FLATHEAD BASIN PROGRAM

Quality Assurance Project Plan (QAPP)

Prepared for:

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and

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SECTION A: PROJECT MANAGEMENT
A1 Approval Sheet

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List of Acronyms

ACRONYM	
ASTM	American Society of Testing and Materials
ARS	Agricultural Research Service
AVSWAT	ArcView Soil Water Assessment Tool
BASINS	Better Science for Integrating Point and Nonpoint Sources
BEHI	Bank Erosion Hazard Index
CAFO	Centralized Animal Feeding Operation
CD	Compact Disk
COE	Coefficient of Efficiency
DCWG	Dayton Creek Watershed Group
DEQ	Montana Department of Environmental Quality
DNRC	Department of Natural Conservation Services
DPHHS	Department of Public Health and Human Services
DQO	Data Quality Objectives
EPA	Environmental Protection Agency
ESRI	Environmental Systems Research Institute
FBC	Flathead Basin Commission
FCD	The Flathead Conservation District
FLBS	The Flathead Lake Biological Monitoring Station
FNF	Flathead National Forest
FroSAM	Forest Road Sediment Assessment Methodology
FTP	File Transfer Protocol
FWP	Montana Fish, Wildlife, and Parks
GIS	Geographic Information System
GRASS	Geographic Resources Analysis Support System
HDR	HDR Engineering, Inc.
HRU	Hydrologic Response Unit
HUC	Hydrologic Unit Code
MBMG	Montana Bureau of Mines and Geology
MQOs	Measurement Quality Objectives
NCDC	National Climatic Data Center
NED	National Elevation Dataset
NFVWG	North Flathead Valley Watershed Group
NHD	National Hydrography Dataset
NLCD	National Landcover Dataset
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service
NSC	Normalized Sensitivity Coefficient
NWIS	National Water Information System
PCBs	Polychlorinated Biphenyls
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan

List of Acronyms (cont.)

QUAL2E/K	Enhanced Stream Water Quality Model
RDG	River Design Group, Inc.
SCC	Swift Creek Coalition
SOPs	Standard Operating Procedures
SOW	Scope of Work
SWAT	Soil Water Assessment Tool
TAC	Technical Advisory Committee
TAG	Technical Advisory Group
TAMU	Texas A&M University
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USFS	United States Forest Service
USGS	United States Geological Survey
VNRS	Voluntary Nutrient Reduction Strategy
WCWSD	The Whitefish County Water and Sewer District
WLI	The Whitefish Lake Institute
WQA	Water Quality Act
WQPB	Water Quality Planning Bureau
WWTP	Waste Water Treatment Plant

A3 Distribution List

The following individuals will receive hard copies of the final QAPP for the Flathead Basin Project Area. The distribution list is compiled of the key participants from all of the government agencies, watershed groups, private contractors and major land management organizations participating in EPA and DEQ funded water quality restoration projects in the Flathead Basin. The final QAPP document will also be made available on the Internet at http://www.deq.state.mt.us/wqinfo/QAProgram/index.asp

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INTRODUCTION

The purpose of this document is to establish a quality assurance project plan (QAPP) to direct all Total Maximum Daily Load (TMDL) data collection activities within the Flathead Basin that are conducted on behalf of the Montana Department of Environmental Quality (DEQ). This QAPP describes the quality assurance program that will accompany these activities, and presents details regarding the project organization, measurement quality objectives, data documentation and collection, data management, response actions, and data validation.

This QAPP is intended to outline a consistent and acceptable approach to TMDL development and data collection/management that will facilitate achievement of program objectives. Implementation of this QAPP will help ensure that all data collected, compiled, and/or generated for the Flathead Basin Project are complete, accurate, and of the type, quantity, and quality required for their intended use.

Under U.S. Environmental Protection Agency (EPA) Order 5360.1 A2, all organizations conducting environmental programs funded by EPA are required to establish and implement a quality system. Additionally, EPA requires that all data used for purposes of environmental decision-making must be supported by an approved Quality Assurance Project Plan. This QAPP intends to satisfy these requirements, and has been prepared according to guidance provided in *EPA Requirements for Quality Assurance Project Plans*, and *Guidance for Quality Assurance Project Plans* (EPA 2001, 2002). Additional EPA quality system references that were consulted in the preparation of this document include *Guidance for the Data Quality Objectives Process* and *Guidance for Data Quality Assessment: Practical Methods for Data Analysis* (EPA 2000).

A4 Project/Task Organization

A total of 23 organizations have been identified as playing significant roles in the development of TMDLs and water quality restoration plans in the Flathead Basin. These organizations, along with key individuals within each organization, are presented in **Table 1.** The "Organization Number" in the left column of **Table 1** corresponds to the number assigned to each organization in the organization chart (**Figure 1**). Complete contact information for these individuals is included in **Appendix A**.

Figure 1- Organizational Chart

Table 1. ***Key Organizations and Individuals in the Flathead Basin TMDL Process***

Organization # (see chart)	Organization	Contacts	Position
1	U.S. Environmental Protection Agency	Julie DalSoglio	Water Program Manager
		Ron Steg	TMDL Coordinator
2	Montana Department of Environmental Quality	George Mathieus	Water Quality Planning Bureau Chief and Flathead QAPP Project Coordinator
		Dean Yashan	Watershed Management Section Supervisor
		Jim Bond	Interim TMDL Coordinator for the Flathead Basin
		Mark Bostrom	Quality Assurance Officer
		Robin Rung	Contract Officer
		Rosie Sada de Suplee	Environmental Program Manager, Water Quality Monitoring Section
		Michael Pipp	Environmental Program Manager, Data Management Section
		Pamela Arroues	Water Quality Information Librarian
3	Flathead National Forest	Cathy Barbouletos	Supervisor
4	Lake Mary Ronan Watershed Council	Ron Steg	Acting Watershed Coordinator
5	Tetra Tech	Kevin Kratt	Project Manager
6	Flathead Basin Commission	Mel Lehman	Executive Director
7	KirK Environmental	Steve MacNeil	Hydrologist
		Scott Payne	Hydrologist
8	Stoner Creek Watershed Group	Scott Mason	Acting Watershed Coordinator
		Scott Payne	Acting Watershed Coordinator
9	Dayton Creek Watershed Group	Lynn DuCharme	Acting Watershed Coordinator
10	North Flathead Valley Watershed Group	Mark Holston	Acting Watershed Coordinator
11	River Design Group	John Muhlfeld	President/Senior Hydrologist
12	Watershed Consulting	Steve Buckley	Hydrogeologist/geomorphologist
13	Ashley Creek Watershed Group	Steve Buckley	Acting Watershed Coordinator
		Mark Holston	Acting Watershed Coordinator
14	Whitefish County Water & Sewer District	Bill Leonard	Manager
15	Mike Miller	Mike Miller	Watershed Coordinator
16	Swift Creek Coalition	Mike Miller	Watershed Coordinator
17	Land & Water Consulting/PBS&J	Paul Callahan	Senior Hydrologist and QAPP project manager
17	Land & Water Consulting/PBS&J	John DeArment	General Contractor for Flathead Basin TMDL Program/Senior Water Resources Scientist
18	Whitefish Lake Institute	Mike Koopal	Executive Director
19	Flathead Conservation District	Larry Van Rinsum	District Administrator
20	Haskill Basin Watershed Council	Mike Miller	Watershed Coordinator
21	Lake Conservation District	Dennis DeVries	Supervisor
		Chris Malgren	District Manager
22	Swan TMDL Technical Advisory Group	Anne Dahl	Executive Director of Swan Ecosystem Center
23	Flathead Lake Biological Station	Scott Relyea	Research Coordinator
		Jack Stanford	Director

(1) The U.S. Environmental Protection Agency (EPA) – Region 8 includes the six states of Colorado, Montana, North Dakota, South Dakota, Utah and Wyoming; and 27 Tribal Nations. EPA Region 8 staff work with state, local, and tribal governments in the region to carry out the nation's environmental laws. The key staff in EPA region 8 related to TMDL efforts in the Flathead Basin are Julie DalSoglio and Ron Steg. Julie DalSoglio serves dual roles as the EPA CWA section 319 watershed grant administrator and is also the water program manager for the Montana office of EPA Region 8. In the role of 319 Grant administrator, Ms. DalSoglio is responsible for oversight of the CWA Section 319 grant program administered by DEQ. As the water program manager for the Montana office of EPA Region 8, she is the primary EPA contact for the projects described in this document.

Ms. DalSoglio is assisted by Ron Steg, EPA Region 8's TMDL coordinator for Montana. Mr. Steg provides EPA oversight of DEQ's TMDL program and leads TMDL development efforts for projects that EPA is designated as the lead agency. Mr. Steg led the TMDL effort for the recently completed Flathead Headwaters TMDL, and is the project manager for ongoing TMDL development efforts in the Lake Mary Ronan Watershed.

(2) The Montana Department of Environmental Quality (DEQ)'s mission is to protect, sustain, and improve a clean and healthful environment to benefit present and future generations. The Planning, Prevention, and Assistance Division (PPA) of the DEQ is tasked with developing integrated air, energy, waste management and water plans to protect Montana's environmental resources. Within the PPA, the Water Quality Planning Bureau (WQPB) is responsible for Non-point Surface Water Quality Programs including Montana's TMDL program in the Watershed Management Section. Staff from the Watershed Management Section will oversee all TMDL efforts in the Flathead Basin except the Flathead Headwaters and Lake Mary Ronan, which, as described above, are being addressed by EPA. All TMDLs developed by DEQ are submitted to EPA Region 8 for approval following a period of public comment.

The Flathead Basin Project coordinator at the DEQ is George Mathieus, chief of the WQPB. Mr. Mathieus is responsible for contract oversight and review of all project deliverables and manages all of DEQ's TMDL-related projects and staff. He is assisted by Dean Yashan, supervisor of the Watershed Management Section. Mark Bostrom is the state water quality monitoring quality assurance officer. Mark is responsible for implementing an EPA approved Quality Management Program. He is responsible for review acceptance and ongoing maintenance of this QAPP. Mr. Bostrom is entirely independent from any organizations generating water quality monitoring and restoration-related data for this project.

