contaminant loading reduction for construction practices. These largely deal with erosion and sediment controls and include the following:

- Construction timing.
- Temporary road construction practices.
- Stockpile and waste management.
- Slope protection and stabilization.
- Construction stormwater collection and handling.

Activity: Review existing practices, encourage BMP implementation, provide adequate resources and information to businesses.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SJR-UR-2 Evaluate and Analyze Impervious Surfaces and Implement Stormwater BMPs

Impervious surfaces throughout the St. Joe River subbasin are the source of substantial stormwater runoff. Within the subbasin, stormwater runoff enters both surface water and

groundwater via infiltration. An understanding of the area and location of the impervious surfaces in the subbasin will guide the need and responsibility for implementation.

Dye tracing of stormwater from drains to outfalls can be helpful to determine where the flows discharge and potential additional BMPs at the discharge location. Around Liberty Lake, Washington, for example, two drains were dye tested, found to discharge to the lake, and subsequently modified with the installation of bio-infiltration systems to provide treatment (Hamlin, 2010).

Activity: Evaluate and quantify existing impervious surfaces, identify areas where vegetated buffer/filter strips or other applicable stormwater BMPs (see Chapter 8) could be installed, and encourage installation.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SJR-UR-3 Evaluate and Revise Stormwater Policies

Only about 1 percent of the subbasin is within municipal boundaries. However, some of this urban/residential area is within close proximity to the St. Joe River and stormwater runoff from these areas impacts surface water quality with little to no attenuation. This action consists of a review of stormwater regulations of municipalities for water quality requirements. Municipalities have unique policies; however, working towards incorporating at least some minimum water quality requirements that address nonpoint source pollution including phosphorus across the watershed will provide some reduction in loads. Resources to consider include the following:

- DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005).
- Idaho Department of Transportation's Erosion & Sediment Control—Best Management Practices Manual (Idaho DOT, 2011).
- DEQ's Compendium of Best Management Practices To Control Polluted Runoff, A Source Book (Metl and Maquire, 2003).
- The Spokane Regional Stormwater Manual (Spokane County et. al, 2008).

Activity: Coordinate on minimum water quality stormwater treatment policies and requirements.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

SJR-UR-4 Strengthen Requirements for Stormwater Treatment BMPs in Key Areas

Stormwater treatment BMPs, such as bio-infiltration swales, bio-infiltration channels, vegetated buffer strips and infiltration basins are important within the St. Joe River subbasin because development frequently occurs above bedrock with limited treatment capacity and in close proximity to the St. Joe River and/or the south end of Coeur d'Alene Lake. Volume 4 of DEQ's

Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005) provides a list and description of permanent stormwater BMPs designed to control stormwater based contaminant loading. These include BMPs that treat stormwater through filtration, infiltration and/or detention.

The St. Joe River subbasin contains commercial and industrial land uses within the Cities of St. Maries and Plummer. More stringent requirements could be considered for implementation of BMPs intended to reduce industrial discharges of phosphorus. This could include installation of sand filters at or near stormwater discharges, installation of catch basin filtration systems, installation of flocculation systems, and/or multi-chambered treatment trains (DEQ, 2005; Oregon DEQ, 2001).

Implementation of this action would strengthen requirements regarding implementation of the stormwater treatment BMPs listed in this section. These requirements could include developed and redeveloped commercial, industrial and residential properties within 1,000 feet of the St. Joe River, Round Lake, Benewah Lake, Chatcolet Lake, and Coeur d'Alene Lake.

This action also could include guidelines regarding BMP maintenance. Stormwater systems that are properly operated and maintained function better and reduce maintenance costs and liability problems. Volume 4 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005) provides information on properly operating and maintaining stormwater systems for residential, commercial, or industrial developments. DEQ (2005) also include inspection and maintenance forms that prompt the user to identify problems that commonly occur with various stormwater control BMPs and provide recommendations for maintenance. BMPs are also described below in the 'Install BMP' (see SJR-UR-4a through 4d).

Activity: Implement rigorous stormwater BMP requirements in key portions of subbasin.
Potential Phosphorus Load Reduction: Varies depending on BMP – refer to SJR-UR-4a through SJR-UR-4d.
Range of Cost: Varies depending on BMP – refer to SJR-UR-4a through SJR-UR-4d.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County, City of Post Falls, City of Coeur d'Alene.

SJR-UR-4a Install Grassed Bio-Infiltration Swales

To implement this BMP, stormwater runoff is directed to a grassed swale where vegetative cover provides pretreatment of stormwater before infiltration to the subsurface. Infiltration occurs either through the swale or within drywells that receive stormwater once the swale is filled to a design overflow elevation. The area surrounding the drywell and underlying the swale should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone.

Specific details regarding bio-infiltration swale design and construction within the St. Joe River subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: Grassed swales have a wide range of potential phosphorus removal efficiencies from 20 to 61 percent (Miller, 1987) to 29 to 99 percent (Yu et al., 2001).
Range of Cost: No specific quantitative information regarding the cost of grassed bio-infiltration swales was found during the project review. However, based on BMP characteristics, costs are expected to be moderate to high with respect to the other BMPs described in this plan.

SJR-UR-4b Install Bio-Infiltration Channels

To implement this stormwater treatment BMP, stormwater runoff is directed to a bio-infiltration channel underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). A bio-infiltration channel is a sloped, vegetated channel or ditch that both conveys and treats stormwater runoff. It does not provide flow control but can convey runoff to facilities designed for that purpose (Spokane County et al., 2008). A bio-infiltration channel provides treatment as stormwater flows through vegetative cover and/or infiltrates. Channel flow can be directed to a pond or other facility. Infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Specific details regarding bio-infiltration channel and construction (also termed infiltration channels) within the St. Joe River subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of bio-infiltration channels was found during planning. However, infiltration trenches and basins have a wide range of potential phosphorus removal efficiencies of 10 to 80 percent (EPA, 1999).
Range of Cost: No specific quantitative information regarding the cost of bio-infiltration channels was found during planning.

SJR-UR-4c Install Vegetated Buffer Strips

Stormwater runoff is directed via sheet flow to a vegetated buffer strip situated adjacent to a rural roadway or parking lot. Vegetative cover within the buffer strip provides pretreatment of stormwater before infiltration to the subsurface, and/or evaporation. Vegetated buffer strips are used to intercept overland sheet flow runoff from adjacent impervious areas. They slow runoff velocities, filter out sediment and other pollutants, and provide infiltration into underlying soils. When buffer strips are used for infiltration, the area underlying the buffer strip should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native

soils comprising the infiltration site's unsaturated zone. Specific details regarding vegetated buffer strip design and construction within the St. Joe River subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness or cost of vegetated buffer strips was found during the project review. However, vegetated filter strips have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Grass filter strips have low phosphorus removal costs of $190 to $250 per pound (Sera-17, 2010).

SJR-UR-4d Infiltration Areas/Bioretention Basins

Stormwater runoff is directed to an infiltration area underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). The infiltration area can be equipped with a drainfield constructed of perforated pipe to facilitate infiltration. A suitable site requires soils with a sufficiently high permeability to allow for relatively rapid infiltration, but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Spokane County and the City of Spokane have recently constructed/enhanced a number of regional stormwater infiltration facilities for the purpose of managing stormwater runoff in areas with difficult infiltration conditions on a site-specific level. When these facilities are located over relatively thick glaciofluvial sand and gravel sequences, benefit of water quality treatment may be limited. Examples include: Hazel's Creek Drainage and Conservation Facility (City of Spokane), Browne's Mountain Regional Stormwater Facility (Spokane County), and Price and Wall Regional Stormwater Facility (Spokane County).

DEQ (2005) provides guidance regarding bio-infiltration basins, which have similar design and operational elements.

Potential Phosphorus Load Reduction: Infiltration basins have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Infiltration structures generally have high phosphorus removal costs of $2,500 to $3,000 per pound (Corrozi, 2009).

SJR-UR-5 Evaluate Phosphorus Load from Septic Tanks along Coeur d'Alene Lake and Other Densely Developed Areas

While there is historical literature that suggests septic systems and subsequent treatment in the unsaturated zone provides phosphorus removal from effluent, recent and emerging evidence indicates the contrary in many locations. Both the current science and measured groundwater concentrations of phosphorus clearly indicate that septic systems release significant phosphorus loads into underlying groundwater and that phosphorus loading can increase with time as a result of the loading of sorption sites in the unsaturated zone. Moreover, the shallow hydrostratigraphy

of many areas within the St. Joe River subbasin consists of shallow bedrock with little to no overlying fine-grained soil and therefore, has little phosphorus removal capacity.

Septic-based phosphorus loading should be considered, at a minimum, within 1,000 feet of the St. Joe River, Round Lake, Benewah Lake, Chatcolet Lake, and Coeur d'Alene Lake.

Activity: Evaluate phosphorus load from septic tanks within densely developed areas and nearshore areas as a basis for future management decisions.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Benewah County or other municipalities.

SJR-UR-6 Septic Tank Elimination within Key Areas

Removal of septic systems by connecting to sewer systems eliminates a source of pollution to surface and groundwater. Wastes are treated more thoroughly and phosphorus removal is more complete at a wastewater treatment facility designed for phosphorus removal than is possible with a septic system. For these reasons, septic tank elimination is an important long-term management approach to controlling nonpoint source phosphorus loading.

Septic tank elimination programs should be based on results of SJR-UR-5, which will assist in identification of specific areas where infrastructure investment will lead to relatively large phosphorus loading reductions. It is likely that septic tanks are sufficiently dispersed within most of the subbasin to preclude sewering. However, it is possible that there are relatively dense distributions of septic tanks adjacent to municipal service areas that could be considered for septic tank elimination.

Activity: Remove septic systems and replace with sanitary sewer in key areas adjacent to existing service areas.
Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of septic tank elimination was found during planning. However, based on the phosphorus removal characteristics of area wastewater facilities and that septic tank discharges are completely eliminated during removal, the expected effectiveness is very high.
Range of Cost: No specific quantitative information regarding the cost of septic tank elimination was found during planning. Potential costs may range from low to high with respect to the other BMPs described in this plan.
Potential Timeline: TBD by Potential Lead.
Potential Lead: City of Coeur d'Alene and/or Kootenai County.

SJR-UR-7 Inspection and Pumping of Septic Systems within Key Areas

Regular inspection and pumping of septic systems prolongs the life of the system, reduces maintenance costs and contamination around the drain field, and slows the breakthrough of phosphorus to groundwater. The priority systems to target are older systems and systems near streams and areas with a high groundwater table. The septic tank should be pumped by a licensed

septage waste-hauler on a regular basis and septage properly disposed of in an approved site or wastewater treatment facility.

Septic system inspection and pumping can be performed throughout the subbasin to achieve nonpoint source loading reduction to area surface water. However, it will have greatest positive impact within nearshore areas and with septic system overlying coarse soil and/or bedrock with minimal phosphorus treatment capacity. Areas to consider include those within 1,000 feet of the St. Joe River and tributaries, Round Lake, Benewah Lake, Chatcolet Lake, and Coeur d'Alene Lake.

Activity: Require regular inspection and pumping of septic systems on a standard interval. The interval should vary as a function of septic tank size and persons per household to achieve acceptable retention times. Standard matrices are available for these requirements.
Potential Phosphorus Load Reduction: Inspection and pumping of septic systems has low to moderate phosphorus removal efficiencies of 40 to 55 percent (DDNR, 2010).
Range of Cost: Inspection and pumping of septic systems has very low phosphorus removal costs of $7 to $25 per pound (DDNR, 2010).
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County.

SJR-UR-8 Develop a Small Community Program for Phosphorus Loading Reduction

Small communities within the St. Joe River subbasin include Plummer, St. Maries, Calder, Avery, Fernwood, Santa, Emida, and others. These communities have a unique set of associated phosphorus loading mechanisms that, in many cases, are not specifically targeted by existing guidelines and regulation. A number of the small communities within the St. Joe River subbasin are in close proximity, and likely runoff directly to the St. Joe River and its tributaries. Because of this, phosphorus loading from these areas could impact subbasin surface water.

The intent of this action is to develop a program to assist smaller communities to develop the tools they need to reduce phosphorus loading. This program could include generation of guidance documents and/or ordinances. Components of the program could include the following:

- Community outreach and education.
- Training programs targeted at local government officials and managers.
- Retrofit of existing stormwater management structures to comply with guidelines described in Action SJR-UR-4.
- Management and education intended to reduce of impact of pet waste on water quality.
- Septic system elimination (if applicable) per Action SJR-UR-6 and inspection/pumping per Action SJR-UR-7.
- Recommendation or requirement for use of phosphorus-free fertilizer, per Action SJR-AA-2.
- Recommendation to retain grass clippings/leaves on lawns or as properly-disposed of solid waste, rather than within runoff.

