Fisheries

Analysis Area

Spatial Bounds

There are two geographic boundaries selected for this analysis. First, the potential for this project to impact fish habitat would be felt at the watershed scale. Therefore, any changes triggered by the project in Lion Creek would be considered against all other cumulative effects to Lion Creek. Since there are activities proposed on Lion, Goat and Piper Creeks, the geographic boundaries include these three watersheds, from the headwaters to the mouth. No measurable changes to fish habitat are expected downstream of these watersheds, so there is no need to include any other streams. A very limited amount of activity is proposed along a half mile of the Swan River itself. The geographic analysis area is strictly in the vicinity of the project, as well as extending downstream for 2 miles. This is because of the very small potential impact to fish habitat, and the impossibility of detecting any cumulative contribution beyond the area.

The second geographic boundary encompasses the entire Swan Lake Watershed. This scale is used for analyzing impacts to fish populations. Bull trout (*Salvelinus confluentus*) and Westslope cutthroat trout (*Oncorhynchus clarki lewisis*) move freely between spawning and rearing tributaries and Swan Lake. These species are thought to exhibit “meta-populations,” whereas each spawning and rearing tributary is a population unto itself; however, a small amount of mixing takes place with all other tributary populations in the Swan Valley. Therefore, any potential harm to one tributary stream population could be felt at the meta-population scale. This boundary only considers potential cumulative effects to populations, not habitat. The Swan Lake Watershed geographic boundary includes all tributaries to the Swan River and the lake itself. The downstream limit of this geographic area is the outlet of the lake. Bull trout and cutthroat trout are believed to seldom migrate downstream due to the warm water characteristics and the barrier created at the Bigfork Hydroelectric Dam.

Temporal Bounds

The analysis timeframe is 12 years from the beginning of project implementation. It is expected that timber harvest would be completed within one or two seasons after the sale date. Following implementation, the potential indirect effects to large woody debris may be felt after the first substantial runoff event that is large enough for the stream to meander across its floodplain. This could happen at any flood stage, but it is assumed that a 10-year flood event would be the most meaningful. Any larger flood could bring so many changes it obscures the potential impacts from this project. A 10-year flood event could happen anytime and in any given year; the stream has a 10 percent probability of this kind of flood. The flood could happen right away or not at all. But, in order to define some timeframe, it is assumed that such a flood could happen in 10 years. If the project begins implementation in 2009, this means the analysis timeframe would extend to 2021.

Data Sources, Methods, and Assumptions Used

Information for this analysis has been gathered from a variety of sources. Since 1982, the Flathead National Forest, Montana Department of Fish, Wildlife and Parks, and Plum Creek Timber Company have conducted over 40 fish population inventories and over 20 fish habitat condition assessments throughout the analysis area. Raw data is available for review in the Swan Lake Ranger District Office and is incorporated by reference. The following discussion reviews key assumptions used. In addition, peer-reviewed scientific literature has been used as the primary source of information regarding the life

histories and habitat requirements of the aquatic organisms and the effect of natural and human-caused disturbances upon those organisms. This report also incorporates a watershed analysis for Piper Creek and Goat Creek prepared by Plum Creek Timber Company in 1997 and a Watershed Analysis for Lion Creek prepared by the Flathead National Forest in 2008. The 2004 Water Quality Protection Plan and TMDL for Swan Lake Watershed prepared by Montana Department of Environmental Quality (Montana DEQ) were also incorporated.

The majority of fish population data available has been collected by electrofishing. Electrofishing offers superior ability for crews to identify and accurately measure each fish. Techniques are virtually unchanged since the earliest available data (1982), thus allowing repeat monitoring. The weakness of electrofishing is that it does not effectively capture all fish, since some individuals drift out of sight or escape the area prior to sampling. Cryptic, bottom-dwelling species, such as bull trout and sculpins, especially tend to be underrepresented. Electrofishing is only done in summertime low-flow conditions in a small, representative area [often 328 feet (100 meters) in length]. This analysis assumes that available electrofishing data does an adequate job in characterizing species relative abundance distribution during low flows. It does not assume that if bull trout and sculpins are absent in the survey that they are entirely absent in the stream.

Redd counts are another type of data used to assess fish population trends. Spawning bull trout dig fairly distinctive redds (spawning nests), which allow biologist to count them annually after the spawning season. Montana Department of Fish, Wildlife and Park Biologists (MDFW&P) have conducted bull trout redd counts annually on Lion Creek and Goat Creek since 1982 and on Piper Creek since 1995. The redd count data offers superior monitoring of adult escapement (survival to spawning age) since it has been conducted by the same observers over a long period of time. However redd counts are poor estimators of actual population size. Redd counts may underestimate actual spawning numbers in certain flow conditions or if redds are superimposed on each other. Conversely they may overestimate spawning numbers if hybrid fish or brook trout create similar looking redds. Redd counts do not provide information on egg or juvenile survival rates. In order to estimate juvenile abundances, MDW&P has electroshocked select areas of Goat and Lion Creeks almost annually since 1987. This analysis relies on both redd counts and electrofishing data to assess bull trout populations.

Since 1994, snorkeling surveys have also been conducted intermittently, primarily by PCTC Biologists. Snorkeling, especially at night, offers superior ability to detect bull trout (Banish et al. 2008). However, since fish are not captured for closer inspection or marked, limitations are that it cannot offer a population estimate, it may misidentify fish, and it can only estimate fish sizes. Snorkel surveys can only be done in low-flow, clear water conditions and tend to be for short distances, often only 164 feet (50 meters). An assumption is made that snorkeling surveys adequately identify species distribution, but also recognizes that they do not prove species absence and may not fully characterize the population. This analysis only relies on snorkeling data when electrofishing dataset is weak, notably in Piper Creek.

Fish habitat surveys were initially conducted in 1983 (Leathe et al 1985), but these are not used. Surveyors visually estimated very long reaches and ascribed a single numeric value for pools, percent gravels, etc. This methodology is not repeatable or verifiable. In 1994 and 1996, PCTC tallied habitat features in various 984-foot (300 meter) segments of Piper Creek and Lion Creek. These surveys adequately sample numerous representative areas of stream and could be repeated. However, no protocol is available that details how habitat features were measured (i.e., how was wood measured). The PCTC surveys provide similar findings to more current data, but it was not used to assess trends. In 1994, the Forest Service collected data for over 3.7 miles (6 kilometers) on Lion Creek using methodology defined by Overton et al. (1997). This survey technique sequentially samples every microhabitat feature of a stream and, thereby, avoids the possibility of selecting an unrepresentative area. Habitat features, such as woody debris, pool dimensions, and others, are defined in essentially the same manner as more current surveys, allowing comparison. However, that survey does not have a fixed sampling location and cannot be used for long-term monitoring. The assumption is made that the 1994 Lion Creek survey correctly quantifies and averages habitat features for over 3.7 miles (6 kilometers). A select area near the

proposed salvage units was sampled in 2008 to verify if the 1994 Survey is still valid and adequately characterizes the stream outside the initial survey area.

In the late 1990s, fish habitat surveys focused on quantifying microhabitat features in smaller representative areas. These surveys offer superior ability for monitoring since they focus on specific areas and have carefully defined habitat measurements to avoid observer bias (Roper et al. 2004). Protocol evolved gradually until it was finally written down in 2006 (USDA Forest Service 2006). This analysis assumes the gradual change in protocol is trivial and the original surveys are compatible to more recent surveys. This protocol offers statistically defendable methodology for numerous habitat attributes including substrate condition, bank condition, and residual depths of pools. The weakness of this type of survey is that it may not fully typify the rest of the stream, especially since the survey is logistically consuming and managers seldom can afford to survey more than one location per stream. It is assumed that the information collected on these recent surveys is the most trustworthy data and adequately represents the stream condition elsewhere. These recent surveys are available in lower Goat Creek and the headwaters of Lion Creek.