Jim Bond is currently the interim contact for TMDL planning activities and contracts within the Flathead Basin. Mr. Bond is responsible for contract oversight and review of all project deliverables until a Lead TMDL Planner for the Flathead Basin is determined. Robin Rung of the (WQPB) is the contracts administrator for all DEQ sponsored water quality monitoring and restoration efforts in the basin.

Other key staff at DEQ are Michael Pipp, Program Manager of the Data Management Section, Rosie Sada de Suplee, Program Manager for the Monitoring Section, and Pamela Arroues, Librarian of the Water Quality Library.

(3) The Flathead National Forest (FNF) comprises 2.3 million acres in western Montana, and the Forest is the largest land manager in the Flathead Basin. Cathy Barbouletos is the Flathead National Forest Supervisor. Resources specialist from the FNF were project partners with the EPA in developing the Flathead Headwaters TMDL, and FNF staff serve as advisors to every major TMDL effort in the Basin.

(4) The Lake Mary Ronan Watershed Council is a newly formed group of technical specialist, local residents, and other interested stakeholder whose mission is to promote water quality in the Lake Mary Ronan Watershed. The group was convened by Ron Steg, TMDL coordinator for EPA Region 8, in conjunction with the initiation of TMDL development efforts in the watershed. Mr. Steg currently serves as acting watershed coordinator for the group.

(5) Tetra Tech, Inc. is a leading provider of consulting, engineering and technical services. With more than 8,000 associates located in the United States and internationally, the company supports commercial and government clients in the areas of resource management, infrastructure and communications. Tetra Tech's services include research and development, applied science and technology, engineering design, construction management, and operations and maintenance. Kevin Kratt, in the firm's Ohio office, is a TMDL project manager, working with EPA on the Lake Mary Ronan TMDL and on basin-wide nutrient and sediment load modeling.

(6) The Flathead Basin Commission (FBC) was created by the Montana Legislature to monitor and protect water quality in one of the state's most important watersheds. The FBC is a uniquely structured non-regulatory organization that works to accomplish its important mandate in a consensus-building manner, stressing education, cooperation, broadly based community involvement, partnerships with agencies and nonprofit groups, and the voluntary participation of basin residents. The 23 members of the FBC represent a wide cross-section of citizens and local, state, tribal, federal and provincial agency representatives who strive to identify the basin's water quality problems and work collectively to implement the most effective solutions. Mel Lehman serves as executive director of the FBC, which currently provides watershed coordination in several of the Basin's planning areas, including Stoner Creek, Dayton Creek, Stillwater River, Ashley Creek, Whitefish River, Swift Creek, Whitefish Lake, and Haskill Creek. Additionally, a committee of the FBC oversees the Voluntary Nutrient Reduction Strategy (VNRS) Program, which consists of 11 grant-funded water quality projects throughout the basin.

(7) KirK Environmental is a private natural resource consulting firm with offices in Sheridan and Helena, Montana. KirK works under contract with the Flathead Basin Commission to steer the Voluntary Nutrient Reduction Strategy in the Basin and to provide coordination services to watershed groups and contractors working on FBC-sponsored projects. Scott Payne and Steve MacNeil lead the watershed services of KirK Environmental.

(8) The Stoner Creek Watershed Group is comprised of residents of the Stoner Creek basin who are interested in preserving water quality. The group recently funded a graduate student at the University of Montana to conduct a study of the watershed. Scott Mason and Scott Payne serve jointly as acting watershed coordinators.

(9) The Dayton Creek Watershed Group (DCWG) is engaged in water quality monitoring and restoration in the Dayton Creek Watershed. Lynn DuCharme serves as watershed coordinator for these activities.

(10) The North Flathead Valley Watershed Group (NFVWG) was formed under the auspices of the Flathead Basin Commission to serve in an advisory role to TMDL development efforts in watersheds within the Basin where no local group exists. This newly formed organization is headed by Mark Holston of the Flathead Basin Commission.

(11) River Design Group, Incorporated (RDG) is an environmental consulting firm offering specialized river restoration, water quality planning, hydraulic engineering and land surveying services to clients across the western United States. RDG employs a diverse, experienced team with expertise in hydrology, fisheries, civil engineering, vegetation ecology, fluvial geomorphology, land surveying, computer-aided design and geographic information systems. RDG offers services to local, state, and federal agencies in addition to private landowners. RDG is working with DEQ, FBC, and NFVWG on Phase I of the Stillwater River TMDL, and with DEQ, FBC, and the Haskill Basin Watershed Council in the Haskill Basin. John Muhlfeld is president and senior hydrologist at RDG.

(12) Watershed Consulting, LLC is a private natural resource consulting firm that provides a comprehensive approach to addressing ecological and biophysical watershed concerns by emphasizing the conservation and restoration of natural processes. Employing a multidisciplinary team of scientists, Watershed Consulting specializes in watershed assessments and ecological restoration, and offers professional services in water quality, forest hydrology, GIS, remote sensing, cartography, professional engineering, riparian heavy equipment use, terrestrial wildlife issues, and botanical surveys. Steve Buckley is a senior geomorphologist with Watershed Consulting, and is involved in TMDL development and watershed restoration in the Ashley Creek Watershed.

(13) The Ashley Creek Watershed Group was founded in 2000 to strengthen the role of local residents in determining how best to carry out needed restoration efforts in the watershed. Ashley Creek has long been documented to be one of the most polluted streams in the greater Flathead Basin. The creek is listed as an impaired waterbody, and the ACWG process will insure a level of citizen involvement in the efforts of the Flathead Basin Commission and other agencies to improve water quality throughout the basin. The watershed process further insures that local residents will become better informed of a variety of water quality-related issues and will serve as catalysis in their neighborhoods for the incorporation of better landowner Best Management Practices. Steve Buckley of Watershed Consulting and Mark Holston of FBC serve jointly as acting watershed coordinators for the group.

(14) The Whitefish County Water and Sewer District (WCWSD) received a DNRC Renewable Resource Program Grant to fund a study of Whitefish Lake, and the WCWSD is actively involved in TMDL development efforts in Swift Creek, Whitefish Lake's largest tributary. Bill Leonard is the manager of WCWSD.

(15) Mike Miller is an independent watershed coordinator who is working on water quality restoration projects with the Whitefish County Water and Sewer District, the Swift Creek Coalition and the Haskill Basin Watershed Council.

(16) The Swift Creek Coalition (SCC) has been in operation since January 2000, and is sponsored by the Whitefish County Water and Sewer District. The Coalition was started in order to investigate concerns about the potential water quality impacts that Swift Creek might be having on Whitefish Lake. Severe high bank erosion problems were thought to be a major impact. The Swift Creek Coalition's mission is to maintain a viable, healthy, and sustainable watershed for the benefit of all users through cooperation with landowners, and the promotion of public education. Mike Miller is coordinator of SCC.

(17) Land & Water Consulting/PBS&J is an engineering and natural resource consulting firm specializing in the assessment and restoration of natural resources throughout the Northwest and Northern Rockies. Land & Water Consulting was the contractor on the now completed Swan Lake TMDL, and is currently working with the Swift Creek Coalition and WCWSD on TMDL development efforts on Swift Creek. Paul Callahan leads L&W's efforts in the Swift Creek Watershed. Land & Water is also working under contract with DEQ to develop this QAPP for the Flathead Basin. John DeArment, senior water resources scientist, is contracted with DEQ to perform the role of "general contractor" for all TMDL related projects described in this QAPP. All data, information, and reports generated in the completion of task orders and work plans must be forwarded to John DeArment. John will review these data, information, and reports according to the provisions described in Section C, ASSESSMENT AND OVERSIGHT, and summarize the results for the DEQ TMDL Project Officer (presently Jim Bond). Any selections of TMDL targets, decisions to proceed or not proceed with TMDL development based on a change in impairment status, or establishment of TMDLs, Load Allocations, Wasteload Allocations, or Margins of Safety must be approved by the DEQ TMDL Project Officer (Presently Jim Bond).

(18) The Whitefish Lake Institute (WLI**)** is a newly organized non-profit organization committed to acquiring scientific research and engaging the local citizenry to protect and improve the Whitefish area lake resources of today, while providing a collective vision for tomorrow. Mike Koopal is WLI's executive director.

(19) The Flathead Conservation District (FCD) works to conserve soil, water, and other natural resources within Flathead County. FCD is the sponsor of the water quality restoration project in Haskill Basin. Larry Van Rinsum, district administrator, is the primary point of contact for that project.

(20) The Haskill Basin Watershed Council is currently working with the Flathead Conservation District and River Design Group on a watershed assessment and TMDL development in Haskill Basin. Mike Miller is coordinating this effort.

(21) The Lake County Conservation District works to conserve soil, water, and other natural resources within Lake County and was the sponsor of the now completed Swan Lake TMDL. Chris Malgren and Dennis DeVries where the lead sponsors of this effort.

(22) The Swan TMDL Technical Advisory Group (TAG) was formed to coordinate TMDL development efforts in the Swan Lake Watershed. Since the completion of the TMDL, the Swan TAG has worked to implement the restoration, monitoring, and educational recommendations of the TMDL. Anne Dahl of the Swan Ecosystem Center coordinates this effort.

(23) The Flathead Lake Biological Station (FLBS) is a state-of-the-art ecological research and education center located in the Rocky Mountains near Glacier National Park. FLBS conducts public workshops, college courses, graduate programs and research focused on the Crown of the Continent Ecosystem. FLBS is currently working with DEQ on synoptic sampling of Whitefish Lake and Whitefish River, and FLBS staff provide technical guidance on nearly all of the water quality investigation being conducted in the Basin. Scott Relyea, Research Coordinator, and Jack Stanford, FLBS Director, are leading these efforts.

A5 Project Definition and Background

The Montana Department of Environmental Quality and the U.S. Environmental Protection Agency are required to develop Total Maximum Daily Loads (TMDLs) and water quality restoration plans for all threatened or impaired waters within the Flathead Basin in order to satisfy state law as well as federal court requirements. To date, the Flathead Basin has been divided into 10 water quality restoration planning areas. Additionally, a portion of the watershed currently lies outside of the boundary of any organized watershed restoration planning area, resulting in a total 11 areas of concern. Restoration planning areas within the Flathead Basin are presented in **Table 2** and **Figure 2**.