This action will also include guidance and/or requirements for LID practices in construction and stormwater management. LID practices that could be applicable to the St. Joe River subbasin are presented in detail in Volume 3 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005). Described LID practices include:

- Clearing and grading practices.
- Use of aquatic buffers and preservation of natural hydrologic function.
- Impervious area practices.
- Green roofs and parking lots.
- Pervious pavement.
- Soil amendments and restoration.
- Rainwater harvesting and reuse.
- Created wetlands.

Activity: Develop a Small Community Program for Phosphorus Loading Reduction to assist smaller communities in developing the tools they need to reduce phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County or other municipalities.

SJR-UR-9 Marina Practices to Prevent Stormwater and other Pollution

Numerous marinas and other boating-related facilities are situated within the St. Joe River subbasin, particularly along the south end of Coeur d'Alene Lake. In addition, numerous house boat facilities occupy various coves and bays within the south end of Coeur d'Alene Lake, such as Chatcolet and Hidden Lakes. Each of these facilities deals with septic and other wastes and is potential sources of phosphorus directly to the Lake. BMP information specific to marina operations, which are of particular importance within the St. Joe River subbasin, is provided in DEQ's Compendium of Best Management Practices to Control Polluted Runoff (Metl and Maguire, 2003) and Volume 2 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005). Types of BMPs that pertain to marinas and boating operations include the following:

- Marina siting and design practices.
- Shoreline stabilization.
- Stormwater management.
- Sewage and solid waste management.
- Boat cleaning practices.
- Establishment of no wake zones and other boat management practices.
- Public education.

Activity: Review existing practices, encourage BMP implementation, provide adequate resources and information to marinas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

18.5.7 Supporting Phosphorus Reduction Activities

Supporting activities to be undertaken as part of this NPS Reduction Plan will provide valuable information for long-term success, in addition to the subbasin-specific actions and BMPs designed to provide direct phosphorus reduction. These activities are described in Chapter 9.

18.5.8 Additional Activities

Additional activities include indirect actions that either lead to overall improvements in ecological functions and thus water quality or provide additional insights into the overall health and conditions of the watershed. Activities are described in Chapter 9. Additional activities in the Upper Coeur d'Alene River subbasin include the coordination of activities on Lake Spokane, nearshore, and upstream activities.

SJR-AA-1 Evaluate, Protect and Enhance Nearshore Areas

Nearshore land management and activities have the potential to impact phosphorus loads to surface water. Within the St. Joe River subbasin, these activities apply to areas nearshore to the St. Joe River, St. Maries River, and numerous tributaries (e.g., Gold Center Creek, Gramp Creek, Flewsie Creek, Emerald Creek, and Santa Creek), Round Lake, Benewah Lake, Chatcolet Lake, and Coeur d'Alene Lake. Nearshore sources may transport phosphorus loads via surface water, stormwater runoff, interflow, and groundwater. Unlike activities and BMPs implemented upstream, there is no attenuation of phosphorus loads associated with nearshore sources. Therefore, reduction of loads from nearshore areas is important and should be considered as part of the overall nonpoint source phosphorus load reduction strategy. Nearshore areas should be inventoried to identify areas where BMPs should be implemented. BMPs that should be considered for nearshore areas include, but are not limited to:

- Erosion control and bank stabilization.
- Filter strips.
- Septic tank elimination.
- Inspection and pumping of septic systems.
- Phosphate lawn fertilizer ban.
- Riparian fencing, riparian zones and buffer strips.
- Education and outreach to nearshore property owners.

Additional detail regarding these BMPs is provided in Chapter 8.

Activity: Evaluate nearshore areas of the St. Joe and St. Maries Rivers and their numerous tributaries within the St. Joe River subbasin and implement activities and BMPs to reduce nonpoint source phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

18.5.9 Support Existing and Planned Activities

The NPS Reduction Plan supports existing water resources and water quality studies and planning. Protection of these resources also supports the reduction phosphorus nonpoint sources. Critical planned activities specific to the NPS Reduction Plan are identified below.

SJR-EP-1 Support, Compliment and Enforce Permits, Ordinances, Plans and Activities Relating to Nonpoint Source Phosphorus Reduction

There are a variety of permits, ordinances, plans and activities within the St. Joe River subbasin that relate to nonpoint source phosphorus reduction, including:

- 2003 St. Joe River Assessment and Total Maximum Daily Loads and associated sediment TMDLs for Mica, Fishhook, and Bear Creeks.
- 2003 St. Maries River Assessment and TMDL and associated sediment TMDL for the entire St. Maries subbasin.
- The 2009 Coeur d'Alene Lake Management Plan.
- Spokane River Forum education efforts.

When taking actions and implementing BMPs to reduce nonpoint source phosphorus, consider these and other related plans, goals, requirements and efforts to optimize reduction potential. Review that erosion control BMPs are followed at land development projects and construction sites.

Activity: Support, compliment and enforce permits, ordinances, plans and activities to achieve nonpoint source phosphorus reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

Chapter 19

Pend Oreille Lake Subbasin - Nonpoint Source Phosphorus Management Strategy and Actions

19.1 Introduction

An objective of this NPS Reduction Plan is to formulate nonpoint source control strategies that contribute to long-term reductions of phosphorus loads. It provides guidance on selecting 'what' strategies and actions to take and 'where' to apply them. Chapter 9 provides an introduction to the subbasin actions and strategies, background of the NPS Study objectives, how the subbasin chapters support the overall NPS Reduction Plan, and regional phosphorus control strategies that should be considered in all subbasins in the Spokane River Watershed.

This chapter identifies specific actions for entities located in the Pend Oreille Lake subbasin and stakeholders supporting these entities to reduce nonpoint source phosphorus. Identified are strategies and actions and areas to target within the subbasin. The guidance identifies potential organization leads and potential timelines for initial and long-term reductions of nonpoint source phosphorus pollution.

The following sections of this chapter describe:

- The identification and relationship of entities and stakeholders in the watershed and associated acres of land ownership.
- An overview of reduction strategies, actions, and schedule for the subbasin.
- An overview of the nonpoint source reduction opportunities and guidance on 'what' BMPs to implement and 'where' to take these actions.
- The specific actions by category identified to be undertaken, including those identified by specific entities and stakeholders.

Estimates of the potential BMP phosphorus reductions and cost per pound are provided in Chapter 8. The overall phosphorus reduction potential is discussed in Chapter 9.

19.2 Entities and Stakeholders

As discussed in Chapter 9, accomplishing nonpoint source reductions will require engaging local, state, and federal agencies and land managers, as well as private land owners. The principal organizations involved with securing funding, identifying priority locations, selecting BMPs, and taking actions in the Pend Oreille Lake subbasin include those shown in Table 19-1. These organizations are subdivided into entities and stakeholders as shown in Table 19-2, along with the area of land owned and miles of streams in the Pend Oreille Lake subbasin. Land ownership for the subbasin is shown in Figure 19-1.

Table 19-1. Organizations and Nonpoint Source Phosphorus

Organization
Local Governments
Bonner County
Kootenai County
Pend Oreille County
Spokane County
Bonner Soil and Water Conservation District
Kootenai-Shoshone Soil and Water Conservation District
Pend Oreille Conservation District
Spokane County Conservation District
Municipalities
Athol
Spirit Lake
Utilities
Municipal water service providers
Tribal Governments
None identified
State Agencies
Idaho Department of Environmental Quality
Idaho Department of Lands
Idaho Department of Parks and Recreation
Idaho Fish and Game
Idaho Forest Products Commission
Idaho Rangeland Resource Commission
Idaho Soil Conservation Commission & Idaho Soil and Water Conservation Commission
Idaho State Department of Agriculture
Idaho Transportation Department
Washington Department of Fish and Wildlife
Washington Forest Practices Board
Washington Land Use Study Commission
Washington State Conservation Commission
Washington State Department of Agriculture
Washington State Department of Ecology
Washington State Department of Natural Resources
Washington State Department of Transportation
Washington State Parks and Recreation Commission
Federal Agencies
U.S. Bureau of Land Management
U.S. Department of Agriculture – Natural Resource Conservation Service
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. Forest Service

Table 19-2. Organizations and Land Area

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Private				
In Athol	10	Athol	Kootenai-Shoshone Soil and Water Conservation District	64.3
In Kootenai County	34,653	Kootenai County		
In Spirit Lake	1,613	Spirit Lake	Bonner Soil and Water Conservation District	107.7
In Bonner County	57,390	Bonner County		
In Pend Oreille County	7,819	Pend Oreille County	Pend Oreille Soil and Water Conservation District	69.6
In Spokane County	19,808	Spokane County	Spokane County Conservation District	202.8
In Kaniksu National Forest	205	U.S. Forest Service	USDA – Natural Resource Conservation Service	0.6
In Public Domain Bureau of Land Management	126	U.S. Environmental Protection Agency		0.8
Incorporated Municipalities[2]				
Athol	*10*	Idaho Department of Environmental Quality, U.S. Environmental Protection Agency	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	0
Spirit Lake	*1,620*			1.1
Local Governments[2]				
Bonner County	*72,966*	Idaho Department of Environmental Quality, U.S. Environmental Protection Agency, Idaho Fish and Game, U.S. Fish and Wildlife Service	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	121.3
Kootenai County	*43,739*			93.3
Pend Oreille County	*8,294*			72.0

Land Owners	Land Area[1] (acres)	Regulatory	Assistance	Stream Distance[1] (Miles)
Spokane County	*26,974*	Washington Department of Ecology, U.S. Environmental Protection Agency, Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service	Washington State Department of Agriculture, Washington State Conservation Commission, Washington Land Use Study Commission	253.1
State Agencies				
Idaho Department of Fish and Game	1,388	Idaho Department of Environmental Quality, Idaho Fish and Game, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency	Idaho Department of Agriculture, Idaho Forest Products Commission, Idaho Panhandle Health District 1, Idaho Rangeland Resource Commission, Idaho Soil Conservation Commission	0.1
Idaho Department of Lands	14,298			27.9
Idaho Department of Parks and Recreation	2,421			0.2
Idaho Transportation Department	239.3			n/a
Washington State Department of Natural Resources	3,620	Washington Department of Ecology, Forest Practices Board, Washington Department of Fish and Wildlife	Washington State Department of Agriculture, Washington State Conservation Commission, Washington Land Use Study	33.5
Washington State Parks and Recreation Commission	3,983			19.4
Federal Agencies				
U.S. Bureau of Land Management	536	U.S. Environmental Protection Agency	USDA – Natural Resource Conservation Service	0.9
U.S. Forest Service	3,651			1.0
Additional Land Areas				
Roads	621 miles		606 stream crossings	

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation, road miles include primary, secondary, local and forest service roads.

[2] Incorporated municipalities and local governments is total land area within boundaries, not land ownership.

