

**STREAMFLOW MONITORING PLAN  
FOR THE  
METHOW BASIN**

Prepared for:

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and  
Methow Basin Planning Unit

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TABLE OF CONTENTSPage No.

1.	INTRODUCTION	1
1.1	Goals and Objectives	1
1.2	Historical Streamflow Data	2
2.	STREAM GAGING PLAN	3
2.1	Critical Stream Reaches	3
2.2	Gage Types	6
2.2.1	USGS Continuous Gaging Stations	7
2.2.2	County/Planning Unit Continuous Stations	7
2.2.3	County/Planning Unit Seasonal Non-Recording Staff Gages	8
2.2.4	County/Planning Unit Temperature Gages	8
2.3	Monitoring Frequency	8
2.4	Data Processing and Analysis	9
2.5	Permitting	9
2.6	Training	9
2.7	Estimated Costs	10

LIST OF TABLES

Table 1	Active USGS Gages in the Methow Basin
Table 2	List of Recommended Continuous Recording Stream Gaging Sites and Selection Criteria
Table 3	List of Recommended Non-Recording Staff Gages
Table 4	Typical Monitoring Program for Gage Site
Table 5	Estimated Costs for Stream Gage Implementation

LIST OF FIGURES

Figure 1	Map of Critical Stream Reaches and Proposed Gage Sites
Figure 2	Typical Portable Gage Site Layout
Figure 3	Field Management of Streamflow

APPENDICES

Appendix A	Maps of Gage Sites
Appendix B	Detailed Cost Breakdown

## **1. INTRODUCTION**

In the Methow Valley there is increasing pressure for streamflow data and timely assessments of streamflow characteristics and trends, especially as related to low flow during the irrigation season and potential effects on the aquatic ecosystem. This information is critical to the Methow Basin Planning Unit and Okanogan County as they develop watershed management strategies under the Watershed Management Planning Act (HB 2514) and in response to Endangered Species Act listings.

This plan forms the basis for implementing a comprehensive streamflow monitoring program in the Methow Basin. The work was completed by Golder Associates under contract to Okanogan County for services associated with (but not funded by) the HB2514 Watershed Planning Act. The work was funded by the Washington Department of Ecology Centennial Clean Water Fund. There are two parts to this document. The report provides an overview of the plan, proposed gaging locations, and monitoring frequency. The Technical Appendix contains detailed specifications, technical procedures, and data recording forms for implementing the plan.

### **1.1 Goals and Objectives**

Quantification of the flow regimes and related environmental variables, such as temperature, will provide data to evaluate natural and management-induced riverine conditions in the Methow Valley. The Aquatic Technical Advisory Group currently developing the Methow Basin Limiting Factors Analysis has identified many of the “limiting factors” for endangered salmonid populations. In many instances, lack of information on flow is cited as a data gap.

The basic objective of the Methow gaging program is to establish a network of gage sites that will be monitored regularly and used to better quantify streamflow conditions throughout the Methow Basin. The focus of the network is on natural stream channels and not on irrigation ditches. Metering and measurement of irrigation diversion flows is being addressed under a separate project.

The data collected from the stream gaging program will be used by various agencies and stakeholders in the basin, including federal agencies (National Marine Fisheries Service, and U.S. Forest Service); state agencies (Ecology, and Fish and Wildlife); local agencies (Okanogan County, local municipalities, and irrigation districts); and other stakeholders (individual irrigators, environmental groups, and non-profit organizations). These stakeholders have a variety of interests and would use the information to address issues such as:

- Low flow conditions during irrigation season;
- Riparian and aquatic habitat conditions and sustainability;
- Nutrient cycling and availability, temperature, and sediment transport
- Flow and water quality conditions for aquatic organisms;

- Geomorphologic and channel forming processes; and
- Economic sustainability issues.

It is critical that streamflow information be collected, processed, and maintained in a consistent fashion so that all stakeholders are basing assessments on data with similar content and quality.

## **1.2 Historical Streamflow Data**

There are abundant individual streamflow records throughout the Methow basin, dating back to the late 1800s. Since there is very little (if any) quality control documentation regarding these measurements, the utility and accuracy of these data is highly variable. Data collected by federal agencies, such as the USGS or US Forest Service are presumed to have a moderate to high degree of reliability and accuracy, based on internal quality assurance procedures. The quality of data collected by other agencies or individuals is difficult to ascertain without further information on field data collection and data processing procedures.

Currently, continuous gages are operated by the US Geological survey at 8 locations along the Methow Mainstem. Table 1 summarizes the location of current continuously recording streamflow data in the Methow basin. The reliability and accuracy of these data are considered high, based on the internal quality control used by the USGS in recording and maintaining the gages.