Figure 2 – Flathead Basin TPAs

Flathead Lake is the receiving body for all other waterbodies in the Flathead Basin. In 2001, Montana DEQ completed a TMDL for Flathead Lake to address nutrient and, concomitantly, sediment loading to the lake. At the time, existing data were not adequate for allocating pollutant loads to the significant sources in the watershed. Instead, allocations were deferred until Phase II of the project, in which TMDLs in each of the 11 sub-basins planning areas could we completed. These TMDLs and the Phase II allocations to Flathead Lake are the subject of this QAPP.

In the sub-basins, as in Flathead Lake itself, the primary pollutants of concern are nutrients and sediment. However, numerous other pollutants and water quality problems are also of concern in the basin and are thus addressed in this QAPP.

Because the Flathead Headwaters TMDL has been completed, this planning area will not be addressed in this QAPP. For the same reason, the Swan Lake Watershed will not be addressed; however, the Swan TMDL did not include the Swan River downstream of the outlet of Swan Lake. This area is included in the QAPP as part of the Unassigned Contributing Areas, which are not part of a formal sub-basin TMDL planning area.

Finally, Lake Mary Ronan is not included in the QAPP, as this TMDL will be prepared by EPA, not by Montana DEQ. The focus of the QAPP is thus the Phase II allocations for Flathead Lake and development of all required TMDLs for the following sub-basin planning areas: Ashley Creek, Haskill Basin, Stillwater River, Swift Creek, Whitefish River, and Whitefish Lake.

No waterbodies within the unassigned contributing area appeared on either the 1996 or 2004 303(d) list and thus, no formal TMDLs are required. However, the status of these waterbodies may change as a result of future DEQ assessment; and regardless of the 303(d) status of this area, it will need to be included in pollutant loading assessments to assist with the Phase II allocations for Flathead Lake TMDL.

Table 2. ***Flathead Basin TMDL Planning Areas Scheduled for Completion through Year 2006***

Scheduled Completion Year	TMDL Schedule From 2002 List	Planning Area	Lead Agency	Included in this QAPP
Completed in 2004	2003	Flathead Headwaters	EPA	No
2007	2005	Lake Mary Ronan	EPA	No
2007	2005	Flathead Lake	DEQ	Yes
2007	2005	Ashley Creek	DEQ	Yes
2007	2005	Haskill Basin	DEQ	Yes
2007	2005	Stillwater River	DEQ	Yes
2007	2005	Swift Creek	DEQ	Yes
2007	2005	Whitefish River	DEQ	Yes
2007	2005	Whitefish Lake	DEQ	Yes
Completed in 2004	Completed in 2004	Swan Lake	DEQ	No
NA	NA	Unassigned Contributing Areas	DEQ	Yes

A summary of the 303(d) list status and history for waterbodies still in need of TMDL development in the Flathead Basin is provided in **Tables 3** and **4**. The 2004 303(d) list is the most recently approved by EPA, but by federal court order, DEQ must also address all pollutant waterbody combinations appearing on the 1996 303(d) list. TMDLs must be developed for all pollutants appearing on either of the 2004 and 1996 303(d) lists, except where the more recent listing represents a refinement of the original listing (based on sufficient and credible data), the sufficient credible data indicates that the basis for the original listing was in error, or that water quality standards are presently being attained and a listing is no longer valid.

The Montana 1996 303(d) list reported that upper, middle and lower Ashley Creek, Spring Creek, Fish Creek, upper and lower East Spring Creek, Logan Creek, the Stillwater River, Swift Creek, East Fork Swift Creek, West Fork Swift Creek, Whitefish Lake, Whitefish River, Lake Mary Ronan and Flathead Lake were impaired (DEQ, 1996). By 2004, Sinclair Creek had been added to the list and several other waterbodies had been scheduled for beneficial use support evaluation, including Ashley Lake, Hand Creek, Sheppard Creek, Stillwater Slough, and Chicken Creek. Reassessment by DEQ indicated that upper and lower East Spring Creeks fully supported their beneficial uses. Although no stream in the Haskill Basin has ever appeared on the 303(d) list, TMDL development was pursued proactively in the watershed to address known pollutant sources and as an added measure of protection in light of development in the area. Several stream in the Haskill Basin have been proposed for inclusion on future 303(d) lists.

Listed threats and causes of impairment for these waterbodies in 1996 and/or 2004 included nutrients, other habitat alterations, siltation, suspended solids, thermal modifications, pH, organic enrichment/DO, dewatering, flow alteration, noxious aquatic plants, pathogens, algal growth/chlorophyll a, unionized ammonia, taste and odor, bank erosion, channel alteration, riparian modification, fecal coliform, habitat degradation, channel incisement, nitrate, phosphorous, metals, oil and grease, PCBs, priority organics, and mercury. In general, sediment and nutrients are the most common water quality problems in the basin, and are the pollutants that link the Flathead Lake TMDL to future TMDLs in each of the Flathead sub-basins. The most common impaired/threatened beneficial uses were cold-water fishery and aquatic life.

EPA defines habitat alteration, channel alteration, riparian modification, habitat degradation, channel incisement, noxious aquatic plants, algal growth, dewatering and flow alteration as “pollution” while nutrients, siltation, suspended solids, thermal modifications, pH, organic enrichment, pathogens, unionized ammonia, metals, oil and grease, PCBs, priority organics and mercury are defined as “pollutants”. EPA’s requires TMDLs only for “pollutants” that are causing or contributing to waterbody impairment (Dodson, 2001). Therefore, the focus of this document is on pollutants. Those parameters defined as pollution may comprise potential sources or causes of impairments and, while no TMDLs will be established to specifically address these issues, they will be addressed as sources, as appropriate.

Table 3. ***Impaired Streams on the Montana 303(d) List Within the Flathead Basin Project Area***

Sub-Drainage Name, Waterbody Number	Use Class	Year Listed	Cold-water Fishery	Aquatic Life	Recreation (Swimmable)	Industry	Agriculture	Drinking Water
Ashley Creek (Ashley Lake to Smith Lake) MT76O003_010	B1	1996	P	P	P	X	X	P
		2004	X	X	X	X	X	X
Ashley Creek (Smith Lake to bridge crossing on Kalispell Airport Road) MT76O003_020	B2	1996	P	P	P	X	X	P
		2004	X	X	P	F	F	X
Ashley Creek (Bridge on Kalispell Airport Rd. to Flathead River) MT76O003_030	C2	1996	N	N	N	X	X	N/A
		2004	X	X	X	F	F	N/A
Ashley Lake MT76O004_010	B1	1996	L	L	L	L	L	L
		2004	X	X	X	X	X	X
Spring Creek MT76O002_040	B1	1996	N	N	N	F	F	P
		2004	X	X	X	X	X	X
Fish Creek MT76O002_050	B1	1996	P	P	P	N	N	N
		2004	P	P	X	F	F	X
Swift Creek MT76P003_020	B1	1996	P	P	X	X	X	X
		2004	P	P	P	F	F	X
East Fork Swift Creek MT76P003_030	B1	1996	P	P	X	X	X	X
		2004	P	P	P	F	F	X
West Fork Swift Creek MT76P003_040	B1	1996	P	P	X	X	X	X
		2004	N	N	P	F	F	X
Chicken Creek MT76P003_050	A1	1996	L	L	L	L	L	L
		2004	X	X	X	X	X	X
East Spring Creek (lower) MT76P003_062	B1	1996	P	P	P	X	X	P
		2004	F	F	F	F	F	F
East Spring Creek (upper) MT76P003_061	B1	1996	P	P	P	X	X	P
		2004	F	F	F	F	F	F
Hand Creek MT76P001_060	B1	1996	L	L	L	L	L	L
		2004	X	X	X	X	X	X
Sinclair Creek MT76P001_040	B1	1996	L	L	L	L	L	L
		2004	X	X	P	X	X	X
Logan Creek MT76P001_030	B1	1996	P	P	X	X	X	X
		2004	P	P	F	F	F	X
Sheppard Creek MT76P001_050	B1	1996	L	L	L	L	L	L
		2004	X	X	F	F	F	X
Stillwater River MT76P001_010	B2	1996	P	P	P	X	X	P
		2004	P	P	F	F	F	N

Table 3. ***Impaired Streams on the Montana 303(d) List Within the Flathead Basin Project Area (cont.)***

Sub-Drainage Name, Waterbody Number	Use Class	Year Listed	Cold-water Fishery	Aquatic Life	Recreation (Swimmable)	Industry	Agriculture	Drinking Water
Stillwater Slough MT76P001_070	B1	1996	L	L	L	L	L	L
		2004	X	X	X	X	X	X
Whitefish River MT76P003_010	B2	1996	P	P	P	X	X	P
		2004	P	P	X	F	F	F
Whitefish Lake MT76P004_010	A1	1996	T	X	X	X	X	X
		2004	T	T	P	F	F	X
Flathead Lake MT76O003_010	A1	1996	X	P	X	X	X	X
		2004	F	P	F	F	F	F
Haskill Creek[1] (from Haskill Basin Road to Monegan Road(no number)	A1 above water intake; B1 below	1996	L	L	L	L	L	L
		2004	P	P	X	X	X	X
First Creek[1] (headwaters to confluence with Second Creek) (no number)	A1	1996	L	L	L	L	L	L
		2004	P	P	X	X	X	X
Second Creek[1] (below water intake diversion) (no number)	B1	1996	L	L	L	L	L	L
		2004	P	P	X	X	X	X
Third Creek[1] (below water intake diversion) (no number)	B1	1996	L	L	L	L	L	L
		2004	P	P	X	X	X	X

1. The listing status of streams in the Haskill Basin is based on recommendations by the TMDL consultant. No formal SCD/BUD review has been completed by DEQ and thus waterbody numbers have not been established.