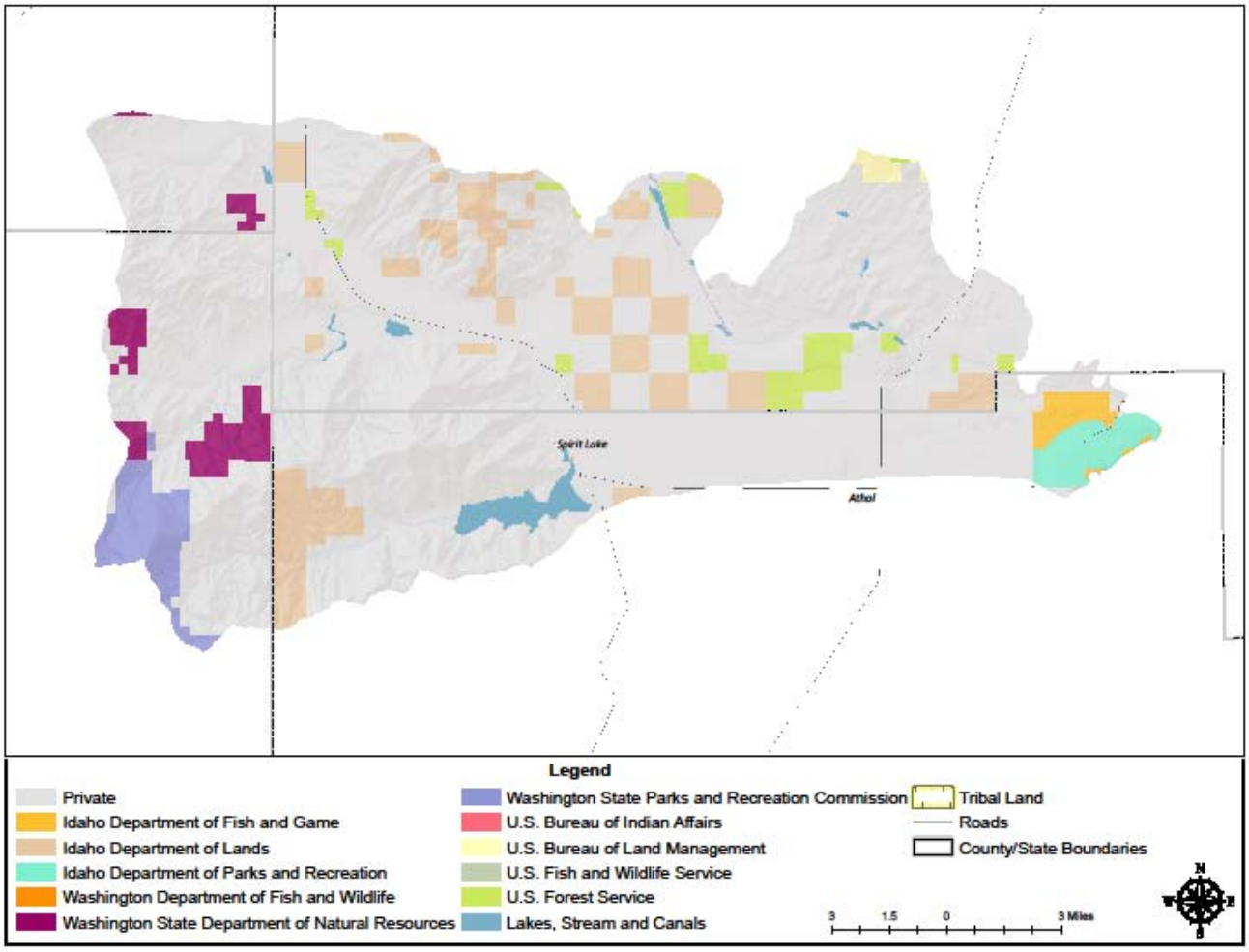

Figure 19-1. Pend Oreille Lake Subbasin and Land Owners

19.3 Overview of Reduction Strategy, Actions, and Schedule

Identifying strategies for reducing nonpoint source phosphorus in the Pend Oreille Lake subbasin is an important step to protect and restore water quality in the Spokane River. A successful strategy will also ultimately support improving dissolved oxygen concentrations in Lake Spokane. The extent of water quality improvements will depend on fate and transport processes which were not addressed in the NPS Study. Nonpoint source phosphorus reductions will have both local and watershed benefits.

19.3.1 Strategy

The strategy for addressing nonpoint sources of phosphorus includes taking actions throughout the subbasin. Nonpoint source reduction actions include addressing obvious problems and undertaking actions that can be readily completed. The strategy emphasizes reducing nonpoint source phosphorus from land uses that generate large phosphorus loads and cover large areas of

the subbasin. A subbasin scale assessment of these land uses revealed that cropland and pasture land and evergreen forest are dominant throughout the subbasin (Chapter 3).

19.3.2 Actions

Actions are the measures or steps from planning through achievement of nonpoint source phosphorus reduction. Actions include sufficient description and specificity for a responsible party to decide to take the action. The actions also help the responsible party determine where, what, when, and how to achieve the potential suggested outcome.

BMPs are the core of the action; whereas, actions encompass the entire process from the identification of the area, selection and implementation of the BMP through post monitoring. BMPs for addressing nonpoint sources of phosphorus include structural (i.e., physical) and non-structural (i.e., educational) measures.

BMPs referenced in the actions in Section 19.5 were identified based on the dominant land uses and the associated loading potential of the land uses. BMP phosphorus percent reduction efficiency, costs, estimated longevity and implementation effectiveness were also key indicators for identifying high priority BMPs for the subbasin. See Chapter 8 Nonpoint Source Phosphorus Control Measures for information about BMPs and the prioritization process.

19.3.3 Schedule

The schedule for nonpoint source actions for this plan is based on meeting the schedule in the Spokane River DO TMDL (Ecology, 2010). The schedule targets expeditious management actions to reduce nonpoint source phosphorus over the next two decades. From the Spokane River DO TMDL approval (May 2010), progress will be evaluated every 5 years, with extensive assessments after 10 and 20 years. The results from the first 10 years will be used to guide actions during the second 10-year period. Actions initiated in the first 10 years and determined to be beneficial should be continued, including successful nonpoint source control.

19.3.4 Summary of Approach

DEQ has not developed a TMDL and load allocation for the Pend Oreille Lake subbasin to match with the Spokane River DO TMDL (Ecology, 2010). Ecology assigned load allocations for the Little Spokane River and Hangman Creek subbasins and provided seasonal estimates for the percent reduction in nonpoint source phosphorus loads. These seasonal estimates were converted to average annual equivalents. Based on the reductions for the Little Spokane and Hangman Creek subbasins, a target reduction of approximately 25 percent within upstream subbasins is estimated to be necessary to meet downstream targets. Using an average efficiency of 54 percent for the priority BMPs (Chapter 8), approximately 85 percent of the major land uses (cropland and pasture and evergreen forest) would need BMPs applied to achieve the target. Based on the average cost for the priority BMPs of about $320/pound (Chapter 8), the total cost for the target reduction would be approximately $1,744,000. Achieving the target reduction over a 20-year period will require that approximately $87,000 is spent annually on BMPs in the subbasin.

19.4 Overview of Opportunities

Opportunities for organizations to undertake nonpoint source phosphorus reductions are available throughout the subbasin. This overview includes a description of what BMPs are the most relevant and where the BMPs should be implemented. Where the BMPs should be implemented is specific to land uses.

19.4.1 Control Measures and BMPs

BMPs specific to land use type and source are described in detail in Chapter 8. The background included in Chapter 8 narrowed the list of BMPs from 108 to 22 based on phosphorus percent reduction efficiency, cost, estimated longevity, and implementation effectiveness. This list of BMPs, if implemented for the appropriate land uses, could result in substantial net nonpoint source reduction of phosphorus.

There are several organizations throughout the Pend Oreille Lake subbasin that can mitigate nonpoint source loads by incorporating BMPs. The agencies and organizations are encouraged to review the land and nonpoint phosphorus sources in their jurisdiction to further identify BMPs that are specific to their situation.

Organizations should examine areas within their influence to identify opportunities where these BMPs can be implemented to reduce nonpoint source phosphorus. These organizations should also examine their stormwater management practices and look for opportunities to implement BMPs since stormwater is a primary transport mechanism for nonpoint source phosphorus. Organizations identified in Tables 19-1 and 19-2 include private, municipal, state and federal entities. Associated opportunities for nonpoint source phosphorus reduction include:

- Private land owners may protect and restore riparian corridors; minimize stormwater runoff; and consider education, land evaluation, and/or aide available from the conservation organizations.
- Municipalities may install BMPs to treat and/or reduce stormwater discharge to water bodies; evaluate where stormwater is being discharged; and/or evaluate the pollutant loading by collecting samples for analysis.
- State and federal agencies should review activities occurring on the land, identify potential impacts, and implement applicable BMPs.

19.4.2 Land Uses and Source Potential

The NPS Reduction Plan is meant to provide guidance on where to take action, as actions are voluntary and not mandatory. The NPS Study was conducted at the watershed and subbasin scales and is limited in its guidance to actions at those scales. Actions by organizations are limited by their jurisdictions and authority. Organizations will need to examine local conditions to determine specifically where they choose to take action.

The NPS Reduction Plan analyses (Chapters 6 and 7) evaluated the dominant land uses and the phosphorus load potential for each subbasin. In some cases, the largest land use did not match

the largest phosphorus load reduction potential. The following land uses have the highest priority for the Pend Oreille Lake subbasin with respect to nonpoint source phosphorus loading:

- Evergreen Forest.
- Range.

The analytical evaluation results indicated that the highest nonpoint source phosphorus loading rates in the Pend Oreille Lake subbasin (see Chapter 7). These two sub-subbasins with the highest estimated loadings are Blanchard Creek (0.081 lbs/ac/yr) and Hoodoo Creek (0.081 lbs/ac/yr). These subareas should be considered as priority areas for action.

The Pend Oreille Lake subbasin is dominated by evergreen forest land and shrub and brush range land. These land uses also have the greatest phosphorus removal potential. Organizations are encouraged to take action in these high priority land use areas. These particular land uses represent the priority areas where nonpoint source phosphorus actions are necessary to achieve a significant net reduction. Organizations should examine areas they own or are within their influence, and look for opportunities to reduce nonpoint source phosphorus from the prioritized land uses. Organizations should also examine areas within their jurisdiction that are obvious areas for nonpoint source reduction opportunities.

19.4.3 Summary of Reduction Opportunities

BMPs have been prioritized first by their ability to remove nonpoint source phosphorus loads and then by land use type. The acres of land use by organization were computed and are tabulated in Table 19-3. The acres in Table 19-3 demonstrate how the land uses are distributed among the land owners and where the opportunities for reductions may exist.

The export coefficients summarized in Chapter 7, along with the land uses and areas, can be used to estimate potential nonpoint source phosphorus loads by organization. There is an associated range of reduction opportunities based on the potential to reduce phosphorus loads. These opportunities are presented in Table 19-4 by assigning a load reduction potential that ranges from low to high. The range is based on total phosphorus load; therefore, higher potential may be due to a greater export coefficient, the total land area, or a combination of both. Table 19-4 is intended to provide further guidance for considering and selecting BMPs for implementation.

Figure 19-2 shows land ownership with stream segments highlighted in areas of high potential for nonpoint source phosphorus reduction based on the land use and export coefficients. Stream segments are shown since the highest priority BMPs in this subbasin generally relate to stream or riparian corridors.

Table 19-3. Organizations Land Area by Land Use

Land Owners	Agriculture[1] (acres)	Forested[1] (acres)	Rangeland[1] (acres)	Urban / Suburban[1] (acres)	Other[1] (acres)
Private					
Private	728	97,097	17,288	2,998	1,614
Incorporated Municipalities[2]					
Athol	0	5	1	4	0
Spirit Lake	0	880	127	605	3
Local Governments[2]					
Bonner County	560	58,746	10,757	1,356	1,547
Kootenai County	19	35,271	4,882	1,790	1,778
Pend Oreille County	141	6,391	1,610	0	151
Spokane County	28	24,497	2,412	8	29
State Agencies					
Idaho Department of Fish and Game	0	1,324	54	9	1
Idaho Department of Lands	1	13,430	826	41	6
Idaho Department of Parks and Recreation	8	1,489	860	64	1
Washington State Department of Natural Resources	0	3,361	262	0	1
Washington State Parks and Recreation Commission	0	3,882	101	3	0
Federal Agencies					
U.S. Bureau of Land Management	0	510	24	0	0
U.S. Forest Service	0	3,487	102	34	27

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation.

[2] Incorporated municipalities and local governments is the total land area within boundaries.

Table 19-4. Organizations and Potential for Nonpoint Source Phosphorus Reduction

Land Owners	Agriculture[1]	Forested[1]	Rangeland[1]	Urban / Suburban[1]	Other[1]
Private					
Private	High	High	High	High-Mod.	Moderate
Incorporated Municipalities[2]					
Athol	n/a	Low	Low	Low	n/a
Spirit Lake	n/a	High-Mod.	Moderate	Moderate	Low-Mod.
Local Governments[2]					
Bonner County	High-Mod.	High	High	High-Mod.	Moderate
Kootenai County	Moderate	High	High-Mod.	High-Mod.	Moderate
Pend Oreille County	High-Mod.	High	High-Mod.	n/a	Low-Mod.
Spokane County	Moderate	High	High-Mod.	Low-Mod.	Low
Idaho Department of Fish and Game	n/a	High-Mod.	Low-Mod.	Low-Mod.	Low
Idaho Department of Lands	Low	High	Moderate	Low-Mod.	Low
Idaho Department of Parks and Recreation	Low-Mod.	High-Mod.	Moderate	Moderate	Low
Washington State Department of Natural Resources	n/a	High	Moderate	n/a	Low
Washington State Parks and Recreation Commission	n/a	High	Low-Mod.	Low	n/a
Federal Agencies					
U.S. Bureau of Land Management	n/a	Moderate	Low-Mod.	n/a	n/a
U.S. Forest Service	Low	High	Low-Mod.	Low-Mod.	Low

[1] Values shown calculated in GIS using 2001 USGS NLCD, 2010 BLM land ownership, 2009 TIGER county limits, 2011 city limits, 2005 National Atlas Federal and Indian boundaries, 2010 NHD, 2011 USGS transportation.

[2] Incorporated municipalities and local governments is the total land area within boundaries.