Despite the abundance of streamflow data, there are significant gaps in the data, in terms of period of record and location of measurements. It is difficult with the existing data to establish a statistically reliable assessment of streamflows in individual sub-basins, and then establish the relative contributions of these sub-basins to flows in the main stem Methow over time. A coordinated and comprehensive attempt to characterize the streamflow hydrographs in individual sub-basins will greatly enhance the ability to derive statistically reliable assessments of streamflow throughout the Methow basin.

## **2. STREAM GAGING PLAN**

This section describes the locations where stream gaging are needed, the location and type of proposed gages, monitoring frequency, data analysis, and estimated costs.

### **2.1 Critical Stream Reaches**

In order to achieve the objective of establishing a gage network that would serve a variety of needs, critical stream reaches were identified for gaging. The criteria for establishing the gaging sites were based on factors identified in the Draft Limiting Factors Analysis being prepared by part of HB2496 Salmon Recovery Act. The criteria used included:

1. Forecasting/water budget: There is a need for better characterization of streamflows in headwater sub-basins (above irrigation diversions) in order to better estimate individual sub-catchment inflow to the Methow mainstem. Streamflow information in these locations will improve the ability to forecast flow conditions based on climatic conditions and to refine the water-budget at a sub-basin scale and monthly time step.
2. Low flow/diversion: There is little data available to characterize the role natural low flow conditions play in limiting aquatic habitat. All but one gage (Andrews Creek) is affected by upstream diversions throughout their record. There is a need to better understand habitat limitations under natural low flow to better evaluate influence of diversions on low flow limiting factors and dewatering of stream reaches. Placing gages upstream and downstream of diversion ditches will provide this information.
3. Passage: Fish passage was identified as a limiting factor for some streams. Passage can be hindered by inadequate depth of water and is usually attributed to low flow. Streamflow data for these reaches will provide information on the timing and duration of passage limited by water depth.
4. Temperature: High water temperatures, mostly during August, may prevent fish from migrating upstream. Also, since salmon cannot regulate their body temperatures, higher water temperatures may cause additional stress to the fish. Water temperatures are a function of incipient water temperature and ambient air temperature, which is influenced by shade and water depth. Temperature data will provide information for identifying the timing and duration of critical temperatures that may be limiting to fish populations.
5. Sediment: Embedded fine sediment reduces spawning habitat within some stream reaches. Sediment transport is dependent, in part, on the flow hydrograph and wet velocity. Streamflow measurements are used in sediment analysis of embedded reaches to evaluate sediment transport dynamics.

Figure 2 shows the recommended gaging sites and associated critical stream reaches. Tables 2 and 3 summarize gage locations and siting criteria. A brief discussion follows.

1. Upper Methow: The proposed location for this gage is near the River Bend Campground. Presently, most of the watershed above this point is in federal ownership managed by the United States Forest Service (USFS) as Congressionally Withdrawn (Wilderness), Late-Successional Reserve, or Riparian Reserve. A gage in this reach will provide information on relatively unaltered hydrologic conditions in the headwaters. Since the location is upstream of the main valley alluvial deposits it will provide data on surface runoff for the water budget and data to evaluate groundwater-surface water interactions in the reach between this gage and the existing Methow River gage near Goat Creek. Currently, Andrews Creek gage is the only benchmark station in the Methow basin. Andrews Creek is much smaller and in a different geomorphic and geologic setting than streams flowing in the Methow Valley. Thus, the proposed gage for the Upper Methow would be more representative for forecasting and characterizing hydrologic conditions as related to the mainstem Methow.
2. Lower Methow: The proposed location is near the head of Black Canyon, where the Methow Valley alluvial fill becomes very thin in comparison to upstream. The constriction in the Valley causes groundwater to move upward towards the surface. This gage will provide information that can be used in assessing groundwater inputs upstream of this point. The information will be used in the water budget.
3. Goat Creek: The proposed location is on the Lost River Road crossing of Goat Creek. This reach of the stream is on the Goat Creek alluvial fan. Data from this gage and a non-recording gage located on Fawn Creek Road will provide information on surface water runoff for the upper Methow water budget. Data from these gages can be used in conjunction with streamflow data from Early Winters and Wolf Creeks to evaluate the dynamics of groundwater-surface water exchange on the alluvial fans in the Upper Methow Sub-Basin, and management options to improve aquatic conditions.
4. Early Winters Creek: The proposed locations are on the Early Winters Creek alluvial fan. The upstream gage will provide information for forecasting low flow conditions for Early Winters Creek and surface water runoff data for the water budget. The gage will also provide information on the hydrologic characteristics of headwater tributaries located on the south side of the Methow Valley. A seasonal recording gage downstream of the Early Winters ditch will provide data to assess possible passage and temperature limitations and the effects of diversions and losing stream conditions.
5. Wolf Creek: The proposed locations are between the Wolf Creek diversion and Methow confluence. The gage on lower Wolf Creek is below upstream diversions. It will provide streamflow data that can be used to evaluate low flow limitations on fish, including temperature. A gage is

also proposed upstream of the diversions. Information on diverted streamflow will provide data to evaluate groundwater-surface water interactions along the alluvial fan. The data can be used to evaluate management options to meet the needs of fish and irrigation.