Definitions for Table 3: Impairment Status

N= Non-support of Beneficial Use.
P = Partial support of Beneficial Use.
F = Full support of Beneficial Use.
T = Threatened support for Beneficial Use.
X = Sufficient Credible Data not available
L = Not Listed
N/A=C2 waters have no drinking water beneficial use

Table 4. ***Causes and Sources of Impairment in the Flathead Basin Project Area***

Sub-Drainage Name, Waterbody #	Use Class	Year Listed	Probable Causes	Probable Sources
Ashley Creek (Ashley Lake to Smith Lake) MT76O003_010	B1	1996	Nutrients, Other habitat alterations, Siltation, Suspended solids, Thermal modifications, pH	Agriculture, Channelization, Non-irrigated crop production, Off-farm animal holding/management area, Onsite wastewater systems (septic tanks), Pasture land, Removal of riparian vegetation, Streambank modification/destabilization
		2004	No SCD	No SCD
Ashley Creek (Smith Lake to bridge crossing on Kalispell Airport Road) MT76O003_020	B2	1996	Nutrients, Organic enrichment/DO, Other habitat alterations, Siltation, Suspended solids, Thermal modifications, pH	Agriculture, Channelization, Non-irrigated crop production, Off-farm animal holding/management area, Onsite wastewater systems (septic tanks), Pasture land, Removal of riparian vegetation, Streambank modification/destabilization
		2004	Dewatering, Flow alteration	Agriculture
Ashley Creek (Bridge on Kalispell Airport Rd. to Flathead River) MT76O003_030	C2	1996	Noxious aquatic plants, Nutrients, Organic enrichment/DO, Other habitat alterations, Pathogens, Siltation, Unionized ammonia	Agriculture, Land development, Municipal point sources, Onsite wastewater systems (septic tanks), Pasture land, Removal of riparian vegetation, Streambank modification/destabilization, Urban runoff/storm sewers
		2004	No SCD	No SCD
Ashley Lake MT76O004_010	B1	1996	Not Listed	Not Listed
		2004	No SCD	No SCD
Spring Creek MT76O002_040	B1	1996	Organic enrichment/DO, Other habitat alterations, Suspended solids, Taste and odor	Channelization, Industrial land treatment
		2004	No SCD	No SCD
Fish Creek MT76O002_050	B1	1996	Noxious aquatic plants, Other habitat alterations, Siltation	Silviculture
		2004	Nutrients, Siltation, Suspended Solids	Silviculture, Unknown sources
Swift Creek MT76P003_020	B1	1996	Nutrients, Other habitat alterations, Siltation	Silviculture
		2004	Bank erosion, Nutrients, Other habitat alterations, Suspended solids	Silviculture
East Fork Swift Creek MT76P003_030	B1	1996	Nutrients, Other habitat alterations, Siltation	Highway/road/bridge construction, Silviculture
		2004	Flow alteration, Other habitat alterations	Silviculture, Habitat modification (other than hydromodification), Bank or shoreline modification/destabilization

Table 4. ***Causes and Sources of Impairment in the Flathead Basin Project Area (cont.)***

Sub-Drainage Name, Waterbody #	Use Class	Year Listed	Probable Causes	Probable Sources
West Fork Swift Creek MT76P003_040	B1	1996	Flow alteration, Other habitat alterations, Siltation	Silviculture
		2004	Flow alteration, Other habitat alterations, siltation	Silviculture, Highway maintenance and runoff
Chicken Creek MT76P003_050	A1	1996	Not Listed	Not Listed
		2004	No SCD	No SCD
East Spring Creek (lower) MT76P003_062	B1	1996	Flow alteration, Nutrients, Organic enrichment/DO, Pathogens, Siltation, Suspended Solids, Thermal modifications	Agriculture, Land development, Onsite wastewater systems (septic tanks), Removal of riparian vegetation, Streambank modification/destabilization
		2004	All uses fully supported	All uses fully supported
East Spring Creek (upper) MT76P003_061	B1	1996	Flow alteration, Nutrients, Organic enrichment/DO, Pathogens, Siltation, Suspended Solids, Thermal modifications	Agriculture, Land development, Onsite wastewater systems (septic tanks), Removal of riparian vegetation, Streambank modification/destabilization
		2004	All uses fully supported	All uses fully supported
Hand Creek MT76P001_060	B1	1996	Not Listed	Not Listed
		2004	No SCD	No SCD
Sinclair Creek MT76P001_040	B1	1996	Not Listed	Not Listed
		2004	Flow alteration	Agriculture, Grazing-related sources, Habitat modification (other than hydromodification), Bank or shoreline modification/destabilization
Logan Creek MT76P001_030	B1	1996	Siltation, Suspended solids	Silviculture
		2004	Flow alteration, Other habitat alterations, Siltation	Silviculture, Logging road construction/maintenance
Sheppard Creek MT76P001_050	B1	1996	Not Listed	Not Listed
		2004	No SCD	No SCD
Stillwater River (Logan Creek to the mouth) MT76P001_010	B2	1996	Nutrients, Pathogens, Siltation, Suspended solids, Thermal modifications	Agriculture, Natural sources, Silviculture
			Nitrate, Nutrients, Other habitat alterations, Phosphorous, Siltation	Construction, Land development, Urban runoff/Storm sewers, Habitat modification (other than hydromodification), Removal of riparian vegetation
Stillwater Slough MT76P001_070	B2	1996	Not Listed	Not Listed
		2004	No SCD	No SCD

Table 4. ***Causes and Sources of Impairment in the Flathead Basin Project Area (cont.)***

Sub-Drainage Name, Waterbody #	Use Class	Year Listed	Probable Causes	Probable Sources
Whitefish River MT76P003_010	B2	1996	Nutrients, Pathogens, Siltation, Suspended solids, Thermal modifications	Agriculture, Natural sources, Municipal point sources
		2004	Metals, Nitrogen, Nutrients, Oil and grease, PCBs, Priority organics, Thermal modifications	Industrial point sources, Silviculture, Construction, Land development, Urban runoff/storm sewers
Whitefish Lake MT76P004_010	A1	1996	Nutrients, Siltation, Oil and grease, Suspended solids	On-site waste water systems (septic tanks), Silviculture, Spills
		2004	Mercury, Metals, PCBs, Siltation	Silviculture, Logging road construction/maintenance
Flathead Lake MT76O003_010	A1	1996	Flow alteration, Noxious aquatic plants, Nutrients, Siltation, Suspended solids	Atmospheric deposition, Domestic wastewater lagoon, Flow regulation/modification, Municipal point sources, Onsite wastewater systems (septic tanks), Silviculture, Upstream impoundment
		2004	Algal growth/chlorophyll a, Mercury, Metals, Nutrients, Organic enrichment/DO, PCBs, Siltation	Municipal point sources, Silviculture, Urban runoff/storm sewers, hydromodification, upstream impoundment, Flow regulation/impoundment, Atmospheric deposition, Source unknown
Haskill Creek[1] (from Haskill Basin Road to Monegan Road) (no number)	A1 above water intake; B1 below	1996	Not Listed	Not Listed
		2004	Siltation, Suspended solids, Nutrients, Channel alteration, Habitat degradation, Riparian modification, Channel incisement, Bank erosion, Fecal coliform	Channelization, Erosion and sedimentation, Grazing-related sources, Habitat modification, Hydromodification, Pasture grazing – riparian and/or upland, Removal of riparian vegetation.
First Creek[1] (headwaters to confluence with Second Creek) (no number)	A1	1996	Not Listed	Not Listed
		2004	Siltation, Suspended solids, Channel alteration, Riparian modification, Nutrients, Fecal coliform	Channelization, Flow regulation/modification, Highway/road/bridge construction, Streambank modification/destabilization, Erosion and sedimentation
Second Creek[1] (below water intake diversion) (no number)	B1	1996	Not Listed	Not Listed
		2004	Flow alteration (suspected)	Flow regulation/modification
Third Creek[1] (below water intake diversion) (no number)	B1	1996	Not Listed	Not Listed
		2004	Flow alteration (suspected)	Flow regulation/modification

1. The listing status of streams in the Haskill Basin is based on recommendations by the TMDL consultant. No formal SCD/BUD review has been completed by DEQ and thus waterbody numbers have not been established.

A6 Project/Task Description

This QAPP presents a framework for implementation of the Phase II nutrient and sediment allocations for Flathead Lake and for TMDL development in each of the listed sub-basins.

A6.1 Flathead Lake Phase II Allocations

The Flathead Lake TMDL (DEQ 2001) recommended a four-part data collection strategy for the Phase II allocation of nutrient and sediment loading to Flathead Lake. The four parts of this strategy included:

- Airborne Source Assessment Study
- Additional Synoptic Tributary Sampling
- Ground-water Studies
- Sub-basin TMDL Development

These data collection efforts were to be used both as a direct measure of potential pollutant sources in the Flathead Basin and to calibrate basin-wide nutrient and sediment load modeling being conducted by EPA, which represents a fifth task for the phase II allocation:

- Nutrient and Sediment Load Modeling

The primary focus of this document is to provide a framework for a consistent basin-wide approach to the Phase II Flathead Lake Allocation. Three of the five tasks listed above area covered in this QAPP, including nutrient and sediment load modeling, sub-basin TMDL development, and the synoptic tributary sampling.

The Airborne Source Assessment Study and the Ground-water Study are beyond the scope of this QAPP because they represent a TMDL development effort for a different or distinct media (groundwater/air) and source (presently unknown). DEQ does not presently have a standardized approach for developing TMDLs of this nature and both the EPA and DEQ staff involved in the planning of this project plan recognized that, as first time TMDL studies, they warrant a study focusing on their unique needs. Although preliminary investigations have been conducted to evaluate pollutant loading from airborne and groundwater sources, continued study of these sources will be deferred to a future phases of TMDL development.

A6.1.1 Nutrient and Sediment Load Modeling

Montana DEQ and the EPA have determined that a modeling approach will be the most effective way to meet the objectives of the Flathead TMDL program and provide a consistent approach to the Phase II allocation of the Flathead Lake TMDL. A modeling based approach will allow flexibility to address the broad range of stakeholder interest and water quality concerns in the drainage. The modeling tool will be used to complete the point and non-point source loading analysis, allocate sediment and nutrients for TMDL development, and formulate water quality restoration plans. Additionally, it will support compliance with the Voluntary Nutrient Reduction Strategy for the Flathead Basin.

The EPA, in consultation with DEQ, has tentatively selected the Soil Water Assessment Tool (SWAT) for use in the Flathead Basin[1]. The SWAT is a watershed-scale loading model developed by the USDA Agricultural Research Service (ARS) and the Blackland Research Center of Temple University to compute non-point source pollutant loads to stream and river systems. The model uses GIS technology, topography, soils, precipitation, plant growth, and urban and agricultural crop management information to form a complete deterministic definition of the hydrology and water quality of a watershed. Benefits of the SWAT approach are:

- The model is physically based. Watersheds can be modeled to evaluate the relative impact of changes in management practices, climate, and vegetation on water quality and other variables of interest.
- The model uses readily available inputs. The minimum data required to make a run are commonly available from government agencies.
- The mathematical solutions within the model are computationally efficient. Simulation of very large basins or a variety of management strategies can be performed without excessive investment of time or money.
- Long-term impacts spanning several decades can be studied. Gradual build up of pollutants can be simulated along with the impact on downstream water bodies spanning several decades.
- The model core has been validated on hundreds of basins throughout the United States and abroad.