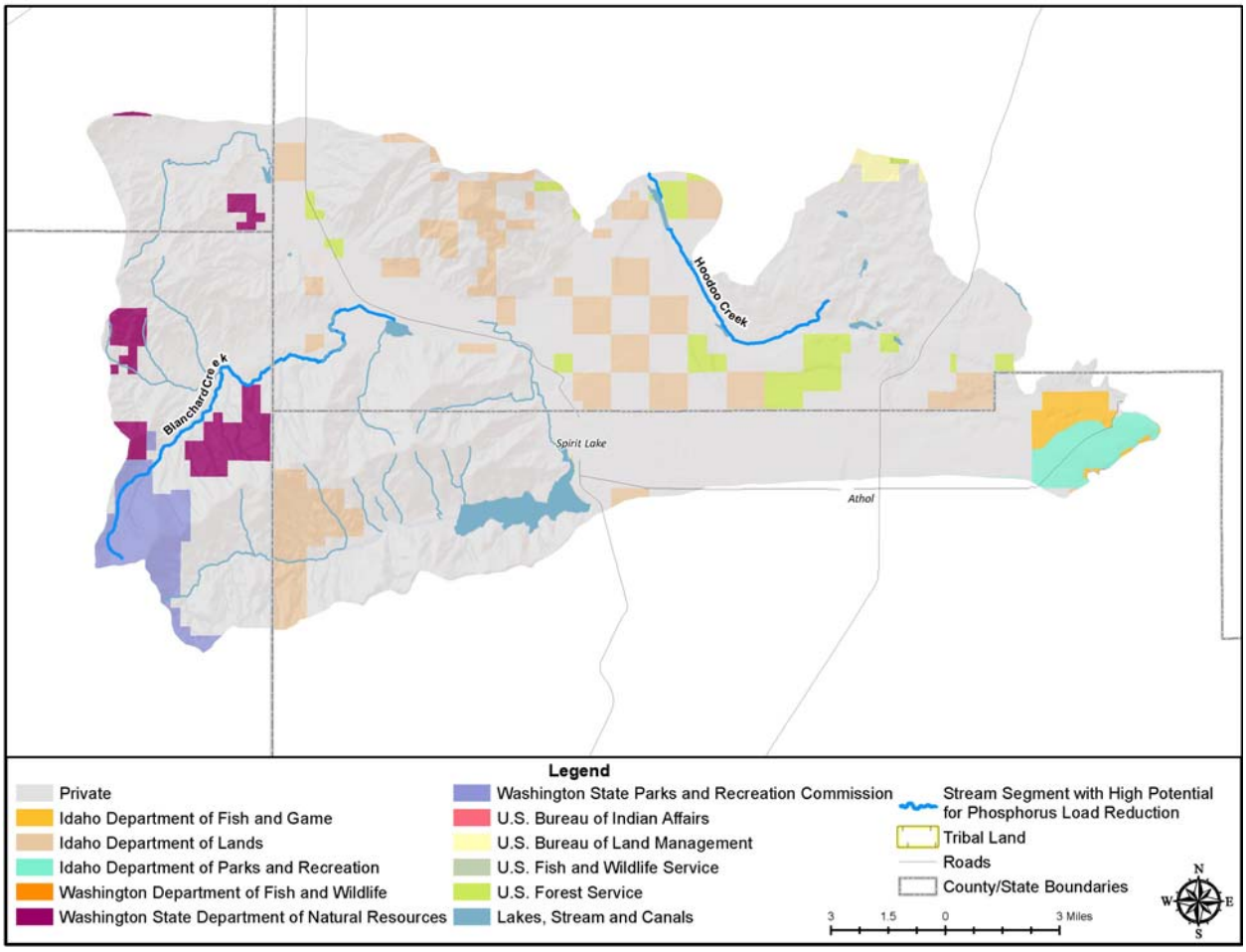

Figure 19-2. Pend Oreille Lake Subbasin High Potential Reduction Opportunities

19.5 Specific Actions by Category

This section includes a list of specific actions to reduce nonpoint source phosphorus loads and ultimately contribute to meeting water quality standards. A general description of each action, an activity summary, potential phosphorus load reduction, a range of costs, potential timelines, and the potential lead entity are provided for each action. Although it was not a primary objective of the NPS Study to specify "who" implements phosphorus control measures, potential lead organizations are identified for some actions to help provide linkage to the "what" and "where" objectives of the NPS Study. The lead organization will need to assist local entities in developing detailed plans for the activities, as well as a schedule and plan for monitoring progress. When the information was available, the action also includes a description of the roles of the organization with responsibility to improve water quality, and the means through which the organization will address the water quality issues.

19.5.1 High Priority BMPs

The analysis provided in Chapter 8 described the following BMPs as having the highest priority for the Pend Oreille Lake subbasin:

- Streamside Management Zones.
- Riparian Zones and Buffer Strips.
- Stream Bank Stabilization.

Specific details regarding implementation of these high priority BMPs are provided in Chapter 9. These BMPs are appropriate for implementation for land uses in the subbasin. The following sections summarize actions appropriate for the specific land uses within the Pend Oreille Lake subbasin.

19.5.2 Regional Phosphorus Management

Regional phosphorus control strategies are not specific to any one land use type or organization, and may contribute to the reduction of nonpoint source phosphorus loadings in the subbasin. Descriptions of the regional or watershed-scale phosphorus management actions intended to facilitate load reductions and/or establish the technical foundation for further phosphorus control activities are described in Chapter 9.

19.5.3 Agriculture Related Activities

Since less than 1 percent of the subbasin land use is being used for agriculture, opportunities for phosphorus loading reduction within subbasin agricultural lands are minor. As such, no specific agriculture actions are presented. Public education and outreach programs under the regional phosphorus management strategy will likely support agriculture BMPs throughout the subbasin.

19.5.4 Forestry Related Activities

BMPs related to forestry practices can reduce nonpoint source phosphorus. While phosphorus export forestry in general is low, local areas of intensive use can have higher phosphorus export rates. Since the Pend Oreille Lake subbasin is mostly forested, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing erosion, reducing sediment transport, protecting and maintaining riparian corridors and streamside management zones.

PDO-FR-1 Evaluate Forestry Practices

Idaho's forest practices regulations will be relied upon to reduce nonpoint source phosphorus loads from private and state forestlands. Ongoing practices should be reviewed by or as directed by the lead organization for compliance. If compliance with the existing regulations is not resulting in sufficient reduction, then more effective methods need to be promoted. Poorly performing practices need to be researched for the causes and potentially modified to improve the outcomes.

With large quantities of adjacent forested land, tributary water quality is likely affected by forest management practices. Logging and road building practices that have been common throughout the intermountain region from the late nineteenth century through most of the twentieth century have likely contributed to the degradation of water quality. In more recent times, implementation of more environmentally sound forest management practices has occurred. These practices may

have reduced forestry-related phosphorus loading within the subbasin but additional reductions are still possible.

The Idaho Forest Practices Act (IDAPA 20.02.01) defines the minimum level of best management practices (BMPs) required to be implemented for commercial timber lands in Idaho. It is anticipated that the new road maintenance and abandonment plans required by the current forest practices rules will slowly reduce phosphorus export from harvested forests.

The agencies have data on forest health, ecology, harvest areas, vegetation types, soil conditions and more. This information can be useful for identifying areas of greater nonpoint source phosphorus loading. However, much of this data is not readily available or in a format that can be interpreted by water quality managers. Coordination between forest and water quality managers is necessary to understand the data and select management activities.

Activity: Enforce existing regulations, evaluate existing practices, discourage poorly performing practices, and encourage best performing practices and improve coordination of sharing information.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

PDO-FR-2 Quantify Sediment-Phosphorus Relationship in Forested Areas

Quantifying phosphorus loading associated with forest management practices may provide additional information that support selection of successful BMPs. The construction and use of roadways represent a major source of sediment from timber harvest activities (DEQ, 2000). A study to quantify the relationship between sediment associated with phosphorus in runoff from these roads can help determine whether additional measures should be undertaken.

Activity: Quantify relationship between sediment and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

PDO-FR-3 Subbasin Scale Road Planning and Rehabilitation

Conduct a subbasin-scale management survey to inventory ownership and identify and prioritize the total miles of erodible roads and road banks. Specific BMPs may then be developed based on survey results to reduce miles of erodible roads associated with road construction, road conversions, and maintenance. A database of roads with tracking of BMP implementation is essential for determining success and accountability. Reduction plans should identify opportunities to abandon non-essential roads or restore roads on non-industrial forest lands and other county roads that contribute obvious erosion problems.

Activity: Quantify relationship between roads and phosphorus in forested areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.

Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

PDO-FR-4 Fire Rehabilitation Areas

Wild fires can significantly impact the landscape. Research has shown increased concentrations of suspended sediments, phosphorus, and potassium in streams below burned areas (Stednick, et al., 1982). Stream monitoring indicated an immediate flush of phosphorus in the runoff, followed by a slower release. Rehabilitation of burn areas, especially the riparian corridors to protect streams, will be important to reducing nonpoint source phosphorus in forested areas. The fire history from 2001 through 2010 suggests approximately 200 acres in the subbasin to have been burned and should be evaluated.

Activity: Identify and assist with rehabilitation of burned areas.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

19.5.5 Range Related Activities

BMPs related to rangeland practices can reduce nonpoint source phosphorus. Since range, shrub and brush land is the second largest percentage of land uses in the Pend Oreille Lake subbasin, reductions in nonpoint source phosphorus will be important to achieve overall changes to water quality. BMPs under this category are typically associated with minimizing disturbance of range land, protecting and maintaining riparian zones and maintaining or stabilizing stream banks.

PDO-RR-1 Evaluate Rangeland Practices

The state's regulations will be relied upon to reduce nonpoint source phosphorus loads from rangelands. Evaluate past and present impacts and review ongoing practices for compliance. The goal of evaluating past and present activities is to manage rangeland to maintain optimum soil and water quality. If compliance with the existing regulations is not resulting in sufficient nonpoint source phosphorus reduction, then more effective methods should be identified and promoted.

Activity: Evaluate existing practices, enforce existing regulations, and encourage BMPs.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

19.5.6 Urban/Suburban Related Activities

Urban/suburban areas can have the most variable impacts on nonpoint source phosphorus loading due to the diversity of development, uses, and control of stormwater runoff. BMPs under this category are typically associated with minimization of pollution sources and the

management of stormwater. Approximately three percent of the total land use in the Lake Pend Oreille Subbasin is considered residential, commercial, or urban.

PDO-UR-1 Evaluate and Analyze Impervious Surfaces and Implement Stormwater BMPs

Impervious surfaces throughout the Pend Oreille Lake subbasin are a source of stormwater runoff. Within the subbasin, stormwater runoff enters both surface water and groundwater via infiltration. An understanding of the area and location of the impervious surfaces in the subbasin will guide the need and responsibility for implementation.

Dye tracing of stormwater from drains to outfalls can be helpful to determine where the flows discharge and potential additional BMPs at the discharge location. Around Liberty Lake, Washington, for example, two drains were dye tested, found to discharge to the lake, and subsequently modified with the installation of bio-infiltration systems to provide treatment (Hamlin, 2010).

Activity: Evaluate and quantify existing impervious surfaces, identify areas where vegetated buffer/filter strips or other applicable stormwater BMPs (see Chapter 8) could be installed, and encourage installation.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

PDO-UR-2 Evaluate and Revise Stormwater Policies

Less than one percent of the subbasin is within municipal boundaries. However, there is abundance dispersed residences. This action consists of a review of stormwater regulations of municipalities for water quality requirements. Municipalities have unique policies; however, working towards incorporating at least some minimum water quality requirements that address nonpoint source pollution including phosphorus across the watershed will provide some reduction in loads. Resources to consider include the following:

- DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005).
- Idaho Department of Transportation's (DOT) Erosion & Sediment Control—Best Management Practices Manual (Idaho DOT, 2011).
- DEQ's Compendium of Best Management Practices to Control Polluted Runoff, A Source Book (Metl and Maquire, 2003).
- The Spokane Regional Stormwater Manual (Spokane County et. al, 2008).

Consider holding a subbasin or watershed summit to evaluate and identify policies, and evaluate and determine areas throughout the Pend Oreille Lake subbasin for implementation and enforcement of the requirements. Keep in mind that some developed areas outside municipal jurisdictions should be considered.

Activity: Coordinate on minimum water quality stormwater treatment policies and requirements.

Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

PDO-UR-3 Develop a Small Community Program for Phosphorus Loading Reduction

Small communities within the Pend Oreille Lake subbasin include Blanchard, Spirit Lake, and Athol. These communities have a unique set of associated phosphorus loading mechanisms that, in many cases, are not specifically targeted by existing guidelines and regulation. A number of the small communities within the Pend Oreille Lake subbasin overly or drain to the SVRP Aquifer. Because of anticipated limited treatment capacity in coarse-grained soils overlying the SVRP Aquifer, phosphorus loading from these areas could impact subbasin groundwater and surface water.