In addition to these surveys, a few other data sources are used. These surveys were conducted independently of assessments described above. First, MDFW&Ps has annually collected McNeil Core Samples in one select riffle in Lion Creek and Goat Creek since 1987. This provides valuable monitoring information about sedimentation in these streams. Second, a low-elevation series of aerial photography was collected along all 66 miles of the Swan River in 2003. This data is valuable for characterizing a river that is otherwise difficult to wade, survey, and measure. Third, numerous water temperature measurements have been collected in the Swan River and certain tributaries by the Swan Ecosystem Center since 2005. The locations of habitat assessments on Lion Creek are shown in Project File Exhibit L-1. The locations of assessments for the other analysis areas are described in the Existing Condition Section of this EA.

Measurement Indicators

This analysis focuses on five measurement indicators, namely:

1. Large woody debris,
2. Pools,
3. Water temperature,
4. Sedimentation, and
5. Management indicator species.

These components could potentially be impacted by the Mid Swan Blowdown Project. Other fish habitat components such as habitat connectivity, bank stability and channel dimensions are not anticipated to be impacted and are not reviewed further. One particular INFISH Riparian Management Objective, the wetted width/depth ratio, is not analyzed in this document, as detailed in Project File Exhibit L-6.

1. Large Woody Debris

The term “large woody debris” describes fallen logs or root wads that are either fully submerged or seasonally submerged in the stream. The wood must be large enough to interact with stream flow and not be swept away. Large woody debris is crucial to fish habitat. Large woody debris provides hiding cover, scours pools, traps bedload, creates overhead shade, and serves as habitat for aquatic insects that fish prey upon. Several studies have found a strong correlation between bull trout occurrence and large woody debris (Rich et al 2003) (Bonneau and Scarnecchia 1998) (Rich 1996).

Large woody debris is recruited into streams either slowly over time as individual trees die, or in episodic events. Disturbances like wildfire, floods, insect infestations and strong wind events can topple many trees into the stream all at once. These trees are then sorted and

used by the stream and may last for decades until they rot away. This allows time for new trees to become established along the stream bank, beginning the cycle all over again. The strong winds from July 2008 are presumably within the range of normal events.

INFISH established a Riparian Management Objective (RMO) of at least 20 pieces per mile of wood greater than 1-foot diameter and 35-feet long. A local dataset found that unmanaged streams in the Swan Valley tend to have between 84 to 932 pieces of wood per mile at least 0.3 feet (10 centimeters) diameter and 9.8-feet (3 meters) long (Gardner et al 2007). The different definition of minimum sizes means that INFISH and the local dataset are not necessarily compatible goals.

In 1994, approximately 3.7 miles (6 kilometers) of Lion Creek was surveyed using the methodology described by Overton et al (1997) (Project File Exhibit L-1). The survey tallied every piece of wood at least 4 inches (10 centimeters) diameter and 3.3 feet (1 meter) long. It also measured the dimensions of a representative subsample of the qualifying wood. A smaller area of the headwaters of Lion Creek (reach 7) was surveyed in 2003 and monitored again in 2008 following Forest Service (2006) protocols. Minimum size criteria did not change but no measurements of dimensions were taken. Additionally, a 328-foot (100 meter) length of Lion Creek near proposed Unit 3 (reach 1) was sampled after the blowdown event. This survey was intended to validate if the 1994 Survey still adequately characterizes Lion Creek adjacent to the proposed units.

2. Pools

Pools are deeper, slower portions of a stream created by plunges, sharp bends, changes in substrate, beaver dams or scouring by large woody debris. Pools are critical to fish habitat as they provide feeding and resting areas. Deep pools are especially needed to provide habitat during winter months.

Determining what makes a qualifying pool has changed over time making it difficult to monitor trends. The 1994 Survey characterized over 3.7 miles (6 kilometers) of pool habitats based on Overton et al (1997). The protocol provided numerous pictures and illustrations of pool habitats, but ultimately relied on the surveyor's judgment to decide what constitutes a pool. The 2003 survey used a much more rigid definition of pools, which tended to count fewer pools than older data (Forest Service 2006). This protocol was revised again in 2008 to accommodate more pools, but still has fewer pools than Overton et al (1997). INFISH established various goals of pool frequency (varies by channel size) but does not define what is a pool. Likewise, the local dataset (Gardner et al. 2007) suggests a range of pool frequency, but has no definition of what is a pool. All the survey protocols do agree on how to measure a pool's dimensions; but without consistency in tabulating pools, the data cannot be used for monitoring. Based on the District Fisheries Biologist's familiarity with how fish use pools, this analysis assumes the 1994 Survey is the most accurate assessment of pool frequency and the 2003 to 2008 surveys are not used.

3. Sedimentation

Sedimentation into trout streams is considered a key concern, and the most frequently cited type of pollutant in streams of the Pacific Northwest (Bauer and Ralph 2001). In 2004, the Montana Department of Environmental Quality (DEQ) identified sedimentation from tributaries of the Swan Valley as one of the reasons for concern about water quality in Swan Lake (DEQ 2004). In discussions about local fisheries habitat, sedimentation is narrowly focused on the amount of silt, sand, clay, and small gravels that are less than 0.25 inches (6.35 millimeters) in diameter. This is based on local fisheries research (Weaver and Fraley 1991) and commonly referred to as "fine sediments."

The amount of fine sediments in a stream can profoundly affect the quality of fish habitat. Trout lay their eggs in between gravel substrate; and, if these eggs are covered with fine sediments, they may suffocate (McIntyre and Rieman 1995) (Weaver and Fraley 1991) or have delayed emergence (Fudge et al. 2008). Furthermore, the vast majority of aquatic insect species depends on cobble and gravel substrate that is not “embedded” or stuffed with fine sediments. In extreme cases, where fine sediment is very thick, it can fill in pool habitat and bury logs that fish need for cover and rest. The exact relationship of fine sediment to fish population density is notoriously hard to correlate since fish respond to many habitat variables. Nevertheless, it is commonly accepted that limiting sedimentation is an important way to maintain the health of aquatic resources.

Though fine sediment is an important parameter, there are no regulatory standards and no consensus on how to quantify the effects (Bauer and Ralph 2001). The challenge comes from the extremely dynamic nature of substrate conditions as it can vary naturally from stream to stream, riffle to riffle, and year to year (Everest et al. 1987). Riparian Management Objectives recommended by INFISH do not have any numeric value for sedimentation. However, the Flathead Basin Commission (1991) recommends that bull trout streams with more than 35 percent fine sediment be considered as “threatened” and streams with more than 40 percent be considered “impaired.” These are recommendations, not a regulatory standard.

Two sources of data on sediment were used: (1) McNeil Core Samples and (2) Wolman Pebble Counts. McNeil Core Samples have been routinely collected at a select riffle in Lion Creek and Goat Creek since 1987. The samples sort various substrate categories by weight within a core that extends 5.9 inches (15 centimeters) below the stream surface (Weaver 2006). Core samples are assumed to offer superior ability to detect and monitor changes in fine sediment over time. Core samples are logistically expensive, and, therefore, Wolman Pebble Counts have been more widely used in the other habitat surveys. Pebble counts consist of measuring the average diameter of at least 100 samples within a riffle. Pebble counts have been widely accepted as reproducible data (Kondolf 1997), and it is the professional opinion of the District Fisheries Biologist that local pebble count data has done an adequate job to minimize variability caused by time of year and observer bias (Olsen et al. 2005). However, Archer et al. (2004) caution that over 100 individual pebble counts are needed to be confident of detecting change at the stream level. Therefore, this analysis assumes core samples are superior for monitoring, while pebble counts are acceptable for inventory, but acknowledges uncertainty about monitoring accuracy.

4. Water Temperature

Water temperature is well understood to be critical for all aquatic life forms; trout require cold water. Since fish can tolerate short-term spikes in temperature, a simple maximum temperature is not as valuable as characterizing stream temperature by averaging the temperature over the warmest 7 consecutive days of the years (usually in late July). This is called the Maximum Weekly Average Temperature (MWAT). Bull trout can tolerate MWAT up to about 15° Celsius (USFWS 1998), but optimal temperatures are about 50°F (10°C) (Rieman and Chandler 1999). Cutthroat trout prefer warmer temperatures with optimal habitat at 53.6°F (12°C) and can tolerate up to 68°F (20°C) (Hickman and Raleigh 1982).