SWAT is supported by twenty years of applied non-point source research by the ARS to predict the impacts of land management practices on water, sediment, and agricultural chemical yields in complex watersheds with varying soils. It is a public domain model and has been applied extensively to support water quality and TMDL planning throughout the United States. Further technical information regarding SWAT can be found at the following web address: http://www.brc.tamus.edu/swat, and in the forthcoming modeling QAPP.

Relevant output parameter will include nitrate, soluble phosphorous, organic nitrogen, organic phosphorous, as well as annual sediment load. The draft QAPP for the SWAT model is included as **Appendix B.**

A6.1.2 Assessment to Support the SWAT Model

Although the SWAT Model will form the core of the sediment and nutrient TMDLs in the Flathead Basin, several supporting assessments will be required:

A6.1.2.1 Road Sediment

In most of the managed forested watersheds in the Western United States, forest roads are frequently one of the largest sources of non-point source pollution. Unfortunately, the SWAT model does not account for sediment delivery from forest roads, and thus an alternative

[1] At the time this QAPP was written, several other models were also under consideration. If a model other than SWAT is selected, then the QAPP will be revised as needed; athough model selection is not expected to result in substantive changes to the modeling QAPP presented at Appendix B.

assessment methodology will be required. The Forest Road Sediment Assessment Methodology (FroSAM) is suggested for this purpose.

FroSAM is a refinement of the methods developed by the Washington Forest Practices Board (WFPB 1997), which is essentially an accounting procedure involving field observation of erosion and sediment delivery to streams. Streams are defined as "any drainage depression containing a defined bed and banks extending continuously below the drainage site. Flow regime can be ephemeral, intermittent, or perennial" (WFPB 1997).

FroSAM has been successfully applied in the Swan Lake Watershed TMDL and in several other basin-wide TMDL efforts in Montana. Due to the extensive forest road network in the Flathead Basin, it is anticipated that the FroSAM analysis will be conducted on a sample of roads and the results extrapolated to the remainder of the watershed. Details of the method are included in **Appendix C.**

A6.1.2.2 Streambank Instability/Erosion

Bank erosion is a natural process in streams and can contribute a significant natural load of sediment. However, anthropogenic sources, such as grazing, mining, roads, riparian harvests, or flow modifications can lead to increased bank erosion. Although the SWAT model includes a channel erosion sub-routine and can thus provide estimates of sediment and nutrient loading from this source, two related concerns make additional assessment necessary: 1) the SWAT model cannot provide estimates of the location and magnitude of bank erosion problems; and 2) the SWAT model requires input data on the conditions of stream banks in the subject watershed to calibrate the bank erosion subroutine.

To provide this information, the Bank Erosion Hazard Index (BEHI) methodology developed by Rosgen (data) has been selected. The BEHI method has already been applied as part of several ongoing TMDL-development projects in the Flathead Basin, including the Ashley Creek, Stillwater River, and Haskill Creek watersheds. Due to the large number listed stream miles in the Flathead Basin, it is anticipated that the BEHI method will be applied to a sample of stream reaches and the results extrapolated to the remainder of the watershed. The BEHI method is summarized in **Appendix D.**

A6.1.2.3 Synoptic Sampling

In-stream nutrient, TSS, and discharge data are necessary to develop and calibrate the SWAT model, and these data will be collected throughout the basin. Although data collection needs will be further refined by the QAPP for the SWAT model, immediate data collection efforts are described in the basin work plans in **Appendix E through K.**

A6.1.2.4 Additional Assessments

Where other potentially significant pollutant sources are identified they will be quantified using methods developed in consultation with DEQ and local stakeholders. Such sources could include, for instance, mass wasting or culvert failure. It will be imperative a single method for each source is selected and that this method be applied consistently across all of the sub-basins.

A6.1.3 Sub-Basin TMDLs

Nutrient and sediment TMDLs and allocations in each of the sub-basins will be developed from the SWAT modeling and supporting assessments described above. This approach will ensure consistent and comparable loading estimates across the Flathead Basin. TMDLs for other listed pollutants in the sub-basins, including temperature, pH, DO, pathogens, unionized ammonia, taste and odor, mercury, oil and grease, PCBs, and priority organics, will be discussed on a case-by-case basis in the sub-basin TMDL development work plans in **Appendix E through K.**

As described in greater detail in the sub-basin work plans, the focus of the 2005 field season will be on the completion of Phase I documents (Watershed Characterization and Impairment Status/Data Review Reports, including targets) in each sub-basin and the collection of water quality data to quantify pollutant loads, identify potential sources, confirm impairment status, and assist with model development.

Completing the Phase II allocations for Flathead Lake and developing TMDLs for all pollutants in all of the sub-basins will require the collection of significant amount of new water quality data Parameters for which new data collection is anticipated for pollutant source assessment, quantification, and allocation, target development, and impairment status determination are summarized in **Table 5,** and quality assurance protocols for this data are included in subsequent sections of this QAPP.

Table 5. ***Anticipated Data Requirements for the Flathead Basin Project***

Nutrients	TSS	Temperature	pH	DO	Pathogens	Unionized Ammonia
Taste and Odor	Mercury	Oil and Grease	PCBs	Priority Organics	Macroinvertebrates	Periphyton
Chlorophyll a	% fines <2mm	% fines <6mm	D50	Width/Depth Ratio	Large woody debris frequency	Pool Frequency
BEHI	FroSAM	Fish Tissue				

A7 Quality Objectives and Criteria

Measurement quality objectives (MQOs) are the quantitative and qualitative terms used to specify how good the data need to be to meet the project's specific monitoring objectives. MQOs for measurement data, also referred to as data quality indicators, include precision, accuracy, measurement range, representativeness, completeness, and comparability. Measurement quality objectives for the Flathead Basin Program are described below.

A7.1 Precision

Precision is a measure of internal consistency, and is demonstrated by the degree of variability in replicate measurements. Precision for parameters measured in the field will be evaluated by conducting repeat measurements. Precision for laboratory analyses of samples will be evaluated through laboratory reporting of relative percent differences (RPDs) in duplicate sample analyses. RPD is calculated as follows:

RPD = (O-D) / ((O+D)/2) x 100, where O = original and D = duplicate

The Montana Department of Public Health and Human Services chemistry lab has a stated precision goal of +/- 10 percent. Precision goals for the U.S. Geological Survey National Water Quality Laboratory vary by parameter. For this project, an initial precision goal of +/-10 percent will be established for water chemistry and a goal of +/- 25 percent will be established for sediment analyses.

Precision of biological data will be ensured through the use of DEQ approved analysts. Beginning in the 2004 field season, the DEQ began assessing the quality of biological data with a rigor similar to analytical chemistry data, utilizing methods described in NABS *Bridges* publication, "Determining the quality of taxonomic data, James Stribling, Steven Moulton II, and Gary T. Lester". Additional details are available in DEQ's Quality Assurance Project Plan Sampling and Water Quality Assessment of Streams and Rivers in Montana, 2005.

Precision of other data, including FroSAM, BEHI, and, where appropriate, target and beneficial use determination data will be ensured selection of qualified contractors and strict adherence to the requirements of each methodology.

Precision of other data, including FroSAM, BEHI, substrate composition, pools, LWD, and w/d ratios, will be ensured selection of qualified contractors and strict adherence to the requirements of each methodology. An initial precision goal of 10 percent has been set for these data.

A7.2 Accuracy

Accuracy is a measure of confidence that describes how close an analytical measurement is to its "true" value. Accuracy reflects the combination of random error (precision) and systematic error (i.e. bias). The "true" value of field measurements is not attainable, however, potential bias in the program procedures will be minimized through appropriate site selection and strict adherence to the QAPP.

Because the "true" value of a field sample cannot be known, the primary tool for assessing accuracy of laboratory analyses will be the percent recovery of matrix spikes and control standards run against the field sample. Percent recovery is calculated as follows:

%R for matrix spikes = ((SSR – SR)/SA) x 100
where SSR = spiked sample result, SR = sample result, and SA = spike amount added

%R for control standards = (FC/TC) x 100
where FC = found concentration and TC = true concentration

For this project, an initial accuracy goal of +/-10 percent will be established for water chemistry analysis and an accuracy goal of +/- 25 percent will be established for sediment analyses. For field measured parameters, the accuracy of equipment will be established using reference standards for calibration. Accuracy applied to biological taxonomy data is defined as the nearness of a measurement to an analytical truth. For taxonomy, the analytical truth is:

1. The most currently accepted taxonomic literature,
2. A reference collection, verified by appropriate taxonomic specialists, or
3. Type material (e.g., holotype)

DEQ uses the 2003 version of the International Taxonomic Identification System (ITIS) for macroinvertebrates and the USGS NAWQA taxa list for periphyton. A system for verifying contractor's reference collections was developed at DEQ and was incorporated into revised DEQ SOPs for periphyton and macroinvertebrates, which are included in **Appendix L.**

A7.3 Measurement Range

Measurement Range is the range of reliable readings of an instrument or measuring device, as specified by the manufacturer. The measurement ranges for field parameters are specified in the operation manuals of each instrument. The factory-determined measurement ranges have been adopted for field parameter measurements under this project. Operation manuals will be kept with each field instrument and will be read and understood before monitoring. Laboratory measurement ranges are determined by the laboratory in their annual method detection limits studies. Each laboratory retains results of these studies.

A7.4 Representativeness

Representativeness is the extent to which the measurements actually represent the true environmental conditions. Achieving a representative sampling of an area of interest from a limited number of sampling points is a challenge given the seasonal and annual variability of some waterbodies and the patchiness of biological data. Further, site access may limit the total number of available sites to a few with conditions better or worse that the remainder of the segment.