The intent of this action is to develop a program to assist smaller communities to develop the tools they need to reduce phosphorus loading. This program could include generation of guidance documents and/or ordinances. Components of the program could include the following:

- Community outreach and education.
- Training programs targeted at local government officials and managers.
- Retrofit of existing stormwater management structures to comply with guidelines described in Action PDO-UR-4.
- Management and education intended to reduce of impact of pet waste on water quality.
- Septic system elimination (if applicable) per Action PDO-UR-6 and inspection/pumping per Action PDO-UR-7.
- Recommendation or requirement for use of phosphorus-free fertilizer, per Action PDO-AA-2.
- Recommendation to retain grass clippings/leaves on lawns or as properly-disposed of solid waste, rather than within runoff.

This action will also include guidance and/or requirements for LID practices in construction and stormwater management. LID practices that could be applicable to the Pend Oreille Lake subbasin are presented in detail in Volume 3 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005). Described LID practices include:

- Clearing and grading practices.
- Use of aquatic buffers and preservation of natural hydrologic function.
- Impervious area practices.
- Green roofs and parking lots.
- Pervious pavement.
- Soil amendments and restoration.

- Rainwater harvesting and reuse.
- Created wetlands.

Activity: Develop a Small Community Program for Phosphorus Loading Reduction to assist smaller communities in developing the tools they need to reduce phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County or other municipalities.

PDO-UR-4 Strengthen Requirements for Stormwater Treatment BMPs in Key Areas

Stormwater treatment BMPs, such as bio-infiltration swales, bio-infiltration channels, vegetated buffer strips and infiltration basins are particularly important within the Pend Oreille Lake subbasin because: 1) development frequently occurs above coarse-grained soils with limited treatment capacity; 2) a portion of the subbasin within Idaho directly overlies the sole-source SVRP Aquifer, which is designated as the only Sensitive Resource Aquifer within the State of Idaho; and 3) much of the forested upland area surrounding within the subbasins drains to and infiltrates to the SVRP Aquifer.

Under Idaho's groundwater quality rule, activities with the potential to degrade Sensitive Resource Aquifers shall be managed in a manner which maintains or improves existing ground water quality through the use of BMPs and best available methods (IDAPA 58.01.11). Volume 4 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005) provides a list and description of permanent stormwater BMPs designed to control stormwater based contaminant loading. These include BMPs that treat stormwater through filtration, infiltration and/or detention.

Implementation of this action would strengthen requirements regarding implementation of the stormwater treatment BMPs listed in this section. These requirements could include developed and redeveloped commercial, industrial and residential properties within the following key areas:

- Within Sensitive Resource Aquifer boundaries.
- Within 1,000 feet of subbasin lakes (Spirit Lake, Blanchard Lake, and Hoodoo Lake, among others).

This action also could include guidelines regarding BMP maintenance. Stormwater systems that are properly operated and maintained function better and reduce maintenance costs and liability problems. Volume 4 of DEQ's Catalog of Stormwater Best Management Practices for Idaho Cities and Counties (DEQ, 2005) provides information on properly operating and maintaining stormwater systems for residential, commercial, or industrial developments. DEQ (2005) also include inspection and maintenance forms that prompt the user to identify problems that commonly occur with various stormwater control BMPs and provide recommendations for maintenance. BMPs are also described below in the 'Install BMP' (see PDO-UR-4a through 4d).

Activity: Implement rigorous stormwater BMP requirements in key portions of subbasin.

Potential Phosphorus Load Reduction: Varies depending on BMP – refer to PDO-UR-4a through PDO-UR-4d.
Range of Cost: Varies depending on BMP – refer to PDO-UR-4a through PDO-UR-4d.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County, City of Post Falls, City of Coeur d'Alene.

PDO-UR-4a Install Grassed Bio-Infiltration Swales

To implement this BMP, stormwater runoff is directed to a grassed swale where vegetative cover provides pretreatment of stormwater before infiltration to the subsurface. Infiltration occurs either through the swale or within drywells that receive stormwater once the swale is filled to a design overflow elevation. The area surrounding the drywell and underlying the swale should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone.

Specific details regarding bio-infiltration swale design and construction within the Pend Oreille Lake subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: Grassed swales have a wide range of potential phosphorus removal efficiencies from 20 to 61 percent (Miller, 1987) to 29 to 99 percent (Yu et al., 2001).
Range of Cost: No specific quantitative information regarding the cost of grassed bio-infiltration swales was found during the project review. However, based on BMP characteristics, costs are expected to be moderate to high with respect to the other BMPs described in this plan.

PDO-UR-4b Install Bio-Infiltration Channels

To implement this stormwater treatment BMP, stormwater runoff is directed to a bio-infiltration channel underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). A bio-infiltration channel is a sloped, vegetated channel or ditch that both conveys and treats stormwater runoff. It does not provide flow control but can convey runoff to facilities designed for that purpose (Spokane County et al., 2008). A bio-infiltration channel provides treatment as stormwater flows through vegetative cover and/or infiltrates. Channel flow can be directed to a pond or other facility. Infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Specific details regarding bio-infiltration channel and construction (also termed infiltration channels) within the Pend Oreille Lake subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of bio-infiltration channels was found during planning. However, infiltration trenches and basins have a wide range of potential phosphorus removal efficiencies of 10 to 80 percent (EPA, 1999).
Range of Cost: No specific quantitative information regarding the cost of bio-infiltration channels was found during planning.

PDO-UR-4c Install Vegetated Buffer Strips

Stormwater runoff is directed via sheet flow to a vegetated buffer strip situated adjacent to a rural roadway or parking lot. Vegetative cover within the buffer strip provides pretreatment of stormwater before infiltration to the subsurface, and/or evaporation. Vegetated buffer strips are used to intercept overland sheet flow runoff from adjacent impervious areas. They slow runoff velocities, filter out sediment and other pollutants, and provide infiltration into underlying soils. When buffer strips are used for infiltration, the area underlying the buffer strip should contain an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity. This requires soils with a sufficiently high permeability to allow for relatively rapid infiltration but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies. The system removes phosphorus from stormwater through filtering/sorption in vegetative cover and native soils comprising the infiltration site's unsaturated zone. Specific details regarding vegetated buffer strip design and construction within the Pend Oreille Lake subbasin are provided by DEQ (2005).

Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness or cost of vegetated buffer strips was found during the project review. However, vegetated filter strips have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999).
Range of Cost: Grass filter strips have low phosphorus removal costs of $190 to $250 per pound (Sera-17, 2010).

PDO-UR-4d Infiltration Areas/Bioretention Basins

Stormwater runoff is directed to an infiltration area underlain by an unsaturated zone that has an appropriate balance of treatment capacity and infiltration capacity (EPA, 1999). The infiltration area can be equipped with a drainfield constructed of perforated pipe to facilitate infiltration. A suitable site requires soils with a sufficiently high permeability to allow for relatively rapid infiltration, but containing sufficient fine-grained particles to filter infiltrating stormwater and provide sorption sites to bind infiltrating contaminants. After treatment in the unsaturated zone, infiltrated stormwater migrates to the groundwater table where it is transported downgradient and ultimately contributes to baseflow within downgradient surface water bodies.

Spokane County and the City of Spokane have recently constructed/enhanced a number of regional stormwater infiltration facilities for the purpose of managing stormwater runoff in areas with difficult infiltration conditions on a site-specific level. When these facilities are located over

relatively thick glaciofluvial sand and gravel sequences, benefit of water quality treatment may be limited. Examples include: Hazel's Creek Drainage and Conservation Facility (City of Spokane), Browne's Mountain Regional Stormwater Facility (Spokane County), and Price and Wall Regional Stormwater Facility (Spokane County).

DEQ (2005) provides guidance regarding bio-infiltration basins, which have similar design and operational elements.

Potential Phosphorus Load Reduction: Infiltration basins have moderate to high phosphorus removal efficiencies of 50 to 80 percent (EPA, 1999),
Range of Cost: Infiltration structures generally have high phosphorus removal costs of $2,500 to $3,000 per pound (Corrozi, 2009).

PDO-UR-5 Evaluate Phosphorus Load from Septic Tanks near Blanchard and Other Densely Developed Areas

While there is historical literature that suggests septic systems and subsequent treatment in the unsaturated zone provides phosphorus removal from effluent, recent and emerging evidence indicates the contrary in many locations. Both the current science and measured groundwater concentrations of phosphorus clearly indicate that septic systems release significant phosphorus loads into underlying groundwater and that phosphorus loading can increase with time as a result of the loading of sorption sites in the unsaturated zone. Moreover, the shallow hydrostratigraphy of many areas within the Pend Oreille Lake subbasin consists of bedrock and/or coarse sediments, which have relatively little phosphorus removal capacity.

Removing septic systems and replacing with sewers involves considerable cost. Therefore, the reduction in phosphorus loading associated with septic tank removal within key densely developed areas that are outside of sewer service areas should be conducted as a basis for future management decisions. Septic system density within the Pend Oreille Lake subbasin is summarized (for the Kootenai and Spokane County portions) in Figure 4-6. The areas that should be considered include but are not limited to the following:

- Densely developed areas near Blanchard, Idaho.
- Residential areas between Spirit Lake and Athol, Idaho.

Particular emphasis with regard to the analysis of the extent and mitigation of septic tank loading (Actions PDO-UR-5 and PDO-UR-6) could be considered above Sensitive Resource Aquifers such as the SVRP Aquifer.

Activity: Evaluate phosphorus load from septic tanks within densely developed areas as a basis for future management decisions.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County or other municipalities.

PDO-UR-6 Septic Tank Elimination within Key Areas

Removal of septic systems by connecting to sewer systems eliminates a source of pollution to surface and groundwater. Wastes are treated more thoroughly and phosphorus removal is more complete at a wastewater treatment facility designed for phosphorus removal than is possible with a septic system. For these reasons, septic tank elimination is an important long-term management approach to controlling nonpoint source phosphorus loading.

Septic tank elimination programs should be based on results of PDO-UR-5, which will assist in identification of specific areas where infrastructure investment will lead to relatively large phosphorus loading reductions.

Activity: Remove septic systems and replace with sanitary sewer in key areas of the Pend Oreille Lake subbasin.
Potential Phosphorus Load Reduction: No specific quantitative information regarding the effectiveness of septic tank elimination was found during planning. However, based on the phosphorus removal characteristics of area wastewater facilities and that septic tank discharges are completely eliminated during removal, the expected effectiveness is very high.
Range of Cost: No specific quantitative information regarding the cost of septic tank elimination was found during planning. Potential costs may range from low to high with respect to the other BMPs described in this plan.
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County.

PDO-UR-7 Inspection and Pumping of Septic Systems within Key Areas

Regular inspection and pumping of septic systems prolongs the life of the system, reduces maintenance costs and contamination around the drain field, and slows the breakthrough of phosphorus to groundwater. The priority systems to target are older systems and systems near streams and areas with a high groundwater table. The septic tank should be pumped by a licensed septage waste-hauler on a regular basis and septage properly disposed of in an approved site or wastewater treatment facility.

Septic system inspection and pumping can be performed throughout the subbasin to achieve nonpoint source loading reduction to area surface water. However, it will have greatest positive impact within nearshore areas and with septic system overlying coarse soil and/or bedrock with minimal phosphorus treatment capacity. Areas to consider include:

- Within Sensitive Resource Aquifer boundaries.
- Within 1,000 feet of subbasin lakes (Spirit Lake, Blanchard Lake, and Hoodoo Lake, among others).

Activity: Require regular inspection and pumping of septic systems on a standard interval. The interval should vary as a function of septic tank size and persons per household to achieve acceptable retention times. Standard matrices are available for these requirements.
Potential Phosphorus Load Reduction: Inspection and pumping of septic systems has low to moderate phosphorus removal efficiencies of 40 to 55 percent (DDNR, 2010).

Range of Cost: Inspection and pumping of septic systems has very low phosphorus removal costs of $7 to $25 per pound (DDNR, 2010).
Potential Timeline: TBD by Potential Lead.
Potential Lead: Kootenai County.

19.5.7 Supporting Phosphorus Reduction Activities

Supporting activities to be undertaken as part of this NPS Reduction Plan will provide valuable information for long-term success, in addition to subbasin-specific actions and BMPs designed to provide direct phosphorus reduction. These activities are described in Chapter 9.

19.5.8 Additional Activities

Additional activities include indirect actions that either lead to overall improvements in ecological functions and thus water quality or provide additional insights into the overall health and conditions of the watershed. Activities are described in Chapter 9. Additional activities in the Pend Oreille Lake subbasin include the coordination of activities on Lake Spokane, nearshore, and upstream activities.

PDO-AA-1 Recommended TMDL and Managed Implementation Plan Actions

The Spokane River DO TMDL and associated Managed Implementation Plan (Ecology, 2010) recognized that nonpoint source pollution contributes to the low oxygen condition in the Spokane River and Lake Spokane. Specific activities are identified that support overall watershed health and improvements in water quality. These actions align with the phosphorus nonpoint source reduction activities and are encouraged to be carried out.