6. Eight-mile Creek: Eight-mile Creek contributes approximately 30-50% of the discharge to the Lower Chewuch River during August-September. Data from this stream will be used in the water budget and forecasting summer low flow conditions for the Chewuch River.
7. Boulder Creek: The proposed gages are at the mouth of Boulder Creek and at the Chewuch just below Boulder Creek. These gages will provide data on natural runoff to the Chewuch from Boulder Creek and flows in the Chewuch above the Skyline Ditch.
8. Cub Creek: The proposed gages are at the mouth of Cub Creek and the Chewuch just below Cub Creek. These gages will provide data on natural runoff to the Chewuch from Cub Creek and flows in the Chewuch above the Fulton Ditch.
9. Twisp River and Tributaries: The Twisp River has a USGS gage near the town of Twisp. An additional gage is recommended above the major diversions to provide inflow data for the water budget and forecasting. During the irrigation season it will provide data for monitoring low flows above the diversions. Non-recording staff gages are proposed on Poorman Creek. The gage will provide additional information for the water budget and evaluating management options for fish and irrigation.
10. Beaver Creek: This gage is located below the box culvert on Highway 153 and below the diversion at Frazer Creek. A gage on this creek would provide data to evaluate management options for irrigation and fish.
11. Libby Creek: The proposed gage is on Libby Creek Road. The streamflow gage will provide data to evaluate sediment transport dynamics and sources of fine sediment to the stream, temperature, and low flow and evaluate management options for steelhead and irrigation.
12. Gold Creek: The proposed gages are located below the diversions on the Twisp-Cotton Road and above the diversions. They will provide streamflow data for the water budget and low flow limitations on fish. They will provide information on the extent of natural dewatering versus diversions. The data can be used to evaluate management options to meet the needs of steelhead and irrigation.

## **2.2 Gage Types**

Three types of gages are recommended for the Methow Basin:

1. Continuous, year-round recording stations installed, operated, and maintained by the U.S. Geological Survey.
2. Continuous year-round or seasonally operated recording stations installed, operated and maintained by Okanogan County and/or the Planning Unit.
3. Seasonal Non-recording Staff Gages operated and maintained by Okanogan County, the Planning Unit, or other stakeholders.



### **2.2.1 USGS Continuous Gaging Stations**

The USGS installs and maintains thousands of stream gages in the U.S. Real-time streamflow data can be obtained from gages that have satellite telemetry installed. All the currently operated continuous gages in the Methow have satellite telemetry and real-time data are available through the USGS site on the World Wide Web (<http://wa.water.usgs.gov/current.html>). This is the preferred method for collecting data for long-term records, obtaining essential information to forecast potential low flow periods, and monitoring flow-dependent habitat conditions.

As shown on Table 2, six monitoring locations are recommended to be installed and maintained by the USGS as continuous gaging stations. The primary criteria for selecting these drainages for year-round USGS gages is that they all have an estimated mean annual discharge greater than 30 cfs. The six locations are:

1. Methow Headwaters: Below Robinson Creek;
2. Methow River at Carlton: Above Black Canyon;
3. Early Winters Creek: At head of alluvial fan (above diversion);
4. Chewuch River: Above the diversions;
5. Wolf Creek: Above the WCRD diversion; and
6. Twisp River: At Little Bridge Creek (above diversions).

The USGS would be responsible for periodic assessments of the data and interpretation in terms of statistical characteristics and trends. They would provide the system for real-time streamflow information delivery, and data processing, quality assurance, access, and storage.

### **2.2.2 County/Planning Unit Continuous Stations**

As shown on Table 2, Portable, continuous recording pressure transducers are recommended for the following tributaries:

1. Early Winters Creek (below diversion);
2. Goat Creek;
3. Wolf Creek (below diversion);
4. Eight-mile Creek (above diversion);
5. Gold Creek (above diversions);
6. Libby Creek;
7. Beaver Creek; and
8. Lost River.

The County/Planning Unit would be responsible for installation, operation, maintenance, and data analysis at these sites. This would involve installing

and downloading pressure transducer data, conducting actual flow measurements using a flow meter, and developing a stage/discharge relationship. As with the USGS gages, the gages would need to be calibrated and maintained, and the data assessed and interpreted, as per specified quality-control protocol.