Beginning in the early 1990’s, technology advanced so that temperature could be read every 30 minutes and stored all season. This allows accurate computation of MWAT. The majority of the temperature data used in this analysis was collected by Swan Ecosystem Center. It is assumed the location of the thermometers adequately characterized the overall stream.

5. Management Indicator Species

There are numerous native aquatic species, including fish, amphibians, and invertebrates. The Forest Plan has identified bull trout and Westslope cutthroat trout as management indicator species (MIS). These indicator species were selected because they are sensitive to habitat degradation, native to the area, and their biological requirements have been documented through research. The Forest Plan assumes that management for these two indicator species would adequately provide habitat requirements for all other native species. Methodology used to characterize the status of these species was described earlier.

Affected Environment

Historic Condition

The historic condition of fish populations and fish habitat is unknown. The earliest available data dates to 1982, several decades after initial human activities in the Swan Valley. Presumably, historic conditions varied over time as streams were subjected to floods, fires, and other natural disturbance. The lack of historical data is a common problem. It is considered acceptable to use data on unmanaged, reference streams as a surrogate for historical data (Kershner et al 2004). This analysis employs local reference stream data, prepared by Gardner et al. (2007) to help evaluate the existing condition. Project File Exhibit L-5 provides further information on this reference stream database.

Existing Condition

Lion Creek

Large Woody Debris

Field assessments by the District Fisheries Biologist observed that while the blowdown near Lion Creek was impressive, it was not so extreme that it would harm or degrade the channel. Debris torrents (debris flows) are not anticipated. Some debris jams are anticipated, but none so massive that they would block fish migration. A sample of 328 feet (100 meters) of Lion Creek found that relatively little of the new blowdown has entered the stream channel; instead it is lying next to the channel or is suspended over the channel. It may take a few years before the majority of the wood is captured by the stream.

The following table characterizes the condition of large woody debris in Lion Creek based on the 1994, 2003, and 2008 surveys. Frequency of wood is compared to INFISH RMOs (USDA Forest Service 1995). It is also compared to an expected range based on Gardner et al. (2007) analysis of unmanaged streams in reference condition. It should be noted that Upper Lion Creek (above the waterfall) is part of Gardner’s database, so it automatically assumes that Lion Creek is within natural range of variability.

TABLE 3-47.

AVAILABLE DATA ON LARGE WOODY DEBRIS IN LION CREEK AS COMPARED TO INFISH OBJECTIVES AND REFERENCE STREAM CONDITIONS. THE LOCATIONS OF THE DATA SURVEYS ARE ILLUSTRATED IN PROJECT FILE EXHIBIT L-1, FIGURE 1

Survey Location Number and Year	Average Diameter and Length	Comparison to Local Dataset. Pieces Greater than 0.1 m diameter and 3m long	Comparison to INFISH. Pieces Greater than 1 Inch Diameter and 35' long. RMO is 20 per mile	Interpretation
Reach 1. Low gradient area 2008 survey	Not recorded	531 pieces per mile (15% is from new blowdown). This is within normal range	Not recorded. Assumed to be similar to reach in following row.	Wood is plentiful but small in size. New blowdown adds more small wood
Reach 2. Low gradient area 1994 Survey	11.8 feet (0.3 meter) diameter and 25.6 feet (7.8 meters) long	233 pieces per mile. This is within normal range	Approximately 18 per mile. Slightly less than RMO	Wood is plentiful but small in size
Reach 3. Low gradient area. 1994 Survey	11.8 feet (0.3 meter) diameter and 49 feet (15 meters) long	367 pieces per mile. This is within normal range	Approximately 137 per mile. Exceeds RMO	Plenty of large wood
Reach 4. High gradient area. 1994 Survey	2.6 feet (0.8 meter) diameter and 52.5 feet (16 meters) long	15 pieces per mile. Far less than normal	Approximately 15 per mile. Less than RMO	Wood is scarce but very big. This should be expected in such a steep gradient
Reach 5. Low gradient area. 1994 Survey	1.3 feet (0.4 meters) diameter and 55 feet (17 meters) long	910 pieces per mile. Considered natural condition	Approximately 520 per mile. Exceeds RMO	Plenty of large wood.
Reach 6. Moderate gradient area	11.8 feet (0.3 meter) diameter and 45.9 feet(14 meters) long	148 pieces per mile. Considered natural condition	Approximately 63 per mile. Exceeds RMO	Plenty of large wood
Reach 7. Moderate gradient area. 2003 and 2008 surveys	Not recorded.	724 pieces per mile* in 2003. 885 pieces per mile* in 2008	Not recorded. Due to high frequency, probably has plenty of large pieces	Plenty of wood. New blowdown adds more wood

* These surveys defined wood as greater than 0.3 feet (0.1 meter) diameter and 3.3 feet (1 meter) length. Thus, it is likely these surveys overrepresented wood as compared to other surveys.

Based on the available data, it is concluded that the majority of Lion Creek had plenty of large woody debris even before the July 2008 wind event. In the upper valley (above the waterfall), the wood was very abundant and had many particularly large pieces. This area has had no past land management other than the construction of a hiking trail and outfitter camp. Since these actions could not have impacted large woody debris in Lion Creek, it is concluded the existing condition is natural. The July 2008 wind event presumably toppled trees in the upper valley. Monitoring of a selected area in the headwaters found a 19 percent increase of wood, probably due to recent blowdown.

Below the waterfall, wood was also very plentiful, but not as large, resulting in not always meeting INFISH objectives. As reviewed in the Cumulative Effects Worksheet (Project File Exhibit L-2), this is thought be a natural condition along most of the stream length. Past harvest activity has had only trivial increases in water yield, thus has not indirectly altered channel conditions. There have been no fires in the Lion Creek Watershed in recorded history. The majority of past vegetation management took place in upland areas, outside the valley floor. The only lingering impact from past vegetation management appears to be that about 0.12 miles (200 meters) of PCTC land and 0.19 miles (300 meters) of private lands removed a portion of floodplain timber within the past two decades (based on aerial photography assessment). These two harvested areas total approximately 4 percent of the

stream length below the waterfalls. It is concluded that these areas probably have insufficient large woody debris, but it too localized to impact the overall fish habitat.

Two exceptional areas are 328 to 492 foot (100 to 150 meter) length patches each on unnamed tributaries to Lion Creek, nicknamed “Tumble Creek” and “Trickle Creek.” These stream reaches acquired far more blowdown than anywhere else in the project area. Tumble Creek is an intermittent stream with a near-continuous line of blowdown trees fallen within its small canyon. Trickle Creek is a cold, perennial stream about 0.6 feet (0.2 meter) deep even more completely buried. Large, blowdown trees are stacked up over the stream at 6.6 to 13.1 foot (2 to 4 meter) depths. Neither Tumble Creek nor Trickle Creek have enough stream power to use or move the wood. While being buried under wood is probably not harmful, it is assumed that the wood would rot away long before it could ever be used by the stream.

Pools

Lion Creek’s existing condition is that some reaches have plenty of pools and some have fewer than expected pools. The pools are deep and offer superior fish habitat. It is assumed that the pool habitat in Lion Creek has been unaffected by past land management. As reviewed in the Cumulative Effects Worksheet (Project File Exhibit L-2) and Lion Creek Watershed Assessment (Project File Exhibit R-1), the past vegetation management and relatively low road density has not caused water yields to increase. Lion Creek’s channel morphology has been unaffected. Likewise, nearly all of the vegetation in the floodplain has been untreated (with the exception of only a small amount of private land); therefore, woody debris needed to scour pools is within natural conditions. The following table summarizes the existing condition of pool habitat within Lion Creek.