Activity: Implement actions in the Spokane River DO TMDL and associated Managed Implementation Plan.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

PDO-AA-2 Evaluate, Protect and Enhance Nearshore Areas

Nearshore land management and activities have the potential to impact phosphorus loads to surface water. Within the Pend Oreille Lake subbasin, these activities apply to areas nearshore to Blanchard, Kelso, Granite, and Spirit lakes which discharge in part or fully to the SVRP Aquifer. Nearshore sources may transport phosphorus loads via surface water, stormwater runoff, interflow, and groundwater. Unlike activities and BMPs implemented upstream, there is no attenuation of phosphorus loads associated with nearshore sources. Therefore, reduction of loads from nearshore areas is important and should be considered as part of the overall nonpoint source phosphorus load reduction strategy. Nearshore areas should be inventoried to identify areas where BMPs should be implemented. BMPs that should be considered for nearshore areas include, but are not limited to:

- Erosion control and bank stabilization.

- Filter strips.
- Septic tank elimination.
- Inspection and pumping of septic systems.
- Phosphate lawn fertilizer ban.
- Riparian fencing, riparian zones and buffer strips.
- Education and outreach to nearshore property owners.

Additional detail regarding these BMPs is provided in Chapter 8.

Activity: Evaluate nearshore areas of the lakes and tributaries within the Pend Oreille Lake subbasin and implement activities and BMPs to reduce nonpoint source phosphorus loading.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

19.5.9 Support Existing and Planned Activities

The NPS Reduction Plan supports existing water resources and water quality studies and planning. Protection of these resources also supports the reduction phosphorus nonpoint sources. Critical planned activities specific to the NPS Reduction Plan are identified below.

PDO-EP-1 Support and Enforce Ordinances that Protect Shorelines and Prevent Erosion

Counties within the Pend Oreille Lake subbasin have local requirements that regulate shoreline use and modification activities. Each set of requirements are unique. For example:

- Kootenai County's Site Disturbance Ordinance purpose is to protect property, surface water, and ground water against significant adverse effects from excavation, filling, clearing, unstable earthworks, soil erosion, sedimentation, and stormwater runoff.
- Bonner County Code that includes shoreline standards that regulate shoreline setbacks, fence restrictions near water, impervious surface standards near water and shoreline vegetative buffers.
- Pend Oreille County Shoreline Master Program.
- Spokane County Shoreline Management Program.

These requirements relate to nonpoint source phosphorus reduction by protecting and enhancing shorelines and preventing erosion.

Activity: Support and enforce city and county ordinances (Ord.), that achieve nonpoint source phosphorus load reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

PDO-EP-2 Support, Compliment and Enforce Permits, Ordinances, Plans and Activities Relating to Nonpoint Source Phosphorus Reduction

There are a variety of permits, ordinances, plans and activities within the Pend Oreille Lake subbasin that relate to nonpoint source phosphorus reduction, including:

- Bonner County ban of commercial sale of household cleaning products containing more than a trace level of phosphorus (Ord. 187, 4-10-1989).
- Bonner County Code requirements for grading, stormwater management and erosion control; wetlands delineation, buffers and setbacks; flood damage prevention and restrictions on development in flood hazard areas; and, requirements for development on hillsides to prevent slope slippage.
- Kootenai County ordinances relating to flood damage prevention.
- Pend Oreille County Development Regulations relating to environmental review, environmentally sensitive areas, and forest practices.
- Spokane County Critical Areas Ordinance, Stormwater Management Guidelines.
- Spokane County Code requirements relating to timber harvest and flood damage protection.
- Spokane County Conservation District Natural Resource Conservation Plans.
- Spokane River Forum education efforts.

When taking actions and implementing BMPs to reduce nonpoint source phosphorus, consider these and other related plans, goals, requirements and efforts to optimize reduction potential. Review that erosion control BMPs are followed at land development projects and construction sites.

Activity: Support, compliment and enforce permits, ordinances, plans and activities to achieve nonpoint source phosphorus reduction.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

PDO-EP-3 Support Existing TMDLs and Management Plans

Support existing TMDLs and management plans in the Pend Oreille Lake subbasin including the following:

- Spirit Lake Watershed Management Plan.
- Pend Oreille Lake Nearshore Nutrient TMDL Implementation Plan (Pend Oreille Lake Planning Team, 2004).
- Implementation Plan for Cocolalla Lake, Cocolalla Creek, and Hoodoo Creek (DEQ, 2004).
- Pend Oreille Lake Tributaries Temperature TMDLs (DEQ, 2007b).

When taking actions and implementing BMPs to reduce nonpoint source phosphorus, consider these and other related plans, goals, requirements and efforts to optimize reduction potential.

Activity: Support existing TMDLs and Management Plans including evaluation of management actions, updating plans, and coordination of recommended activities.
Potential Phosphorus Load Reduction: TBD by Potential Lead.
Range of Cost: TBD by Potential Lead.
Potential Timeline: TBD by Potential Lead.
Potential Lead: TBD.

Chapter 20

Implementation Considerations

20.1 Introduction

This chapter describes other considerations of the NPS Reduction Plan that will assist in successful changes in water quality as a result of the actions in Chapters 9 through 19. Other considerations include:

- Potential Funding Sources.
- Measuring Progress.
- Adaptive Management.

20.2 Potential Funding Sources

There are many funding sources available for nonpoint source pollution management, watershed planning and implementation, fish and wildlife habitat enhancement, stream restoration, and education. Public sources of funding include federal and state government programs, which can offer financial as well as technical assistance. Private sources of funding include private foundations, which most often fund nonprofit organizations with tax-exempt status. Forming partnerships with other government agencies, nonprofit organizations, and private businesses can often be the most effective approach to maximize funding opportunities.

The U.S. Department of Natural Resources Conservation Service (NRCS) and the U.S. Department of Agriculture Farm Service Agency (FSA) administer federal non-regulatory programs with funding available in Idaho and Washington. Their programs include:

- Conservation Reserve Program.
- Environmental Quality Incentives Program.
- Wildlife Habitat Incentives Program.
- Grassland Reserve Program.
- Wetlands Reserve Program.
- Conservation Stewardship Program.
- Emergency Watershed Protection.

Potential water quality funding sources available in Idaho include:

- Idaho NRCS Agricultural Water Enhancement Program.
- Idaho NRCS Small Watershed Program.
- Idaho NRCS Environmental Quality Incentives Program.
- Idaho NRCS Conservation Stewardship Program.
- DEQ NPS Management 319 Subgrants.

Potential funding sources available in Washington through Ecology's water quality financial assistance programs include:

- Centennial Clean Water Fund grants.
- Section 319 grants for nonpoint source reductions.
- State Revolving Fund loans.
- Watershed Planning.
- 319 Direct Implementation Fund.

Financial assistance for wastewater and stormwater projects in the Spokane River Watershed could be available through the following organizations:

- USDA Rural Development.
- State Departments of Health.
- State Departments of Transportation.
- Washington State Conservation Commission.
- Washington State Department of Community, Trade and Economic Development.
- Washington State Department of Commerce Public Works Board.
- DEQ's Water Pollution Control State Revolving Loan Fund.

Other funding sources that may be available to some groups in the Spokane River Watershed are the Conservation Districts, state conservation commissions, the Agriculture Watershed Enhancement Program, the Housing Rehabilitation Loan Program, the Salmon Recovery Funding Board Aquatic Land Enhancement Account, the Bonneville Power Administration and the Bonneville Power Foundation.

A summary of a number of these possible funding sources are provided in Table 20-1.

Table 20-1. Possible Funding Sources to Support Nonpoint Source Pollution Management

Organization	Funding Source	Uses of Funds	Geographic Restrictions
NRCS/FSA	Environmental Quality Incentive Program http://www.nrcs.usda.gov/programs/eqip/	Voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals; includes cost-share funds for farm BMPs.	None
	Emergency Watershed Protection http://www.nrcs.usda.gov/programs/ewp/index.html	NRCS purchases land vulnerable to flooding to ease flooding impacts.	None
	Wetland Reserve Program http://www.wa.nrcs.usda.gov/programs/wrp/wrp.html	Landowners may receive incentives to enhance wetlands in exchange for retiring marginal agricultural land.	None
	Conservation Reserve Program http://www.nrcs.usda.gov/programs/crp/	Provides technical and financial assistance to eligible farmers and ranchers to address soil, water, and related natural resource concerns on their land.	None
	Wildlife Habitat Incentives Program http://www.nrcs.usda.gov/programs/whip/	Assists conservation-minded landowners who want to develop and improve wildlife habitat on agricultural land, nonindustrial private forest land, and Tribal land.	None
	Grassland Reserve Program http://www.nrcs.usda.gov/programs/grp/	Voluntary conservation program that emphasizes support for working grazing operations, enhancement of plant and animal biodiversity, and protection of grassland under threat of conversion to other uses.	None
	Conservation Stewardship Program http://www.nrcs.usda.gov/programs/new_csp/csp.html	Voluntary conservation program that encourages producers to address resource concerns in a comprehensive manner by: 1) undertaking additional conservation activities; and 2) improving, maintaining, and managing existing conservation activities.	None

Organization	Funding Source	Uses of Funds	Geographic Restrictions
Ecology, Water Quality Program	Centennial Clean Water Fund http://www.ecy.wa.gov/programs/wq/funding/funding.html	Provides grants for water quality infrastructure and nonpoint source pollution projects to improve and protect water quality. Eligible nonpoint projects include stream restoration and buffers, on-site septic repair and replacement, education and outreach, and other eligible nonpoint activities.	Washington
	Section 319 http://www.ecy.wa.gov/programs/wq/funding/funding.html	Provides grants to eligible nonpoint source pollution control projects similar to the state Centennial program.	Washington
	State Revolving Fund http://www.ecy.wa.gov/programs/wq/funding/funding.html	Provides low interest and forgivable principal loan funding for wastewater treatment construction projects, eligible nonpoint source pollution control projects, and eligible Green projects.	Washington
	Watershed Planning http://www.ecy.wa.gov/programs/wq/funding/funding.html	Provides grants to watershed planning groups, their lead agencies or other local governmental entities within one or more Water Resource Inventory Areas (WRIAs) for managing water resources and for protecting existing water rights.	Washington
Washington State Conservation Commission	Water Quality Implementation Grants Program http://www.scc.wa.gov/index.php/Water-Quality-Implementation/Water-Quality-Implementation-Grants-Summary-2007.html	A partnership between the Conservation Commission and Washington State's 47 Conservation Districts that promotes and supports local water quality protection efforts to conduct outreach activities, provide technical and financial assistance to landowners for implementation of best management practices, participate in watershed planning, and coordinate water quality monitoring activities.	Washington
Washington State Department of Transportation	Transportation Enhancement Program http://www.wsdot.wa.gov/LocalPrograms/ProgramMgmt/TransEnhancement.htm	Funds community based projects that improve the cultural, historic, aesthetic and environmental aspects of the transportation infrastructure. Includes environmental mitigation to address water pollution due to highway runoff.	Washington

Organization	Funding Source	Uses of Funds	Geographic Restrictions
Idaho NRCS	Idaho Agricultural Water Enhancement Program http://www.id.nrcs.usda.gov/programs/awep/index.html	A voluntary conservation initiative that provides financial and technical assistance to agricultural producers to implement agricultural water enhancement activities on agricultural land for the purposes of conserving surface and ground water and improving water quality.	Idaho
	Idaho Small Watershed Program http://www.id.nrcs.usda.gov/technical/small_watershed.html	Provides technical and financial assistance to local organizations for planning and carrying out watershed projects that help solve natural resource and related economic problems in a specific watershed. Project purposes include watershed protection, flood prevention, erosion and sediment control, water supply, water quality, fish and wildlife habitat enhancement, and wetlands creation.	Idaho
	Idaho Environmental Quality Incentives Program (EQIP) http://www.id.nrcs.usda.gov/programs/eqip/2005/eqip_sp_proj_05.html	A voluntary conservation program that supports production agriculture and environmental quality as compatible goals. Through EQIP, farmers may receive financial and technical help to adopt land management practices, such as nutrient management, manure management, pasture management and wildlife habitat management.	Idaho
	Idaho Conservation Stewardship Program http://www.id.nrcs.usda.gov/programs/new_csp/	A voluntary program that pays participants for conservation performance. The program encourages agricultural and forestry producers to address resource concerns by improving and maintaining existing conservation activities and undertaking additional conservation activities.	Idaho

Organization	Funding Source	Uses of Funds	Geographic Restrictions
DEQ	NPS Management 319 Subgrants http://www.deq.idaho.gov/water/prog_issues/surface_water/nonpoint.cfm#management	A grant program supporting a wide variety of nonpoint source and focusing on improving the water quality of lakes, streams, rivers, and aquifers. Funds may be used to address a variety of nonpoint source management and prevention activities in the areas of agriculture, urban storm water runoff, transportation, silviculture/forestry, mining, ground water activities, and hydrologic and habitat modification and related activities.	Idaho
	Water Pollution Control State Revolving Loan Fund http://www.deq.idaho.gov/water/assist_business/pwws/construction_loans.cfm	Provides below-market-rate interest loans to help build new or repair existing wastewater treatment facilities and to address nonpoint source pollution control activities. Eligible nonpoint source activities include projects such as effluent trading, upgrading or replacing individual septic tanks, restoring wetlands, treating and controlling stormwater, and dealing with agricultural runoff.	Idaho

20.3 Measuring Progress

This section summarizes mechanisms that can be used to measure whether nonpoint source reduction activities have been completed and if interim targets and water quality standards are being met. Tracking performance measures that provide information on the following will be useful to understanding changes in water quality and selecting future actions.