With this in mind, DEQ uses a multi-metric, weight-of-evidence approach in water quality assessment and TMDL development. With this approach, multiple lines of evidence measuring different aspects of the ecosystem should weed out an anomalous result obtained from a single data assemblage. Representativeness will also be achieved through adherence to the monitoring protocols and procedures outlined in this QAPP and in DEQ SOPs (**Appendix L).** Finally, the future development of sampling and analysis plans (SAPs) for key parameters will help ensure representativeness by providing detailed guidance on site selection, seasonal variability, and other critical data collection considerations.

A7.5 Completeness

Completeness is the comparison between the amounts of data that were planned to be collected versus how much usable data was actually collected, expressed as a percentage. Data may be determined to be unusable in the validation process. A project completeness of greater than 90 percent is expected under normal operating conditions. If project completeness falls below 90 percent, then corrective measures including re-sampling or re-analysis will be employed.

A7.6 Comparability

Two data sets are considered to be comparable when there is confidence that the two sets can be considered equivalent measures of a parameter or constituent. Comparability of previously collected data to new data is important to insure that analyses reflect changes in environmental conditions rather than changes in methods or techniques. Data produced from this project will be obtained by using standard procedures, and can be compared to past monitoring data within the watershed, provided that data were collected using the same or similar procedures.

Comparability will be achieved for this project through consistent sampling locations, procedures, and analyses as outlined in this QAPP. Some modification to proposed sampling techniques may be required to insure comparability, and will be reviewed on a case-by-case basis.

A8 Special Training/Certification

No special training or certifications are required for analysts or data managers of this project. However, strict adherence to assessment methodology described in this QAPP is required to ensure compliance with measurement quality objectives (MQOs). In some cases, methodologies will be more precisely defined in the sampling and analysis plans (SAPs) that will ultimately be developed to guide the implementation of the work described in this QAPP. Strict adherence to these SAPs will further ensure compliance with MQOs.

Training may be required for watershed group participants, subcontractors, or other personnel involved in various monitoring and assessment tasks in the Flathead Basin. Assessment oversight and training will be the responsibility of the project managers in each of the sub-basins. Selection of field personnel should be reviewed and approved by the project manager.

All chemical analyses for this program will be performed by the U.S. Geological Survey's National Water Quality Laboratory, the State of Montana Department of Public Health and Human Services (DPHHS) chemistry laboratory, Energy Laboratories, or other approved laboratory facilities. Chlorophyll *a* samples will be analyzed by the Montana DPHHS chemistry laboratory or Energy Laboratories in Helena. Both of these facilities are state-certified analytical laboratories. Macroinvertebrate and periphyton samples will be analyzed by accredited private contractors. All contractors hired for TMDL-related tasks will be selected from DEQ/EPA lists of qualified vendors.

A9 Documents and Records

The documents and records produced from water quality monitoring, source assessment, or restoration monitoring components of this project will consist of sample collection records, laboratory reports, and periodic narrative summary reports. Sample collection records will consist of field notes and field forms collected during site visits. Sample shipping and custody records should also be kept with the field notes.

It is anticipated that he following documents will be generated as components of the Flathead Basin Project:

1. *Field Notebooks and Related Forms*. These will be generated during the course of the field component of the monitoring program.
2. *Chain-of-Custody Forms*. These will also be completed during the field component of the monitoring program, with documentation of sample transferal added during the shipping process.
3. *Sample Shipping Receipts*. These will be generated during sample shipping and will be used to document transferal of samples.
4. *Laboratory Data*. These will be prepared by the analytical laboratory and will include reports of sample analysis results and related QA/QC information. Laboratory records, including instrument printouts and laboratory bench sheets, will be kept under the custody of the laboratory manager for possible use during data validation.
5. *Project Reports*. These are anticipated to include the interim Phase I through III assessment and a final TMDL and water quality restoration plan that integrates all three phases of the project for each sub basin.

Additional project documents will be generated during the course of the monitoring program, and will be maintained by the project manager. These documents may include the following:

1. *Data and Methodology QA/QC Evaluations*. These include documentation of QA/QC reviews that include data validation, assessment, and response actions, and other issues that may arise during the course of the monitoring program. These will be provided by the TMDL contractor.
2. *Data Evaluation and Management Notes*. These will be generated as a precursor to and in between regularly scheduled reporting events by the respective monitoring coordinators.
3. *Communication Records*. These include records of relevant communication between project team members and agencies, program sponsors, and watershed groups. Records will be maintained in a central location at DEQ in Helena.

In addition to hardcopy or paper documents, computer files will be generated during the course of the monitoring program. The project manager will maintain these files during the course of the program. The project manager will also maintain copies of all program documents on a regular basis for incorporation into a central project file.

All project contractors will be required to provide data to DEQ in Access Database format, or in a DEQ-approved format that will allow the data to be imported easily into Access.

All hardcopy and electronic information produced from assessment monitoring will be retained indefinitely at DEQ in the WQPB library or on the DEQ network. Electronic records retained on the DEQ network are backed up by the Information Technology Section routinely to assure that important records and data are not lost.

This QAPP and all attachments will be made available for review on the web at http://www.deq.state.mt.us/wqinfo/QAProgram/index.asp. All individuals and organizations identified in the distribution list on page 4 will be notified of the final approval and its location on the web.

SECTION B: DATA GENERATION AND ACQUSITION

B1 Sampling Process Design

The sampling process design for the sub-basin TMDLs is discussed in the sub-basin work plans in **Appendix E though K**. The sampling process design for the SWAT modeling is presented in the QAPP for that project (**Appendix B**).

It is beyond the scope of this document to provide specific details for all of the sampling that will be required in the Flathead Basin. Additional sampling details such as sampling locations and sample collection frequency will be developed in subsequent sampling and analysis plans (SAPs) that will be developed to guide the implementation of this QAPP. All SAP will be developed in close consultation with DEQ and details of the sub-basin SAPs will be carefully coordinated to ensure consistency of methods across the Flathead Basin.

B2 Sampling Methods

B2.1 Biological Monitoring

Biological sampling is expected to include the collection of macroinvertebrate, periphyton and chlorophyll *a* samples. In selected watersheds where PCBs are a pollutant of concern, fish tissue sampling may also be required. Periphyton sampling methods will utilize a single composite sample collected at each station as described in DEQ Field Procedures Manual SOP WQPB WQM-020. Macroinvertebrate sampling methods will include traveling kick net sampling as described in DEQ sampling procedure WQPBWQM-009.

Chlorophyll sampling methods will utilize the whole rock sampling method with six samples per site collected from natural substrates when the goal of the sampling is to assist with beneficial use support determinations. When the goal of chlorophyll sampling is to assist with nutrient source characterization or other components of a nutrient TMDL, then the template method will be used. Both methods are described in SOP WQPBWQM-011, which is included as part of **Appendix L.**

One-time sampling for PCBs in fish tissue will require the collection of 4 specimens of similar size class providing a minimum total sample weight of 560 grams. Fish will be captured with electrofishing equipment, weighed, measured, and wrapped in aluminum foil/double plastic bags. Fish will be frozen and shipped to the lab for analysis of a composite sample. Analysis will consist of PCB (Aroclor) screening.

Sampling methods and associated field information forms for biological parameters are provided in the references listed in **Appendix L** of this QAPP.

B2.2 Water Chemistry Monitoring

B2.2.1 Field Parameters

Field parameters that may be required as part of this project include stream flow (cfs), water temperature (˚C), pH (standard units), turbidity (NTU), and dissolved oxygen (mg/l). Water temperature, pH, turbidity, and dissolved oxygen will be collected using a water quality probe.

Details of operation for the instrument are provided in the field manual, which is to be kept with the instrument during use. Stream flows will be measured during each sampling visit using conventional USGS methods. Water temperatures will be recorded using data loggers as described in DEQ's temperature SOP WQPBWQM-006, which is included in **Appendix L**.

B2.2.2 Laboratory Parameters

Laboratory parameters that required for this project include nutrients, total suspended sediment (TSS), E-Coli bacteria[2], unionized ammonia, mercury, oil and grease, PCBs, and priority organics. Nutrient parameters include: total phosphorus (TP), nitrate plus nitrite-nitrogen (NO_2+NO_3-N), ammonia (NH4-N), total kjeldhal nitrogen (TKN), and ortho-phosphorus (OP). All samples will be collected using a depth-integrated sampling technique (equal-width or equal-flow increment methods).

Water samples for TP, NO_2+NO_3-N, NH4-N and TKN will be collected directly in acid washed polyethylene bottles. Bottles shall be rinsed twice with native water prior to sampling. Samples will be acidified to a pH of less than 2 by adding concentrated sulfuric acid (H_2SO_4).

Water for soluble nitrogen parameters and Ortho-P samples will be filtered in the field through a 0.45 µm filter and submitted to the laboratory immediately to comply with the 48 hours holding time. If analysis within 48 hours is impractical, then OP samples can be filtered and frozen, but should still be analyzed as soon as possible.

Water column mercury samples (low-level EPA 1631) will be collected in an acid washed 250 ml *glass* bottles in accordance with the ultra clean sampling technique instructions provided by the laboratory. Samples will be preserved with ultra trace pure Hydrochloric Acid to a pH <2 (provided by the laboratory), or returned to the laboratory unpreserved within 48 hours. Low-level mercury samples will be accompanied by a Field/Trip Blank that originates in the Class 100 clean room of the low-level laboratory and follows the sample bottles to the site. At the site, the bottle designated as reagent water will be transferred to the bottle designated trip blank (making this a combination trip/field blank). This QC sample will be returned in the same cooler as the investigation samples.

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[2] E-Coli standards were presented to the board of environmental review on September 30, 2004 as part of the triennial review of water quality standards. The Board agreed to initiate rulemaking at that time, which, following public comment and response from the Board, may result in the replacing of the current Fecal Coliform standard with E-coli. The outcome of the proposed changes should be known in early February 2006.

Coliform samples (E-coli) are collected in sterilized 120 ml bottles provided by the laboratory. Rapid transfer to the lab is essential due to the short holding time for these samples. Oil and grease samples will be collected in 1 liter glass bottles and acidified with sulfuric acid.

Fish tissue samples for PCB and or mercury samples will be kept frozen until they are ready for analysis. Taste and odor samples will be collected in 200 ml glass containers, chilled to 4°C and analyzed within 24 hours.