TABLE 3-48.
AVAILABLE DATA ON POOL HABITAT CONDITION AND COMPARISON TO INFISH OBJECTIVES AND REFERENCE DATA
DATA SURVEY LOCATIONS ARE SHOWN IN PROJECT FILE EXHIBIT L-1

Location and Year of Survey	Number of Pools & Residual Depth of Pools	INFISH RMO	Comparison to Local Dataset	Interpretation
Reach 2. 1994 Survey	12.2 Per mile. Depth is 9.8 feet (3.0 meters)	47 per mile No standard for depth	44.38 per mile. Depth is 0.46m	Pools are sparse but extremely high quality
Reach 3. 1994 Survey	45.3 per mile Depth is 2.6 feet (0.81 meter)	47 per mile No standard for depth	49.95 per mile Depth is 0.46m	Sufficient number and quality of pools
Reach 4. 1994 Survey	33.3 per mile Depth is 3.6 feet (1.09 meters)	56 per mile No standard for depth	67.03 per mile Depth is 0.43m	Pools are sparse but high quality
Reach 5. 1994 Survey	61.8 per mile Depth is 2.9 feet (0.88 meter)	56 per mile No standard for depth	53.32 per mile Depth is 0.43m	Sufficient number and quality of pools
Reach 6. 1994 Survey	11 per mile Depth is 3.0 feet (0.94 meter)	56 per mile No standard for depth	49.1 per mile Depth is 0.42m	Pools are sparse but high quality

Sedimentation

The core sample data for Lion Creek is displayed on Figure 3-6 below, along with the average core sample results for all nine annually monitored streams in the Swan Valley. The location of the coring monitoring is shown in Project File Exhibit L-1 (Figure 1). Fine sediment levels peaked in 1990 and then declined to lower levels (similar to all other streams). Lion Creek has fairly consistently had more fine sediment than most bull trout streams in the Swan Valley. The Flathead Basin Commission (1991) recommends that bull trout streams with more than 35 percent fine sediment be considered as

"threatened" and streams with more than 40 percent be considered "impaired." Under this strategy, Lion Creek would be considered "threatened" and the Commission recommended landowners should minimize new sediment production. However, as described earlier, there are no regulatory standards for sediment.

The 21 pebble counts collected in 1994 found that fine sediment ranged from 14 to 32 percent of the total stream bed. This is somewhat higher than the normal range found in unmanaged, reference streams although the statistical rigor of the fine sediment dataset is weak (Gardner et al. 2007).

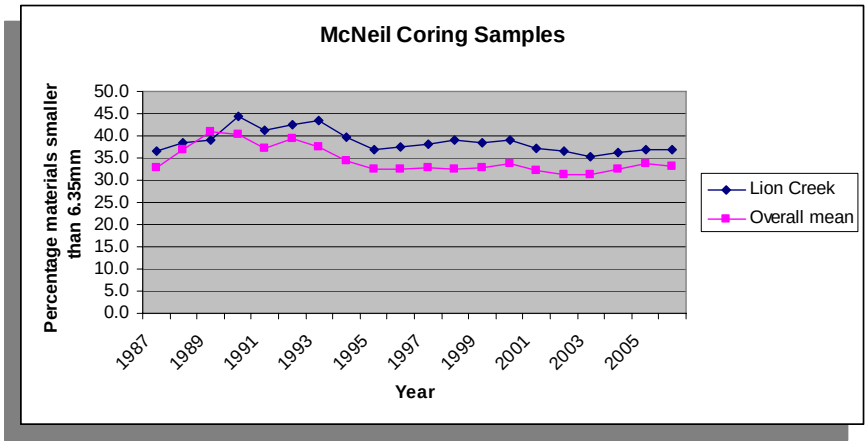

Figure 3-6. Results of McNeil Coring Sampling on Lion Creek in Comparison to All Nine Monitored Streams in the Swan Valley. Data provided by MTDW&P.

The best available data indicates that the fine sediment level in Lion Creek is largely a natural phenomenon. Weaver and Fraley (1991) noted that while Lion Creek was considered "undisturbed," it had "significant natural sediment sources with high levels of channel storage." In 1996, DEQ listed Lion Creek as "impaired" from sedimentation, but then removed it from the list in 2000 based on the evidence that Lion Creek was clearly supporting a native, coldwater fishery (DEQ 2004).

While the sedimentation in Lion Creek is mostly natural, past land management actions have probably contributed a small amount. Typical sediment sources in the Swan Valley tend to be poorly designed roads and/or stream bank erosion. Lion Creek has about 1.4 miles of roads per square mile and all are within the lower elevations (none in the upper 2/3 of the Basin). As discussed in the Lion Creek Watershed Assessment (Project File Exhibit R-1), the low road density and desirable location means it is unlikely past road construction contributed much sediment. The DEQ (2004) completed an inventory of most roads in Lion Creek and found that current road erosion in Lion Creek was only 1.3 percent above background levels. Furthermore, a very small amount of continuous erosion is coming from hiking trail crossings and horse fords. A 1987 intermediate harvest by PCTC immediately adjacent to Lion Creek may have also contributed a small amount of erosion (not confirmed). No other lingering impact from past harvest is known.

Water Temperature

The water temperature of Lion Creek varies by location. Near the stream's confluence with Swan River, thermometer readings from 2005 to 2007 found MWAT to range between 51.8 and 53.6 F (11 and 12 C). The stream reach is cold enough for bull trout migration and rearing, although it has some daily temperature fluctuations and does not appear dominated by groundwater. Further upstream, a thermometer set in 2000 found the MWAT at 47.8 F (8.8 C). Daily temperature readings fluctuated by only 1 C, which indicates considerable influence by groundwater. This area is used by bull trout for spawning habitat. The extreme headwaters of Lion Creek are apparently more influenced by snowmelt than groundwater and the MWAT in 2003 and 2008 was between 50 F and 59 F (10 C and 15 C) (original data not preserved). This is optimal for cutthroat trout habitat, but not for bull trout spawning. There is no indication that Lion Creek's temperature has been adversely impacted by any land management to date. The stream meets the INFISH objective of less than 59 F (15 C) for adult holding habitat and less than 48.2 F (9 C) for spawning habitat.

Management Indicator Species

Lion Creek is a key bull trout spawning and rearing stream and considered an INFISH priority watershed. Private land on Lion Creek is designated as critical habitat by the USFWS. Bull trout spawning habitat extends from the mouth of Lion Creek upstream for about 6.8 miles (11 kilometers) to a waterfall in T22N, R17W, Section 13 (Project File Exhibit L-1, Figure 1). Bull trout have never been found above the waterfall. Due to the importance of Lion Creek to the Swan Valley bull trout population, all fishing in Lion Creek has been prohibited since 1985.

Bull trout redds have been counted in Lion Creek every year since 1982. From 1982 to 1995, Lion Creek averaged about 75 bull trout redds per year, which was roughly 20 percent of the overall census for streams surveyed in the Swan Valley. In 1995, biologists began to census more streams. This was about the same time when the overall bull trout population began to strongly increase. From 1995 to 2008, Lion Creek averaged about 130 bull trout redds per year. This increase was typical throughout the Swan River Valley, and Lion Creek still tends to contribute about 20 percent of the overall bull trout redd count. The 2008 redd count of 92 redds was lower than usual. Surveyors speculated the cause of the 2008 decline was that all the freshly toppled trees made it very difficult for biologists to observe redds (Tom Weaver, MDFW&P biologist, personal communication December 1, 2008). Figure 3-7 illustrates the overall Swan Valley redd counts and Lion Creek's redd counts.