- What activities have been performed and where.
- What practices should be considered for adaptive management, if necessary (see section 20.4).
- Whether reduction activities have been adequate to meet watershed objectives and/or water quality standards.

Progress may be measured by: 1) direct measurement of water quality and comparison to performance targets; 2) assessment of the number, content and effectiveness of implementation projects completed; and 3) monitoring of individual BMP performance.

20.3.1 Performance Monitoring and Targets

Monitoring of watershed water quality and comparison with both previous data and performance targets provides a direct measurement of the progress of the Nonpoint Source Reduction Program.

20.3.1.1 Concentration-Based Targets

In the Spokane River DO TMDL, Ecology (2010) assigned load allocations to:

- Mouths of the main Spokane River tributaries (Hangman Creek, Coulee Creek, and the Little Spokane River).
- Groundwater inflow to the main stem of the Spokane River upstream of Lake Spokane.
- Groundwater and surface water runoff in the watershed immediately adjacent to Lake Spokane.

Tributary load allocations are summarized in Table 20-2.

Table 20-2. Tributary Total Phosphorus Load Allocations

Water Body and Season[1]	Reduction Percentage (%)	Flow (cfs)	Allocation Concentration (mg/L)	Load Allocation (lbs/day)
Hangman Creek				
March-May Average	20	229	0.113	140.2
June	40	31	0.044	7.5
July-October Average	50	9	0.030	1.4
Coulee Creek				
March-May Average	20	30	0.113	18.2
June	40	8	0.044	1.8
July-October Average	50	2	0.030	0.4
Little Spokane River				
March-May Average	36	565	0.034	102.5
June	36	426	0.023	53.9
July-October Average	36	364	0.016	32.2

[1]Ecology, 2010 adapted from Tables 6a and 6b.

The phosphorus load allocations associated with groundwater sources are specified in Table 20-3 (Ecology, 2010).

Table 20-3. Groundwater and Lake Spokane Watershed Total Phosphorus Load Allocations

Water Body and Season[1]	Flow (cfs)	Allocation Concentration (mg/L)	Load Allocation (lbs/day)
Groundwater – Upstream of Lake Spokane			
March-May Average	1946	0.0081	87
June	1583	0.0078	66
July-October Average	1165	0.0076	48
Groundwater / Surface Water Runoff – Lake Spokane Watershed			
March-May Average	588	0.025	79
June	225	0.025	30
July-October Average	180	0.025	24

[1]Ecology, 2010 adapted from Tables 6a.

Development of a sampling program to monitor surface water concentrations at these locations and subsequent comparison of tributary and groundwater phosphorus concentrations to these allocations is an important mechanism for evaluating the overall progress of the watershed nonpoint source reduction program.

20.3.1.2 Flow and Water Quality Monitoring

Individual entities and source groups implementing or constructing projects are recommended to include budget allowances for a monitoring program (qualitative and/or quantitative) for the project site. Those entities may be required to perform data collection and report monitoring results to EPA, Ecology, DEQ, and/or an otherwise designated data tracking party depending on the funding source or other requirements. This data should be used to evaluate the effectiveness of the project. Results should be used to recommend or discourage similar projects in the future and to identify specific sub-watershed, or reservoir, monitoring information that indicate the implementation plan is not achieving expected results.

All monitoring conducted per the recommendations of this Reduction Plan should be conducted using methodology and analytical techniques consistent with the following, if applicable:

- Water Quality Data Act of 2004 codified in RCW 90.48.570 through 90.48.590 (Washington).
- Ecology's Water Quality Program Policy 1-11 (Washington).
- DEQ's Surface Water Ambient Monitoring Plan, dated October 2004 (Idaho).

A monitoring schedule should be developed for each monitoring station. The schedule should include critical sampling periods such as coincident with high flows, low flows, or other periods of potentially high phosphorus loads. The water quantity and quality parameters that should be monitored will be project-specific but should, at a minimum, include samples for appropriate phosphorus analytical species, flow, conductivity, pH, temperature, and dissolved oxygen measurements taken during sample collection for field and/or laboratory analysis.

20.3.1.3 Monitoring Methods

Monitoring related to this Reduction Plan should be conducted after the completion of a project-specific QAPP that meets state and/or federal requirements for the collection of high quality data. QAPPs are required for all environmental studies funded by the EPA, Ecology, and DEQ. A QAPP describes in detail the planning, implementation, and assessment procedures for a project and includes the following elements:

- A list of the goals and objectives of the study.
- Identification of the type and quality of data that will be collected.
- Description of the sampling and measurement procedures needed to acquire those data.
- Description of the quality control/quality assurance procedures required to ensure that the study objectives are met.

Specific guidance related to QAPP development and implementation is provided by the EPA (2002) and Ecology (2004).

Because of the diversity in nonpoint phosphorus source, receiving water body, and land use throughout the watershed, the strategy and components of specific water quality monitoring study will be highly variable. However, each study should consider the following relative to project objectives during the planning stage:

- Duration of monitoring (short term or long term).
- Frequency of monitoring (monthly, seasonally, or event-based).
- Funding requirements and sources.
- Labor requirements (volunteers and/or professionals).
- Required chemical analyses and appropriate laboratories.
- Record keeping and data management requirements.

20.3.1.4 Implementation of Actions

Although tracking of implementation will be difficult because of the diversity in the types of entities that will be initiating projects (private landowners, agencies, municipalities, corporations, etc.), progress can also be monitored at the project level, by documentation of individual actions completed by stakeholders as they relate to the specific actions listed in Chapters 9 through 19 of this plan. Implementation projects currently identified in the plan are modifications in agricultural practices, forestry practices, road rehabilitation and planning, education and outreach, restoration, baseline establishment, monitoring, and assessment. This approach assesses how many projects have been implemented, the project type, and project locations, but does not directly quantify the effectiveness of the program in achieving water quality objectives.

In many cases, the actions described in this plan will be implemented on a voluntary basis. In others, actions will be compulsory as directed by permits of other regulatory tools. Entities with enforcement authority will be responsible for following up on any enforcement actions. Stormwater permittees will be responsible for meeting the requirements of their NPDES and

other permits. Those conducting restoration projects or installing BMPs will be responsible for monitoring plant survival rates and maintenance of improvements, structures and fencing.

20.3.1.5 Monitoring of BMPs

As summarized by GeoEngineers, HDR and HGC (2011), information within the literature that quantifies BMP effectiveness is variable on a national scale and limited to negligible for the Spokane River Watershed. Monitoring of individual BMPs will assist in the evaluation of how various BMP perform locally and can be important to guide adaptive management activities.

The objective of monitoring individual projects is to verify that BMPs are properly installed, being maintained, and working as designed. The monitoring design, including additional parameters, monitoring timing and frequency, are related to the BMPs. Periodic review of BMP implementation and effectiveness could be used to evaluate advancement toward reductions and could be part of a project tracking system and annual reports. Table 20-4 lists effectiveness monitoring for the recommended BMPs in Chapter 8.

Table 20-4. BMP Recommended Effectiveness Monitoring Protocols

BMP	Water Quality Effectiveness Monitoring Approach	Potential BMP Effectiveness Monitoring Protocols
Conservation Tillage / No-Till / Direct Drill Seeding	Stormwater Monitoring	ISSC, 2003
Contour Plowing and Terracing		
Contour Strip Crop		
Conversion to Perennial Crops		
Detention Ponds/Impoundments		
Dry Swale		
Erosion Control		
Filter Strips		
Grassed Bio-Infiltration Swales		
Manure Management		
Nutrient Management Plan with Phosphorus Soil Testing		
Phosphate Lawn Fertilizer Ban		
Inspection and Pumping of Septic Systems	Dry Season Seepage Runs	SCCD, 2003b
Septic Tank Elimination (Sewering)		

BMP	Water Quality Effectiveness Monitoring Approach	Potential BMP Effectiveness Monitoring Protocols
Off-Stream Livestock Watering	Before-After-Control-Impact	WSRFB, 2008b
Riparian Fencing		WSRFB, 2008b
Riparian Zones and Buffer Strips		WSRFB, 2008a
Stream Bank Stabilization		WSRFB, 2008b
Stream Crossings		TFW, 1998a; TFW, 1998b; Benkert et al., 2002
Streamside Management Zones		WSRFB, 2008a
Vegetated Buffer Strips		WSRFB, 2008a
Timber Harvest Planning	Stratified by riparian reach (landscape scale); Before-After-Control-Impact (Site Scale)	TFW, 1998a; TFW, 1998b; Benkert et al., 2002

The effectiveness of phosphorus reduction at the project scale may be difficult to detect. In addition, information on the cumulative reduction of phosphorus in the major river systems including the Spokane River is needed to assess the overall effectiveness of BMP implementation. Therefore, status and trend monitoring in receiving waters should be implemented. Existing programs, such as Ecology's ambient "River and Stream Water Quality Monitoring Program" and DEQ's water quality monitoring that maintain long-term monitoring stations throughout the Spokane River Watershed could serve this purpose. Periodic TMDL effectiveness monitoring will add to the phosphorus load information in the coming years.

20.4 Adaptive Management

Under this NPS Reduction Plan, adaptive management is defined as a process of seeking feedback on nonpoint source phosphorus reduction strategies and actions followed by revising or adapting the approach in an effort to achieve and/or improve reductions. The sharing of information and feedback on successes and deficiencies is an important part of the process. This includes both positive and negative outcomes of plans, future analyses, identification of solutions, on the ground actions, and monitoring of results (as discussed above). Identifying these issues helps to improve the long-term success of nonpoint source phosphorus reduction.

The adaptive management process is iterative with lead agencies and/or stakeholders taking actions and making decisions guided by best available science (e.g., new information generated from the monitoring specific resources). Adaptive management informs management policies and practices by assessing the effectiveness of BMPs and water resource responses as nonpoint source phosphorus reduction measures are implemented. It is a proven approach to managing complex ecosystems.

As part of this plan, Ecology, DEQ, and the nonpoint source stakeholders anticipate using an adaptive management approach. This approach provides flexibility in protecting beneficial uses and water quality by making adjustments identified throughout the implementation period. The adaptive management approach includes:

- Robust data collection and analyses to further identify and assess loads from nonpoint sources and their impacts on Lake Spokane.
- Validation of the load allocations specified in the Spokane River DO TMDL.
- Comparison of computer-simulated changes in water quality to actual changes in water quality (caused by variations or changes in source loadings).
- Consideration of changes to the load allocations (if supported by the additional data collection and analyses).
- Evaluation of the most effective ways to comply with water quality standards.

In order to be able to adapt, evaluation of progress will occur throughout the implementation period. Ecology, DEQ and the nonpoint source stakeholders may agree to develop a schedule for evaluating progress. The evaluation of progress should be done in accordance with a QAPP. A QAPP documents the planning, implementation, and assessment procedures. This includes quality assurance and quality control activities for obtaining environmental data specific to a given project, decision and/or use.

Ecology, DEQ and the nonpoint source stakeholders will use an adaptive management approach that is scientifically defensible and provides the greatest level of protection of the resources. Data collected will meet the QAPP requirements of the state environmental agency where the waterbody is located. Ecology and DEQ will only accept data deemed to be relevant and credible for evaluating nonpoint source phosphorus. The nonpoint source stakeholders expect this will provide empirical data for evaluating progress. They will also make adjustments to the nonpoint source phosphorus reduction strategy as needed.

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Glossary

303(d) List – Section 303(d) of the federal Clean Water Act requires the state to periodically prepare a list of all surface waters in the state for which designated uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants. These are water quality limited estuaries, lakes, and streams that fall short of state surface water quality standards, and are not expected to improve within the next 2 years.

Action – Measures or steps, such as means to reduce nonpoint source phosphorus, with sufficient description and specificity for a responsible party to decide to take the action, such as by implementing a BMP, and determine where, what, when, and how to achieve the potential suggested outcome.

Best Management Practices (BMPs) – Structural, non-structural, physical and/or operational practices that, when used singularly or in combination, prevent or reduce pollutant discharges.