Figure 3 shows the layout of a typical County/Planning Unit stream gage site.

### **2.2.3 County/Planning Unit Seasonal Non-Recording Staff Gages**

As shown on Table 3, on-recording staff gages are recommended at the following locations:

1. Boulder/Chewuch crossing;
2. Cub Creek/Chewuch;
3. Poorman Creek (Twisp River);
4. Beaver Creek; and
5. Gold Creek.

### **2.2.4 County/Planning Unit Temperature Gages**

Temperature is an important parameter for assessing streamflow health, and should be measured when possible. For stations with continuous stage recorders, automated temperature monitoring equipment is recommended that would simultaneously record water temperature.

## **2.3 Monitoring Frequency**

USGS continuous gages typically measure at 15-minute intervals. Actual streamflow measurements will be recorded over a range of flow conditions to develop the rating curve. The Technical Appendix discusses the rating curve in more detail.

The County maintained gages should measure water level every 15 minutes, similar to USGS gages. Temperature can be measured on an hourly schedule. The seasonal gages should be operated from June 15-November 15. Actual streamflow measurements will be recorded over a range of flow conditions to develop the rating curve. The dataloggers used to record stage can generally hold approximately two months of data measured at 15-minute intervals. However, the data should be downloaded whenever a discharge measurement is made.

The recommended monitoring program for County/Planning Unit seasonal gages is shown on Table 4.

## **2.4 Data Processing and Analysis**

For USGS continuous gages, standard USGS protocols would be used to process and analyze data. Typically, the data are provisional until it has undergone a technical review for final publication.

For County/Planning Unit gages, stage recorder data would need to be downloaded from data loggers on a regular interval and uploaded into a database. The raw data would be checked for calibration conversions, datum and offset errors, and data gaps caused by instrument or programming errors. The processed raw river stage data would then be converted to streamflow based on a rating curve developed when sufficient streamflow measurements have been obtained. The final streamflow hydrograph developed from continuous stage recorders cannot be finalized until the rating curve is established. Thus “real-time” streamflow data cannot be made available initially.

Streamflow measurements collected at County/Planning Unit gage sites will also need to be processed after it is collected and uploaded into a database. After an appropriate technical review, the results of an individual stream gaging can be made publicly available. Details on the collection, processing, and analysis of streamflow measurements are discussed in the Technical Appendix.

## **2.5 Permitting**

Portable continuous recording stream gages or non-recording staff gages typically do not require County or State permits. However, this will have to be confirmed at each proposed gage site. Landowner permission may be an issue at some locations, and formal documentation of access agreements is recommended.

Permanent USGS gages may require hydraulic permits, since they often involve permanent structures such as concrete footings or cable frames on the riverbank. Similarly, landowner access easements may be necessary. It is recommended that the County/Planning Unit take the lead on permitting issues for USGS gages.

## **2.6 Training**

County and agency personnel, as well as volunteers who will be collecting streamflow data should be properly trained. The County/Planning Unit should hold a training workshop for all stream gaging personnel to insure that data are collected in a consistent manner. The workshop would include a seminar on the information presented in the Technical Appendix, and field training on stream gaging.

A single point of contact is recommended for general oversight of stream gaging activities and management of the streamflow database.

Stream gaging is potentially dangerous, particularly at high water. Training should emphasize a “buddy system,” safety precautions, and recognition of unsafe conditions.

## **2.7 Estimated Costs**

Table 5 summarizes estimated costs for implementing the stream gaging plan. This includes site identification and permitting, training of personnel, installation and operation of gages, database management, and preparation of an annual stream gaging summary report. Total initial capital cost for the gage network is \$127,800. Annual operations and maintenance costs are on the order of \$122,400 per year. Table 5 shows the cost breakdown and assumptions used in developing the cost estimate. Specifications for the recommended equipment are provided in the Technical Appendix.

The costs for a USGS gage are based on estimates given by Ray Smith, USGS Spokane District Office. We recommend that the County explore potential cost-share partnerships for the maintenance of the USGS gages. The Department of Ecology already cost-shares on some of the USGS gages in the Valley. Other potential cost-share agencies are the National Marine Fisheries, U.S. Fish and Wildlife, U.S. Forest Service, the Bonneville Power Agency, the Yakama and Colville Tribes, and Washington Department of Fish and Wildlife since they all have an interest in water issues in the Methow Valley.

Costs for County/Planning Unit gages are estimated based on the cost of equipment, installation, and maintenance. Again, the most expensive portion of the gages will be annual operation and maintenance costs.

## **TABLES**

## **FIGURES**

**APPENDIX A**  
**MAPS OF GAGE SITES**

**APPENDIX B**  
**DETAILED COST BREAKDOWN**