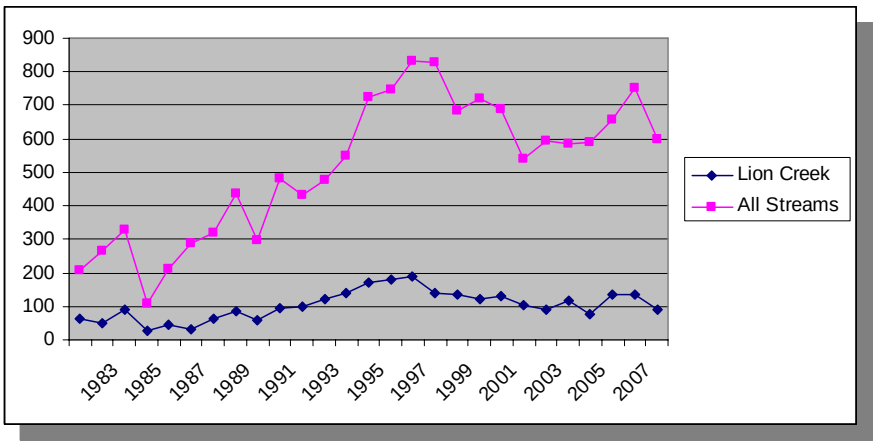

Figure 3-7. Results of Annual Bull Trout Redd Counts in Lion Creek in Comparison to the Total of all Other Inventoried Streams in the Swan Valley. Data provided by MDFW&P.

In addition to redd counts, population estimates where conducted in 1982, 1994, and 2000 to characterize the overall stream fish population. The surveys were not designed as monitoring efforts and not compatible to each other, but they all found similar results. Juvenile bull trout are fairly common from the mouth of Lion Creek to the waterfalls. From 1988 to 2005, a select representative area of Lion Creek was monitored most years to assess trends of juvenile bull trout. Juvenile bull trout densities have remained fairly constant through the years (averaging 2.3 juvenile bull trout per 1076 square feet (100 square meters) of surface area (Weaver 2006). The steady numbers of juvenile bull trout densities in spite of increased redd counts may be an indication of the deleterious impact of non-native brook trout (*Salvelinus fontinalis*).

Brook trout were stocked in the Swan Valley in the 1930's and 1940's and are now widespread and abundant. Brook trout are common throughout Lion Creek up to the waterfalls. Brook trout can spawn with bull trout, resulting in a hybrid species. The hybrids may attempt to dig redds or spawn with pure bull trout, thus potentially misleading redd counts. In 1992, researchers searched for hybrid fish in five streams in the Swan Valley. Eleven first generation hybrids and one subsequent generation hybrid were documented in Lion Creek, more than any other stream. In 2006, further investigation of Lion Creek determined that the total number of hybrids has not increased over the years, nor do the hybrids appear to be fertile (Fredenberg, DeHaan, and Ardren 2007). The authors postulate that the large bodied, migratory bull trout may be crucial to prevent further genetic introgression.

Westslope cutthroat trout are also native to lower Lion Creek up to the waterfall, but they have never been numerous. The 1982, 1994, and 2000 population estimates all found relatively low densities of cutthroat trout. It is uncertain if the low numbers of cutthroat trout are natural or depressed due to competition with brook trout. The genetic purity of these cutthroat trout are not known; and since there is no barrier to block non-native rainbow trout, it is likely that the population is hybridized to some degree. Above the waterfalls, Lion Creek was historically fishless. However, cutthroat trout were illegally introduced to a headwater lake decades ago. The cutthroat trout are now widespread and well established throughout Upper Lion Creek.

Swan River

Large Woody Debris

An aerial assessment of the entire river was completed in 2003. This effort found the Swan River has abundant large woody debris, primarily in debris jams, although the exact amount is not quantified. The District Fisheries Biologist considers the Swan River to be largely unconfined and undeveloped and, consequently, capable of maintaining complex fish habitat with numerous pools, riffles, runs, and debris jams. In the 2.5-mile long Mid Swan Analysis Area, woody debris appears abundant, except immediately above the Piper Creek Bridge (FDR #966). This bridge has a center pier and is vulnerable to catching debris in the river, forcing officials to routinely clear woody debris at the bridge. Relatively little blowdown from the July 2008 storm entered the Swan River itself. A small patch of trees toppled into the Swan River from the west banks both above and below the Piper Creek Bridge. About eight of these trees were immediately upstream of the bridge. Due to potential damage to the bridge, the Forest Service removed those trees within a few weeks after the blowdown. No other trees were removed.

Pools

The number and dimensions of pools in the river are not known, but it is assumed to be in good condition. The District Fisheries Biologist reviewed aerial photographs of the river taken in 2003 and noted that the river is unconfined, has abundant debris jams and has very little development intruding with the floodplain. These factors imply that the Swan River has pool frequency and quality within natural ranges.

Sedimentation

During the development of a TMDL for Swan Lake, the DEQ ascribed that a possible cause for the lake impairment was from excessive sedimentation in Swan River. The DEQ calculated that the Swan River carries approximately 24 percent more sediment than its natural background. The primary source for the sediment is from poorly designed road/stream crossings throughout the valley (DEQ 2004). The river banks themselves were not a key sediment source. Less than 1 percent of the river banks were deemed erosive due to human impacts.

Water Temperature

The Swan River is 66 miles long and water temperature varies as it passes through different elevations, channel types and tributary streams. The nearest temperature monitoring location on the Swan River is at the Salmon Prairie Bridge, located about 2.5 miles (4 kilometers) upstream of Lion Creek confluence [about 3 miles (4.8 kilometers) upstream of the analysis area]. Thermometer readings from 2005 to 2007 found MWAT to range between 66.2 to 68 F (19 to 20 C) every year. The Swan River is warmer than the INFISH objective. This is beyond bull trout tolerance, but since it takes place in mid-summer when bull trout are not present, it is assumed to have no impact. Bull trout obviously have no difficulty migrating through the river the rest of the year. Cutthroat trout are present year-round in this river stretch and can tolerate these temperatures although it is not optimal.

Although considerable land management has taken place in the Swan River Watershed, there is no indication of any water temperature degradation. No concern about water temperature has been identified in the Swan Lake Watershed TMDL Report (DEQ 2004) or the 1996 Bull Trout Status Report (Montana Bull Trout Scientific Group 1996). To the best available knowledge, the Swan River has never had summertime fishing restrictions due to thermal stress.

Management Indicator Species

The Swan River contains both native and non-native species. Native bull trout use the river for subadult rearing and also adult migration corridors on their way to spawning streams. No bull trout spawning takes place in the river. All private land on the Swan River is designated as critical habitat for bull trout. Cutthroat trout also migrate freely through the river and likely occupy deep pools during the winter months. Other native fish include mountain whitefish, slimy sculpins, longnose suckers, and peamouths. Non-native fish include rainbow trout, lake trout, northern pike, central mudminnows, yellow perch, and brook sticklebacks.

Piper Creek

Large Woody Debris

In 1996, PCTC characterized approximately 10 miles (16 kilometers) of Piper Creek with visual estimates of how much cover was provided with woody debris, as well as noted the condition of the riparian forest. From this, PCTC's technical specialists concluded that all of Piper Creek has "on target" amounts of woody debris, high future recruitment potential, and overall moderate or high channel sensitivity to wood (PCTC 1997). Since the completion of the watershed assessment by PCTC, numerous homes have been built along about 0.4 miles (700 meters) of lower Piper Creek near its mouth. Based on an assessment from aerial photography, it appears that a considerable amount of vegetation was cleared in that area; and, as a result, it is assumed that large woody debris is deficient in that area. The remaining 90 percent of length of fish habitat is presumed to still have plenty of woody debris.

Much of Piper Creek experienced blowdown from the July 2008 storm, but the exact amount and extent has not been quantified. The Mid Swan Blowdown Project has a single proposed unit located about 1.2 miles (2 kilometers) upstream of Piper Creek's river mouth In this area, PCTC classified the channel as "Type #4: Moderate Gradient Avulsing." This channel type is regarded as "highly sensitive" to wood and dependent on woody debris for formation of pools, storage of sediments, and creation of side channels and valley floor migrations (PCTC 1997). The District Fisheries Biologist observed how the 2008 blowdown event contributed scattered amounts of very large wood in this stream reach. Virtually none has affected the channel to date, but the Biologist anticipates that the wood would substantially impact the stream channel during the 2009 spring runoff.

Pools

The number and dimension of pools in Piper Creek is unknown. Since neither the watershed assessment prepared by PCTC (1996) nor the TMDL Report for the Swan Lake Watershed (DEQ 2004) identified any concern with pool habitat in Piper Creek, it is assumed to be in good condition.