Three EPA approved methods have been selected for priority organics: 624 (volatile organic compounds - VOC) 625 (semi-volatile organic compounds - SVOC) and 608 (pesticides/PCBs - PPCB). VOC samples will be collected in 3 40 VOA vials, preserved to pH < 2 with HCL, chilled to 4°C, and analyzed within 14 hours. SVOC and PPCB samples will each be collected in 1000 ml glass containers, chilled to 4°C, and delivered to the lab is less than 7 days.

Suspended sediment samples will be collected with a depth-integrating sampler (such as a DH-48) using equal-width or equal-flow increment methods.

Unionized ammonia will be calculated from ammonia results using temperature and pH field observations (Morgan and Turner 1977).

Samples must be clearly labeled with a waterproof marker or with pre-printed labels. Label information must include the site identification number, date and time, sample type, preservative, and sampler's initials. Each bottle must be entered onto the chain-of-custody form before leaving the site. All samples are stored in coolers and chilled to 4°C or less (or frozen for PCBs) for transport to the lab. A summary of sampling protocols is provided in **Table 6**. Field procedures are described in more detail in the various references contained in **Appendix L** of this QAPP.

Table 6. ***Sample Volumes, Containers, Preservation, and Holding Times***

Analyte	Sample Volume	Container	Preservation	Holding Time
TP	250 ml	Acid-washed polyethylene	Add H_2SO_4 to pH<2, cool to 4°C	28 days
TKN	500 ml	Acid-washed polyethylene	Add H_2SO_4 to pH<2, cool to 4°C	28 days
NO_2+NO_3	250 ml	Acid-washed polyethylene	Filter, add H_2SO_4 to pH<2, cool to 4°C	28 days
NH4	250ml	Acid-washed polyethylene	Filter, Add H_2SO_4 to pH<2, cool to 4°C	28 days
Ortho-P	250 ml	Acid-washed polyethylene	Filter, cool to 4°C[1]	48 hours
Mercury (EPA 1631)	250 ml	Acid-washed glass	Add HCl or BrCl to pH<2, or return unpreserved within 48 hours, 4°C	28 days
E-coli	120ml	Sterilized Polyethylene	Cool to 4°C	6 hours
TSS	1 liter	HDPE	Cool to 4°C	7 days
Oil and Grease	1 liter	Glass	Add H_2SO_4 to pH<2, cool to 4°C	28 days
Fish Tissue: PCBs and /or mercury	4 each	Plastic	Frozen	7 days
Taste and Odor	200 ml	Glass	Cool to 4°C	24 hours
Priority Organics	Varies	Varies	Varies	Varies

1. Or frozen if necessary

B2.3 Substrate Composition

Substrate composition will be evaluated with Wolman pebble counts according to the method described in the DEQ Field Procedure Manual SOP WQPBWQM-020, which is included as part of **Appendix L**.

B2.4 Other Data

Pool and LWD frequency counts may need to be conducted by different methodologies in different sub-basins to maintain comparability with existing reference data. Methods should be well documented in project reports allowing a determination of comparability to be made. Width to depth ratios will be measured according to the method described by Rosgen 1996. FroSAM and BEHI data will be collected according to the guidelines provided in **Appendices C and D**.

B3 Sample Handling and Custody

All water quality and biological samples will be immediately placed into appropriate storage containers in the field, as specified in **Section B2** above. Samples will be packaged appropriately to avoid damage and to maintain the specified holding temperatures. Chain-of-custody forms will be completed in the field as each sample is collected, and will be kept with the samples at all times. Whenever samples are transferred, the "relinquished by" portion of the chain-of-custody form will be completed.

B4 Analytical Methods

All analyses are to be performed by a DEQ approved laboratory using methods shown in 40 CFR Part 136.3, Tables IA, IB, IC, ID, or IE. Alternate Test Procedures or significant modifications to existing methods must be approved by the EPA Region 8 Regional Administration as per 40 CFR Part 136.5. The analysis methods listed in **Table 7** represent standard accepted procedures. The USGS National Water Quality Laboratory, the Montana Department of Public Health and Human Services chemistry laboratory, and Energy Laboratories are approved laboratories for performing analytical services for the Flathead Basin monitoring programs described in this QAPP.

The analysis methods listed in **Table 7** represent standard accepted procedures that will be followed. Details regarding these methods are not included in this QAPP document but are described in, EPA publications 600/ 4-79-020, or EPA 600/R-94-111. Additional information for the USGS laboratory (Methods, QA Program, etc.) is accessible through the web site provided in the references section.

Biological samples will analyzed by the Montana Department of Public Health and Human Services chemistry laboratory (chlorophyll *a*), Energy Laboratories (chlorophyll *a*), Rithron (macroinvertebrates), Hannaea (periphyton), and GERG (fish tissue samples) following standard procedures.

Table 7. ***Analytical Methods and Detection Limits***

Analyte	Method	Analytical Detection Limit
Total Phosphorus (TP)	EPA 365.3	1 µg/l
Total Kjeldahl Nitrogen (TKN)	EPA 351.3	100 µg/l
Nitrate + Nitrite-Nitrogen (NO_2+NO_3-N)	EPA 353.2	10 µg/l
Total Ammonia-Nitrogen (NH_3+NH_4-N)	EPA 350.1	10 µg/l
Ortho-Phosphorus (OP)	EPA 365.1	1 µg/l
Mercury (water)	EPA 1631	0.0002 µg/l
E-coli	MF 9222D	1CFU/ml
TSS	EPA 160.2	1 µg/l
Oil and Grease	EPA 413.2	100 µg/l
PCB (Fish Tissue, Aroclors)	EPA 8082	PQL of 2-5 ug/kg
Mercury (Fish Tissue)	EPA 245.6	~5 mg/kg
Taste and Odor	SM 2150	NA
Priority Organics	EPA 624, 625, and 608	1 µg/l for 624; varies by parameter for 625 and 608

Following is a list of the laboratories to be utilized in the monitoring program. The project manager may consider and approve additional laboratories on an as-needed basis.

USGS National Water Quality Laboratory
Denver Federal Center
Building 95, MS 407, Entrance E-3
Lakewood, CO 80225-0046
Contact: Greg Mohrman (303) 236-3500
Analysis: nutrient, metals, sediment, common ions

Energy Laboratories, Inc.
3161 E Lyndale Ave (59601)
PO Box 5688
Helena, MT 59604-5688
Contact: John Hagar (877) 472-0711
Analysis: Water Chemistry, chlorophyll *a* samples

Phycologic
3883 Flaxstem
East Helena, MT 59635
Contact: Erich Webber
Analysis: periphyton samples

Hannaea
1032 12th Avenue
Helena, MT 59601
Contact: Loren Bahls (406) 443-2196
Analysis: periphyton samples

Montana Dept. of Public Health and Human Services
Laboratory Services
P.O. Box 6489
Helena, Montana 59604
Contact: Judy Halm (406) 444-2642
Analysis: chlorophyll *a* samples

GERG (Geochemical and Environmental Research Group)
Texas A&M University
833 Graham Road
College Station, Texas 77845
Contact: Terry Wade (979) 862-2323
Analysis: PCBs and Mercury in fish tissue

Montana Environmental Lab
P.O. Box 8900
Kalispell, MT 59904
Contact: (406) 755-2131
Analysis: E-Coli

Rithron Associates, Inc.
1501 West Central Avenue
Missoula, MT 59801
Contact: Wease Bollman (406) 721-1977
Analysis: macroinvertebrate samples

B5 Quality Control

Field quality control for the restoration will be maintained by following the sampling methods described in Section B2. Field quality control for the water quality sampling will be monitored by submitting a deionized water blank (field Blank) and a field replicate sample for analysis during each monitoring event.

> **Blank -** During field sampling, de-ionized water is transferred from a larger (stock) bottle into the bottles used during a particular sampling event. If dissolved parameters are necessary, this is performed with the filtering apparatus in place. Field Blanks are then acidified, and otherwise treated as a sample.
>
> **Field Replicate Samples -** A co-located (replicate) sample is taken for each analyte and submitted to the laboratory. Results of this sample will be used to determine the (combined) reproducibility of the sampling method, the representativeness of the sampling technique to the media sampled, and the reproducibility of the analytical method. Co-located replicate samples should be taken simultaneously, if possible, and handled with the same procedures as the original.

Field quality control samples will be packaged, labeled and submitted to the analytical laboratory in a manner identical to the natural samples to ensure that they are treated and analyzed by the lab in a similar fashion as the natural samples.

The respective analytical laboratory through their documented QC procedures will monitor laboratory quality control. Immediately upon receipt of samples, the laboratory will:

1. review the chain-of-custody form for completeness and for clarity of instruction;
2. inspect the cooler to make sure the samples have been kept at the proper temperature; and
3. inspect the samples for leakage or breakage and to confirm that sample labels are consistent with the chain-of-custody forms.

The samples will then be logged in and stored in accordance with the laboratory's procedures. The project quality assurance manager will be immediately notified if any deficiencies are observed upon sample receipt.

The project labs must follow procedures consistent with their own QA plans and laboratory certification requirements, including sample tracking and chain-of-custody procedures. For laboratories performing water chemistry analyses, a quality control summary must be provided with each analytical report along with the final chain-of-custody. The quality summary will include (at a minimum) the results of the method blank, lab duplicates (internally split samples run through the same method), laboratory control sample(s), and matrix spike/matrix spike duplicate (if applicable to the requested method).

Generally, lab duplicates are run on 10 percent of the samples for a given analyte to determine method error or issues with sample homogeneity. During analysis, standards are run regularly (about every 10 samples) to check instrument calibration. Matrix interference is assessed by spiking samples with a range of known quantities of the analyte. The standards and spikes should be within the same concentration range as the samples being analyzed.

The results of laboratory quality assurance and quality control checks are reviewed at the end of each sampling run. Relative percent difference (RPD) from laboratory replicate samples is calculated to determine precision. The percent recover (%R) from matrix spikes and known standards are used to determine accuracy. Any water chemistry samples with unacceptable precision (RPD > 15%) should be flagged in the sample report and results interpreted with caution.

B6 and B7 Instrument Calibration, Testing, Inspection, and Maintenance

All field instruments and sampling equipment will be maintained in proper working order, with regular maintenance being performed as required by the manufacturer. Prior to mobilization to the field, personnel will inspect the equipment to make sure it is in proper working order. Maintenance notes will be entered into the field logbook.