Bi-State Nonpoint Source Phosphorus Study (NPS Study) – A study of nonpoint source phosphorus in the Spokane River watershed and development of a Nonpoint Source Phosphorus Reduction Plan (NPS Reduction Plan) that identifies best management practices (BMPs) to reduce nonpoint source phosphorus loads for various land uses within the Spokane River watershed. The study area includes the subbasins associated with Coeur d'Alene Lake, the Spokane River and its tributaries Hangman Creek (also known as Latah Creek) and Little Spokane River, and Lake Spokane.

Carbonaceous Biochemical Oxygen Demand (CBOD) – The depletion of dissolved oxygen by biological organisms in a body of water.

Clean Water Act (CWA) – Federal Act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the CWA establishes the TMDL program.

Coeur d'Alene Lake – The natural lake and water impounded by Post Falls Dam.

Confined Animal Feeding Operation (CAFO) – An EPA term used to describe an agricultural practice where animals are kept and raised in confined situations.

Critical Aquifer Recharge Area (CARA) – Areas designated by Chapter 365-190-080(2) of the Washington Administrative Code that are determined to have a critical recharging effect on aquifers used for potable water.

Cubic Feet per Second (cfs) – In hydrologic terms, a unit expressing rates of discharge. One cubic foot per second is equal to the discharge through a rectangular cross section, 1 foot wide by 1 foot deep, flowing at an average velocity of 1 foot per second. It is also approximately 7.48 gallons per second.

Designated Uses – Those uses specified for each waterbody or segment, regardless of whether or not the uses are currently attained.

Digital Elevation Model (DEM) - Digital representation of land surface elevations.

Dissolved Oxygen – A relative measure of the amount of oxygen that is dissolved or carried in a given medium, such as water.

Environmental Protection Agency (EPA) – Federal regulatory agency responsible for protecting human health and the environment.

Existing Uses – Those uses actually attained in fresh and marine waters on or after November 28, 1975, whether or not they are designated uses. Introduced species that are not native to the state, and put-and-take fisheries comprised of nonself-replicating introduced native species, do not need to receive full support as an existing use.

Federal Energy Regulatory Commission (FERC) – An independent agency that regulates the interstate transmission of natural gas, oil, and electricity. FERC also regulates natural gas and hydropower projects.

Foundational Concepts for the Spokane River TMDL Managed Implementation Plan (Foundational Concepts) – A 2006 settlement agreement reached during a collaborative effort that identified several commitments for the dischargers and Washington State Department of Ecology to follow during implementation of the dissolved oxygen TMDL.

Hangman Creek – A stream in eastern Washington and north central Idaho south of Spokane, Washington, also known as Latah Creek.

Hydrologic Unit Code (HUC) - The HUC system is a standardized watershed classification system developed by the USGS in the mid-1970s. Hydrologic units are watershed boundaries organized in a nested hierarchy by size.

Idaho Department of Environmental Quality (DEQ) – State agency responsible for environmental protection and water quality issues in Idaho.

Lake Spokane – The reservoir formed by Long Lake Dam on the Spokane River, also known as Long Lake.

Load Allocation (LA) – The portion of a receiving waters' loading capacity attributed to one or more of its existing or future sources of Nonpoint pollution or to natural background sources.

Loading Capacity – The greatest amount of a substance that a waterbody can receive and still meet water quality standards.

Low-Impact Development – An approach to land development that uses planning and design practices and technologies to both conserve and protect natural resource systems and reduce infrastructure costs.

Margin of Safety (MOS) – Required component of TMDLs that accounts for uncertainty about the relationship between pollutant loads and quality of the receiving waterbody.

Municipal Separate Storm Sewer Systems (MS4) – A conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains): 1) owned or operated by a state, city, town, borough, county, parish, district, association, or other public body having jurisdiction over disposal of wastes, storm water, or other wastes; and 2) designed or used for collecting or conveying stormwater; 3) which is not a combined sewer; and 4) which is not part of a Publicly Owned Treatment Works (POTW) as defined in the Code of Federal Regulations at 40 CFR 122.2.

National Hydrography Dataset (NHD) – A digital representation of surface water features including lakes, ponds, streams, rivers, and canals. These data are designed to be used in general mapping and in the analysis of surface-water systems.

National Land Cover Dataset (NLCD) – The land cover data distinguishes 16 different land use classes. The land-cover image shows the heterogeneous mixture of land-cover types, including the intermixing of evergreen, deciduous, forested wetland, and agriculture and urban/suburban.

National Pollutant Discharge Elimination System (NPDES) – National program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements under the Clean Water Act. The NPDES program regulates discharges from wastewater treatment plants, large factories, and other facilities that use, process, and discharge water back into lakes, streams, rivers, bays, and oceans.

Natural Resources Conservation Service (NRCS) – NRCS works with landowners through conservation planning and assistance to benefit the soil, water, air, plants, and animals for productive lands and healthy ecosystems.

Nonpoint Source (NPS) – Pollution that enters any waters of the state from any dispersed land-based or water-based activities, including but not limited to atmospheric deposition, surface water runoff from agricultural lands, urban areas, or forest lands, subsurface or underground sources, or discharges from boats or marine vessels not otherwise regulated under the NPDES program. Generally, any unconfined and diffuse source of contamination. Legally, any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act.

Nonpoint Source Advisory Committee (NPAC) – An advisory group to the Nonpoint Source Study. Participants include, among others: City of Coeur d'Alene, City of Post Falls, City of Spokane, City of Spokane Valley, Coeur d'Alene Tribe, Idaho Department of Environmental Quality, Kootenai County, Lands Council, Liberty Lake Water and Sewer District, Panhandle Health District, Sierra Club-Center for Justice, Spokane County, Spokane County Conservation District, Spokane River Dissolved Oxygen TMDL Oversight Committee, Spokane Tribe, United States Environmental Protection Agency, and the Washington Department of Ecology.

Nonpoint Source Database (NPS Database) – A database of phosphorus data compiled from studies and reports from throughout the Spokane River watershed as part of the NPS Study.

Nonpoint Source Phosphorus Reduction Plan (NPS Reduction Plan) – The final report for the Bi-State Nonpoint Source Phosphorus Study (NPS Study) that identifies best management practices (BMPs) to reduce nonpoint source phosphorus loads for various land uses within the Spokane River watershed.

Phase I Stormwater Permit – The first phase of stormwater regulation required under the federal Clean Water Act. The permit is issued to medium and large municipal separate storm sewer systems (MS4s) and construction sites of five or more acres.

Phase II Stormwater Permit – The second phase of stormwater regulation required under the federal Clean Water Act. The permit is issued to smaller municipal separate storm sewer systems (MS4s) and construction sites over one acre.

PLOAD – PLOAD is a simplified GIS based model that estimates nonpoint source loads of pollution on an annual average basis for any user-specified pollutant using export coefficients.

Point Source – Sources of pollution that discharge at a specific location from pipes, outfalls, and conveyance channels to a surface water. Examples of point source discharges include municipal wastewater treatment plants, municipal stormwater systems, industrial waste treatment facilities, and construction sites that clear more than 5 acres of land.

Pollution – Such contamination, or other alteration of the physical, chemical, or biological properties, of any waters of the state. This includes change in temperature, taste, color, turbidity, or odor of the waters. It also includes discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state. This definition assumes that these changes will, or is likely to, create a nuisance or render such waters harmful, detrimental, or injurious to: 1) public health, safety, or welfare; or 2) domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses; or 3) livestock, wild animals, birds, fish, or other aquatic life.

Polychlorinated Biphenyl (PCB) – A class of organic compounds with 2 to 10 chlorine atoms attached to biphenyl, which is a molecule composed of two benzene rings.

Quality Assurance Project Plan (QAPP) – A document of the planning, implementation, and assessment procedures for a particular project, as well as any specific quality assurance and quality control activities. It integrates all the technical and quality aspects of the project in order to provide a "blueprint" for obtaining the type and quality of environmental data and information needed for a specific decision or use.

Spokane County Conservation District (SCCD) – An agency in Spokane County with the mission of promoting the sustainable use of natural resources within the County.

Spokane River Nonpoint Source Database (NPS Database) – The database of phosphorus, sediment, and flow measurements from historical studies compiled for this plan.

Spokane River Subbasins (subbasin) – The 8-digit HUCs that subdivide the Spokane River watershed into eight smaller contributing drainage areas: Upper Coeur d'Alene (17010301), South Fork Coeur d'Alene (10710302), Coeur d'Alene Lake (17010303), St. Joe (10710304), Upper Spokane (17010305), Hangman (10710306), Lower Spokane (17010307), and Little

Spokane (17010308). In this plan, the Upper Spokane subbasin is frequently subdivided by the state line boundary into Idaho and Washington portions.

Spokane River TMDL Collaboration (Collaboration) – In 2005, Ecology and the community began exploring how an acceptable Spokane River TMDL Implementation Plan might be developed. This allowed discussion about how to best achieve the water quality standards by considering various pollution sources, while meeting local needs. This dialogue became known as the Spokane River TMDL Collaboration (Collaboration), and included Ecology, the Idaho and Washington dischargers, local governments, DEQ, EPA, the Spokane Tribe of Indians, environmental groups, and Avista Utilities. The outcome of the Collaboration was the June 30, 2006 Foundational Concepts for the Spokane River TMDL Managed Implementation Plan.

Spokane River Watershed (watershed) – The 6-digit HUC (170103) of the drainage area contributing to Lake Spokane, excluding the area below Long Lake Dam.

Spokane Valley Rathdrum Prairie (SVRP) Aquifer – The SVRP Aquifer, which extends across Idaho and Washington, is the sole source of drinking water for more than 450,000 people.

Stormwater – The portion of precipitation that does not naturally percolate into the ground or evaporate but instead runs off roads, pavement, and roofs during rainfall or snowmelt. Stormwater can also come from hard or saturated grass surfaces such as lawns, pastures, playfields, and from gravel roads and parking lots.

Streamside Management Zone – An area adjacent to a stream where management practices that might affect wildlife habitat or water quality, fish, or other aquatic resources are modified with respect to the surrounding area. In many cases, within a streamside management zone, vegetation is maintained or managed to protect water quality. The width depends on slope, but 50 feet is the typical minimum.

Surface waters of the state – Lakes, rivers, ponds, streams, inland waters, saltwaters, wetlands and all other surface waters and water courses within the jurisdiction of the state.

To Be Determined (TBD) – Information important for taking action or implementing BMPs but beyond the scope of the NPS Reduction Plan.

Total Maximum Daily Load (TMDL) – A distribution of a substance in a waterbody designed to protect it from exceeding water quality standards. A TMDL is equal to the sum of all of the following: 1) individual wasteload allocations (WLAs) for point sources, 2) the load allocations (LAs) for Nonpoint sources, 3) the contribution of natural sources, and 4) a Margin of Safety to allow for uncertainty in the wasteload determination. A reserve for future growth is also generally provided.

United States Environmental Protection Agency (EPA) – Federal agency responsible for environmental protection and water quality issues.

United States Geological Survey (USGS) – The USGS is a science organization that provides impartial information on the health of our ecosystems and environment, the natural hazards that

threaten us, the natural resources we rely on, the impacts of climate and land-use change, and the core science systems that help us provide timely, relevant, and useable information.

Washington State Department of Ecology (Ecology) – State agency responsible for environmental protection and water quality issues in Washington.

Washington State Department of Transportation (WSDOT) – State agency responsible for transportation systems including building, maintaining, and operating the state highway system, and working in partnership with agencies to maintain and improve local roads, railroads, airports, and multi-modal alternatives to driving.

Wasteload Allocation (WLA) – The portion of a receiving water's loading capacity allocated to existing or future point sources of pollution. WLAs constitute one type of water quality-based effluent limitation.

Wastewater Treatment Plant (WWTP) or Wastewater Treatment Facility (WWTF) – An operation that treats municipal sewage via a combination of physical, chemical and/or biological processes resulting in environmentally safe fluid (effluent) and solid (treated sludge) outcome.

Water Resource Inventory Areas (WRIA) – Watersheds defined in Washington code for planning and protection purposes. Ecology and other state natural resources agencies have divided the state into 62 Water Resource Inventory Areas or WRIAs to delineate the state's major watersheds. Federal agencies frequently use an alternative watershed system based on USGS HUCs. The federal system is similar to the WRIA system except that the basin groupings differ and the units extend beyond the Washington state boundary into Canada, Oregon, and Idaho.

Water Quality Attainment Plan (WQAP) – A plan that includes several different components, including an assessment of reasonable and feasible alternatives to meet water quality standards or to attain the highest level of improvement. Washington Administration Code 173-201A(510) requires that dam operators develop a WQAP for facilities that contribute to or cause a violation of water quality standards.

Water Quality Implementation Plan (WQIP) – A plan developed following approval of a TMDL that describes and prioritizes specific actions planned to improve water quality and achieve water quality standards.

Watershed – A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.