Sedimentation

In 1989, DEQ noted "moderate impairment from fine sediments thought to result from timber harvest and roads." In 1996, the DEQ listed all of Piper as "impaired" but later refined this in 2000 as only having Piper Creek below the Moore Creek confluence as listed. However, in 2004 DEQ concluded that

> *"land use activities are not currently causing an impairment for sediment or stream channel habitat conditions".*

DEQ noted that periphyton results and evidence of bull trout spawning would indicate that sediment levels are within normal range. The road/stream crossings survey also found very few erosion point-sources in the Piper Creek Watershed. Piper Creek is no longer considered "impaired" by the DEQ (2004). No other data is available, and it is concluded that sediment levels in Piper Creek are natural and have not been substantially impacted by land management.

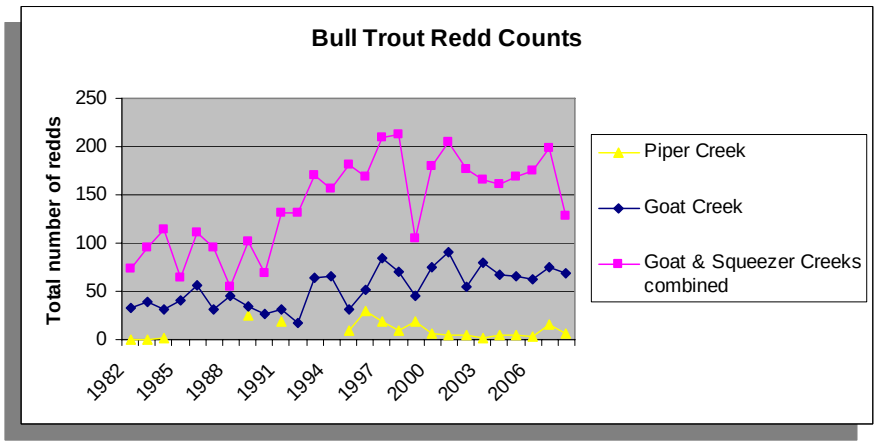

Figure 3-8. Results of Bull Trout Redd Counts in Piper Creek, Goat Creek and the Combined Goat and Squeezer Creek Drainage. Data provided by Montana Fish, Wildlife and Parks.

Water Temperature

A thermometer set in Piper Creek approximately 2.5 miles (4 kilometers) upstream from the mouth found MWAT to be 53.6°F (12°C) in 2002. In 2008, a thermometer set another kilometer upstream found the MWAT to be 48.2°F (9°C). Piper Creek meets the INFISH objective for adult holding habitat, but is borderline if it meets spawning habitat criteria. However, judging by fish population data and redd counts, the stream does support spawning habitat and temperature does not appear to be a limiting factor.

Management Indicator Species

Piper Creek is considered a bull trout priority watershed and has designated critical habitat on private land. The extent of spawning habitat is not fully known but thought to extend for roughly 2 miles (3.2 kilometers) ending near the Moore Creek confluence. Redd counts have been collected intermittently since 1982 and range from 0 to 25 redds. As shown in Figure 3-8, there is no clear upward or downward trend. The District Fisheries Biologist has observed numerous brook x bull trout hybrids in Piper Creek, which suggests the bull trout population may be threatened. Cutthroat trout are numerous through the drainage all the way to the extreme headwaters. The genetic purity of cutthroat trout is unknown, but it is speculated that the upper few miles are pure since a high gradient cascade may block invasion by rainbow trout.

Goat Creek

Large Woody Debris

A considerable amount of Goat Creek, and its tributary Squeezer Creek, had riparian vegetation management from 1970 to 1984. In 1996, all of Goat Creek was listed as “impaired” by the DEQ due to flow alteration, organic enrichment, siltation, and habitat alteration. The basis for this listing from apparently from a 1989 survey that noted poor riparian harvest practices in the lower reaches (original survey report is not available). The following year, PCTC prepared a watershed assessment and characterized approximately 11 miles (17.7 kilometers) of Goat and Squeezer Creek. The entire watershed had “on target” amounts of woody debris, high future recruitment potential but varying amounts of channel sensitivity to woody debris (PCTC 1997). In 2004, DEQ edited the list of “impaired” streams and deleted all concern about habitat alteration in Goat Creek (but retained concern about siltation). The DEQ reported that aerial assessments did not identify any riparian concerns and “earlier problems were no longer an issue.” A 2003 habitat assessment near the mouth of Goat Creek found 1,142 pieces of large woody debris per mile greater than 3.9 inches (0.1 meter) diameter and 3.9 inches (1 meter) in length. Although this survey uses different definitions of large woody debris than the local dataset of reference streams (Gardner et al. 2007), it is assumed that wood is plentiful and within normal expected range. Based on these data, it is concluded that while fish habitat conditions in Goat Creek may have previously been poor, conditions have recovered, and past land management no longer has an impact on large woody debris. There has been no recent blowdown within Goat Creek’s riparian area, but a considerable amount is reported on Squeezer Creek on PCTC lands. The Mid Swan Blowdown Project proposes to salvage harvest an upland area in the Goat Creek Watershed, but there is no blowdown near Goat Creek itself.

Pools

Although Goat Creek was initially considered “impaired” due to habitat alteration, the 2004 TMDL Report concluded that the physical channel features of Goat Creek were acceptable (Montana DEQ 2004). A habitat survey near the mouth of Goat Creek in 2003 found 71 pools per mile, which exceeds INFISH objectives and the local dataset. Considering that the 2003 survey protocol tends to underrepresent pools anyway, it is assumed that pool habitat in Goat Creek is within natural range.

Sedimentation

There are conflicting reports about the existing condition of sedimentation in Goat Creek. On one hand, McNeil Core Sample monitoring since 1987 has found Goat Creek consistently has fewer fines than the average of Swan Valley streams. The most recent samples found 31 percent fine sediments, which is below a threshold of concern suggested by the Flathead Basin Commission (1991). Conversely, in a paired watershed study Ellis et al. (1999) concluded that suspended sediments and nutrient loading resulted in poor water quality in Goat Creek compared to unmanaged Lion Creek. The authors were unable to determine if Goat Creek’s condition was natural or as a result of land management. While acknowledging that Goat Creek has low levels of sediment deposition, DEQ continues to list Goat Creek as “impaired” due to higher than expected levels of suspended sediments (turbidity) (2004). The DEQ recommends that sediment sources from forest roads be curtailed to reduce the stream’s turbidity.

Water Temperature

The only available information on Goat Creek’s temperature is from a thermometer placed at the stream’s confluence with Swan River from 2005 to 2007. During this period, the outlet of Goat Creek had MWAT of 57.2 to 50°F (14 to 15°C). The lowermost portion of Goat Creek is suitable for bull trout migration, but too warm for spawning. It meets INFISH objectives for adult holding habitat, but not spawning. However, there is no indication that this is not a natural condition. The DEQ evaluation of

Goat Creek's listing as "impaired" is due to concern about sedimentation and nutrient loading, while there is no mention of thermal impairment (2004).

Management Indicator Species

Goat Creek is a bull trout priority watershed and has designated critical habitat on all Swan River State Forest land. Goat Creek has approximately 6 miles (9.6 kilometers) of spawning habitat. Due to its importance to bull trout spawning, all recreational fishing on Goat Creek has been prohibited since 1985. Redd counts have been collected annually since 1982 and results range from 17 to 91 redds. Goat Creek redd counts exhibit considerable fluctuation, but the overall trend has improved since initial surveys. Goat Creek has a large tributary called Squeezer Creek, which is also a key spawning area. It is unknown if the Goat and Squeezer Creek bull trout are one population or two separate populations (Project File Exhibit L-1).The 2008 redd counts in Squeezer Creek were considerably lower than usual, probably due to the difficulty of seeing redds amidst all the blowdown on PCTC lands (Tom Weaver, Montana FWP biologist, personal communication December 1, 2008). Cutthroat trout are also found in the lower few miles of Goat Creek and one unnamed tributary. The headwaters of Goat Creek and Squeezer Creek are devoid of fish, which is believed to be a natural condition. The genetic purity of cutthroat trout in Goat Creek is unknown.