Field instrument calibration will be performed at the beginning of every sampling day. More frequent calibration will be performed at the discretion of field personnel, and may be warranted by weather conditions or if problems with the instruments are suspected. Post-sampling calibration will be used when warranted to verify accuracy. Calibration procedures will conform to manufacturer specifications. Calibration notes will be entered into the field logbooks.

B8 Inspection of Field Supplies and Materials

All monitoring supplies and materials will be inspected by the sampler to ensure they are in proper condition and working order prior to mobilization in the field. Any problems as well as application of maintenance requirements will be documented in the field notes. Extra monitoring supplies and containers will be brought into the field in the event that contamination or damage occurs.

B9 Non-Direct Measurements

Non-direct measurements are data collected using professional judgment and observation. For the Flathead Basin Project, these are expected to include the BEHI bank instability assessment, the FroSAM road sediment assessment, and the macroinvertebrate habitat assessments that are part of DEQ's SOPs for biological data. All three of these rely on professional judgment to varying degrees. Quality of non-direct measurements will be maintained by strict adherence to methodological requirements and the selection of qualified contractors for data collection. Where necessary, field training will be provided to ensure that contractors are calibrated on the methods.

B10 Data Management

Data generated during the Flathead Basin Project will be stored in field notes and on field forms, and will be entered into Excel spreadsheet or other suitable database format by project staff. Analytical data will be submitted by laboratories in both hard copy and electronic formats.

Electronic data files will include the date and time of sample collection, date received, date of analysis, constituent, batch ID, results, and data qualifiers. QC samples (blanks, controls, spiked samples) will also be provided in this format. This information will be retained in subsequent data base formats intended for STORET upload. These data will be summarized in annual reports generated by each watershed group. All data generated in the monitoring component of this project will be stored with the watershed group coordinator, and also at DEQ's Helena office.

Water chemistry, biological, and field measurement data generated during the water quality program will undergo standard QA/QC review procedures and be uploaded to the STORET database. Under the direction of the project manager, the watershed group or private contractor will format the data for entry into the U.S. EPA STORET water quality database using SIM templates. DEQ staff will perform the actual uploads to STORET.

SECTION C: ASSESSMENT AND OVERSIGHT

The primary mechanism through which project measurement quality objectives (MQOs) will be met is prevention. Planning and design of the project, documented instructions and procedures, and use of qualified and experienced personnel as outlined in this QAPP are expected to prevent most problems associated with data quality or quantity.

An assessment program will be used to identify any problems with the project data and trigger response actions to bring the data back in line with the project MQOs. The assessment will include routine evaluation of the data with respect to MQOs such as precision, accuracy, and completeness, as presented Section A7. The assessment will also include a structured data validation process, as discussed in Section D. Assessment may include high-level monitoring of certain project activities or audits initiated as a response action (discussed below).

C1 Assessments and Response Actions

In the event that the assessment program identifies problems with project data, response actions will be triggered. The nature of these actions will depend upon the severity and types of problems encountered, and will begin with a review of project procedures related to the identified problem(s). Additional costs to the monitoring program may incur if response actions are triggered. The project manager must approve these additional costs before response actions commence. Additional response actions may include:

C1.1 Preventive Response Actions

These measures would be directed at preventing the identified problem from being repeated, and include 1) implementation of high-level monitoring of project activities associated with the problem to prevent further deviations; and 2) initiation of a system of audits that will include random and unannounced evaluations of personnel, equipment, or organizations to determine if procedures outlined in the QAPP are being adhered to. The project manager will be responsible for implementing corrective measures to address identified deviations from the QAPP.

C1.2 Corrective Response Actions

These measures will result in a correction of the problem and replacement of the problematic data with data that meet the project MQOs. Potential corrective actions include 1) re-analysis if the problem identified is or may be related to laboratory procedures and sample holding times allow it; and 2) re-sampling if the problem is related to field procedures or if a new sample is required for laboratory analysis.

C2 Reports to Management

C2.1 Review and Approval Process

This QAPP and future versions will be distributed to all personnel and organizations listed on the distribution list. All key personnel involved in Flathead Basin water quality monitoring programs are to review, sign and date the approval section of the most recent version and return the signed portion to the QA Officer. By signing the approval section, the signatory agrees that he/she has read and understands his or her role in the monitoring program, and will adhere to all sections of this QAPP. All personnel involved in the project should retain the current version of this QAPP.

C2.2 Annual Review and Revision Process

This QAPP will be reviewed by the project manager, John DeArment (PBS&J/L&W) annually, or as needed upon the adoption of changes to the program. Any modifications to this QAPP will require approval by the project planning team included in Section A1 Approval list.

SECTION D: DATA VALADATION AND USABILITY

D1 Data Review, Verification, and Validation

Data will be reviewed annually through the detailed examination of raw data to check for calculation and transformation errors, measurements within calibration range, and data entry errors. Various computer software programs, including Microsoft Excel and SPSS, may be used to assist in the data review process to help identify potentially erroneous data. Any data provided by the USGS will employ standard checks and internal review procedures to ensure data validity, which will be documented in annual data validation reports.

D2 Verification and Validation Methods

Data verification refers to the routine checks the sampling oversight officer conducts in ensuring that the QAPP is followed, as well as to the quality control procedures of the analytical laboratory. The sampling oversight officer is the DEQ or subcontractor (consultant) staff who is responsible for management and oversight of field sampling and resulting analytical data. The laboratory will provide electronic and paper formats of the supporting laboratory quality assurance documentation.

At a minimum, data verification will include evaluation of sampling documentation/ representativeness, compliance with sample holding times, instrument calibration and tuning, field and lab blank sample analyses, method QC sample results, field duplicates and the presence of any elevated detection limits. The output of data verification includes the verified data package from the laboratory with any applicable laboratory qualifiers.

D3 Reconciliation with User Requirements

Data validation refers to the confirmation by examination and provision of objective evidence that the particular requirements for the intended use of data have been met. Data validation is conducted on verified data and the methodology will differ for each parameter according to the project MQOs. All incoming data must pass the validation process before entry into the database. Data that fail the validation process will be qualified and flagged as such or, in extreme cases, excluded from the database. Identification of invalid data will trigger preventive or corrective response actions.

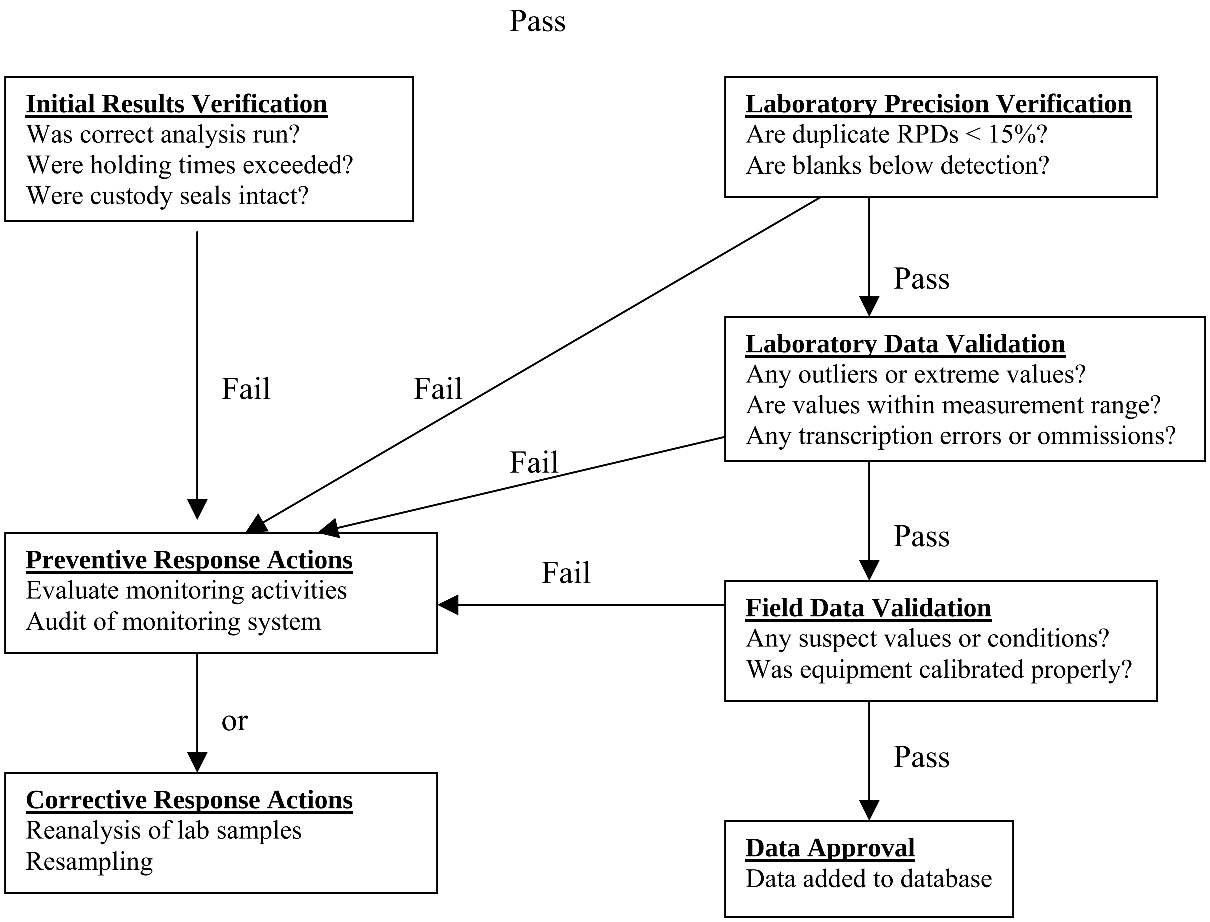
At a minimum, the validation process will address the following:

- chain-of-custody forms and laboratory data sheets will be checked to verify that appropriate analyses were run and that the samples were analyzed within specified holding times;
- reviews of duplicate and blank samples will be used to evaluate method precision by the laboratory;
- a comprehensive review of the sample delivery group will be conducted to evaluate the overall quality of the data. Included will be a review for potential transcription errors, detection limit discrepancies, data omissions, and suspect or anomalous values; and

- field data will be reviewed, and anomalous or suspect values will be noted and an explanation provided.

A flow chart describing the data validation process is provided as **Figure 3**.

Figure 3. ***Data Validation Process***



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