Environmental Consequences

Lion Creek

Alternatives A (No Action) and D
Direct and Indirect Effects

Large Woody Debris

Implementing either Alternative A or D would have no potential direct or indirect effect to large woody debris. Alternative A would simply leave all the blowdown in place and allow Lion Creek to incorporate the wood. Alternative D would have no salvage within interim buffers prescribed by INFISH. The interim INFISH buffers are defined as 300 feet from a fish bearing stream, or to the outer edge of a 100-year floodplain, or to the outer edge of riparian vegetation, or to the distance of two site-potential trees, whichever is greater. This means that most of the units within the Lion Creek Watershed would have a 300-foot buffer from either side of Lion Creek, since this is the greater distance. Lion Creek is roughly 20 feet wide, so the unsalvaged corridor would average roughly 620 feet wide. The lone exception might be Unit 6, which could receive an exceptionally wide buffer because the 100-year floodplain may extend about 400 to 500 feet from the stream (will be identified by the District Fisheries Biologist or Hydrologist using survey equipment prior to implementation). Figure 3-9 provides a schematic of the 100-

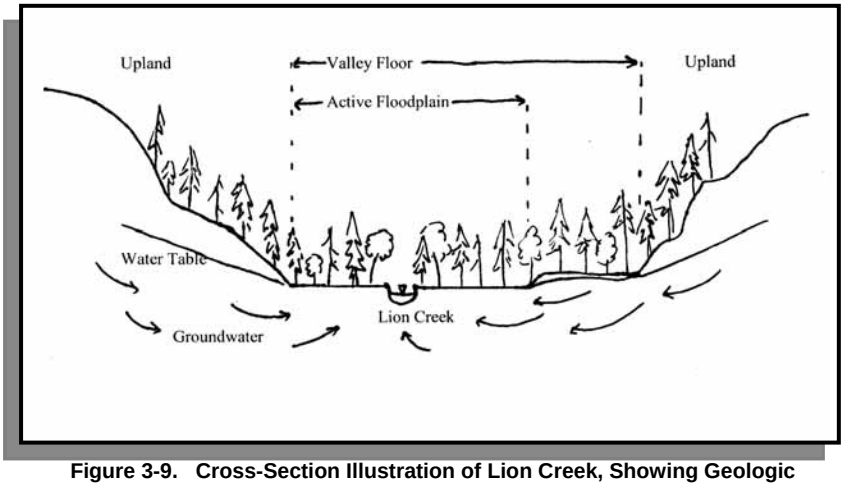

Figure 3-9. Cross-Section Illustration of Lion Creek, Showing Geologic Terms and Probable Groundwater Movement.

year floodplain (active floodplain). Trickle and Tumble Creeks, which are not fish-bearing, would have 150 and 100-foot buffers, respectively. All of these buffers are equal to or beyond the distance of a site-potential tree and beyond the active floodplain. This leaves behind all woody debris that could possibly reach the stream channels. Alternative D meets recommendations by Brown et al. (2003) and Reeves et al. (2006) for ensuring adequate woody debris supply to streams.

Pools

Neither alternative would have any direct or indirect effect to pool habitat. Actions that could have impacted pool habitat are changes in water yields, extreme sedimentation or reduction of large woody debris. Alternative A (No Action) leaves all the blowdown to natural processes and has no impact. Alternative D would salvage upland blowdown, but leaves all wood within a site-potential tree length or active floodplain, thus leaving all wood that could potentially interact with Lion Creek or its tributaries. Furthermore, this alternative would harvest only dead or dying trees, thus having no impact on water yields. Finally, as reviewed below, Alternative D would not generate sediment and, thus, has no potential impact to pool habitat.

Sedimentation

There would be no direct or indirect effect of sedimentation from either Alternative A or Alternative D. Both alternatives defer any activity within the INFISH buffers. No activity would be at least within 300 feet of Lion Creek, which is more than enough to filter sediments (USDA Forest Service 1995). Trickle and Tumble Creeks would have smaller buffers (150 and 100 feet, respectively), but these extend beyond the “canyon walls” of the stream and into the flat, upland terraces and, thus, it is physically impossible for sediments to reach the streams. Furthermore, neither alternative has any indirect sedimentation risk changes in water yield. The temporary roads or skid trails proposed in Alternative D are far from water and have no risk of sedimentation. Alternative D would include BMP application on existing roads used for haul routes. Only one site identified in the road sediment source survey (Montana DEQ 2004) would be used for haul and, therefore, have BMP’s applied to that location. This site was modeled to annually erode 1.09 tons per year into Trickle Creek. Since Trickle Creek has no surface water connection to Lion Creek, the BMP work has no real benefit to Lion Creek.

Water Temperature

Factors that could potentially influence water temperature are elevation, climate change, changes to groundwater, and exposure to solar radiation. Alternatives A and D have no impact on Lion Creek’s elevation, microclimate weather, or groundwater impacts. Furthermore, both alternatives would leave all trees, standing or down, within the riparian areas so they help shade the stream from solar radiation. Therefore, there would be no direct or indirect effects to water temperature from either alternative.

Management Indicator Species

Alternatives A or D would have no impact to any aspect of fish habitat, as described above. Alternative D would include a minimum of 300-foot buffer during implementation, and this should be sufficient to protect bull trout from any noise, light, or vibration disturbance. Alternative A (No Action) doesn’t have any disturbance at all. Recreational fishing on Lion Creek would remain closed with any alternative selected. Thus, implementation of either alternative would protect bull trout from any habitat or population disturbance. The same would be true for cutthroat trout.

Alternatives A (No Action) and D
Cumulative Effects

Large Woody Debris

As reviewed in the Existing Condition Section, past land management actions have had very little impact on Lion Creek's woody debris. The only activities that may have reduced the frequency of woody debris could have been private land clearing and a 1987 PCTC harvest adjacent to the stream. These areas total approximately 4 percent of the stream length below the waterfalls. The June 2008 blowdown would add considerably more woody debris over time (it would take a while before it enters the stream). There are no present actions that would impact woody debris. A private landowner is salvaging blowdown on upland portions of his property, but there is little streamside blowdown since he previously harvested most of the riparian trees. There are no reasonably foreseeable actions that would alter the frequency or size of large woody debris in Lion Creek. Thus, implementation of the Alternatives A or D would mean that large woody debris would increase uninterrupted in Lion Creek due to the new pulse of blowdown trees. Trickle and Tumble Creeks would have especially large amounts of woody debris. These streams are too small to handle so much wood and most of it would remain suspended over the channel throughout the analysis timeframe.

Pools

As reviewed previously, past land management activity has had little, if any, impact on Lion Creek's pool habitat. The impact of past road construction and vegetation management has not altered channel morphology. Large woody debris remains abundant along most of the stream, with the possible exception of two locations on private or industrial forest lands. There are no present activities that would alter pool habitat. Over time, the addition of new blowdown woody material would cause Lion Creek to scour or dam up new pools and also abandon older ones. There is no reasonably foreseeable action that would impact pool habitat in the future. Thus, selecting this alternative would mean that Lion Creek would continue to have good pool habitat and the blowdown would rearrange things, probably slightly increasing the overall frequency of pools. However, little or no change would be expected in Trickle or Tumble Creeks. Most of the blowdown wood is far too large for the streams, and the water would just pass under the wood without scouring new pools. Only the smaller diameter limbs could scour a few new pools, if any.

Sedimentation

As reviewed in the Existing Condition Section, the best available data indicates that existing levels of sedimentation in Lion Creek are largely natural phenomena. The cumulative effects of past and present actions have resulted in a small amount of erosion from roads, a hiking trail and possibly from a small amount of riparian harvest on private and industrial lands. The ongoing salvage of blowdown on upland portions of private lands would not generate sediment into Lion Creek. There are no reasonably foreseeable actions that would cause sedimentation. Implementation of either Alternative A or D would generate no sediment nor would it have any meaningful reduction of existing sedimentation from roads. The cumulative effects of either alternative would result in no change in Lion Creek's sediment levels. Trickle and Tumble Creek would likely have no potential for sediment and no cumulative effects.

Water Temperature

As described earlier, there are no known past or present activities that have altered Lion Creek's water temperature. Alternatives A and D would not have any potential impact to water temperature either. There is no reasonably foreseeable project that could affect water temperature but global

climate change may cause a trend towards stream temperature warming. Implementation of Alternatives A or D would not add to or modify this possible warming trend.

Management Indicator Species

As reviewed in the Cumulative Effects Worksheet (Project File Exhibit L-2), there have been past factors that contributed to a decline of bull trout in the Swan Valley. Historic logging practices and road construction caused a perceived, but not documented, habitat decline. However, due to improved logging practices, better road conditions and elimination of most recreational harvest, bull trout numbers began to increase in the early 1990s. Lion Creek has consistently been a vital spawning and rearing stream for the Swan Valley population, averaging about 20 percent of the known spawning effort. Past land management actions in the Lion Creek Watershed caused only trivial impacts to fish habitat quality, but far more important has been the role of non-native fish species. Brook trout compete with juvenile bull trout for food and have been documented to hybridize with bull trout in Lion Creek. Brook trout also compete with juvenile cutthroat trout. Rainbow trout can hybridize with cutthroat trout and reduce fitness. In recent years, lake trout have become established in Swan Lake and are likely preying upon subadult bull trout. At present, agency biologists are working to suppress lake trout numbers, and it is reasonably foreseeable that lake trout suppression would continue at least another 3 years. The District Fisheries Biologist considers that in light of these past, present, and reasonably foreseeable actions, bull trout and cutthroat trout numbers in Lion Creek would remain at current levels. No further increase or decrease is expected. Alternatives A and D would not add to any cumulative impact.

Alternatives B (Proposed Action) and C
Direct and Indirect Effects

Large Woody Debris

No immediate or direct effect to large woody debris in Lion Creek would be anticipated. All blowdown trees within one site potential tree length from both sides of the stream (ranging from 100 to 125 feet) would be left as they fell. Considering that Lion Creek averages about 20 feet wide, this means that every blowdown tree within approximately a 225 to 250-foot corridor would remain for natural processes. While leaving trees outside the immediate stream channel may initially seem unnecessary, Ralph et al. (1994) observed that nearly half of the woody debris that influenced fish habitat was outside the wetted channel and primarily influenced fish habitat during the crucial flood events that scour fish habitat. Reeves et al. (2006) note that large woody debris delivery to the stream should be fully functional if the width of the riparian buffer is one site potential tree length. Brown et al. (2003) recommended that 60 to 100-foot buffers on each side of the stream would sufficiently maintain large woody debris in streams. Although both recommendations cited are for post-fire salvage, it is assumed they would be applicable for blowdown salvage. It is a reasonable conclusion that trees beyond any possible contact with the current stream channel would not have any immediate effect on fish habitat.

Figure 3-10. Example of Recent Blowdown over Lion Creek. Photo taken October 2008.

However, these alternatives could have a small, indirect effect on large woody debris over time. Lion Creek wanders through a broad valley floor bounded by terraces (ancient glacial floodplains that the stream has long since abandoned) as illustrated in Figure 3-

10. It is anticipated that the blowdown would interact with Lion Creek and form several debris jams. The stream would then migrate around the debris jam and scour a new channel in its active floodplain. There is no way to predict the frequency or location of these new stream channels. Judging from aerial photographs, Lion Creek currently has a meander width of 98 to 295 feet. Portions of Units 4, 6, and 8 include blowdown salvage ranging within its active floodplain, ranging from 100 to 125 feet from the existing channel. Thus, it is possible that the new stream channel could migrate over to Units 4, 6, or 8 and would have less woody debris to interact with than what would have been there otherwise. Design Criteria for these units includes retaining approximately 28 tons per acre in the valley floor, with emphasis on leaving especially long pieces. The long pieces are more valuable to fish habitat since short pieces are too easily washed downstream by Lion Creek. The District Fisheries Biologist estimates that this is the mean tonnage that was present on the valley floor prior to blowdown (See Project File Exhibit L-7 for further details). Thus, if Lion Creek does wander across its floodplain, there would still be some woody debris available to the stream. It would be as if the blowdown never occurred and the pulse of woody debris input is bypassed. The potential indirectly affected area totals about 900 meters, which is about 8 percent of the stream length available to bull trout, from the mouth to the waterfalls. Considering that the lifespan of large woody debris in streams is estimated to be 50 years (Hauer et al. 1999) or possibly 100 years if very large (Ralph et al. 1994), this indirect effect is best characterized as unlikely but potentially a long term risk.

These alternatives also include a unique situation on Trickle and Tumble Creeks, which are within the Lion Creek Watershed. The amount of blowdown trees within this riparian area is unusually high and Unit 6 would salvage harvest the majority of it. Unlikely anywhere else in the project, Unit 6 would remove trees within the site potential tree height and even over the stream channel. A Design Criteria for this unit is that 10 trees per 100 lineal feet of stream length would be left, all others would be cabled out. Preference is given to leaving behind the “bottom layer” and cabling out the suspended layers. The streams are not fish-bearing and they both sink underground before reaching Lion Creek. Therefore, this action would reduce the amount of woody debris in Trickle and Tumble Creek but it would not affect woody debris in Lion Creek.

The other units in these alternatives present no direct or indirect effect to large woody debris. These salvage units are either far from streams or on top of ancient terraces outside the valley floor. It is inconceivable how blowdown trees in these upland areas could have any potential impact to Lion Creek’s large woody debris.

Pools

The frequency and quality of pool habitat could be potentially altered by actions that either increase water yields (which in turn affect channel morphology) or cause extreme sedimentation or reduce large woody debris. Alternatives B and C would have no impact to water yields and thus channel morphology would be unaffected (see Water Resources Section for further details); nor would they trigger extreme sedimentation as described below. The alternatives would have no direct impact to large woody debris, but there would be a potential small, indirect effect. Lion Creek would certainly experience an increase of woody debris as the blowdown trees are gradually captured by the stream. This would create small debris jams and scour new pools. Meanwhile some older pools would likely become abandoned as the channel adjusts. This type of change has probably gone on for thousands of years, and it is not considered harmful. The net frequency of pools could slightly increase simply due to the pulse of wood without any accompanying flood or landslide.

Even if the debris jams cause Lion Creek to wander across its floodplain more than 100 to 125 feet into Units 4, 6, or 8, the stream would still encounter about 28 tons of big woody debris per acre. This is less woody debris than Alternative A, but it still should be of sufficient size and frequency to scour new pools. Any difference in pool frequency caused by these alternatives would be considered trivial since there is no certainty that the stream would wander into the salvage units, or that the remaining wood isn’t sufficient to scour pools anyway, or that the total potential area (8 percent of stream length) is large enough to influence Lion Creek’s fish habitat.

In spite of the tremendous amount of blowdown in Trickle and Tumble Creeks, salvage harvest of the majority of it would have no impact to pools in those streams. Due to the small size of Trickle and Tumble Creek, only smaller wood can interact with the stream and scour pools. Most of the blowdown is large diameter suspended over the channel and the stream would simply pass under the big wood without scouring pools.

Sedimentation

Neither Alternatives B nor C would cause any direct or indirect sedimentation to Lion Creek. The project has no new roads or temporary road construction within any floodplains or near stream crossings. A small amount of BMP work is proposed on existing roads to be used for haul, most of which is far from water. Only a single road/stream crossing would be addressed that was previously identified as a sediment source, eroding approximately 1.09 tons per year (DEQ 2004). Curtailing erosion from this site would reduce sedimentation to Trickle Creek; but since the stream sinks underground shortly downstream of the road; it would have no benefit to Lion Creek.

The actual salvage action would also cause no sedimentation to Lion Creek. Units 14, 15, 16, 17, 20, 21, 22, 2, 3, 5, 9, 10, and 11 are all located on flat, upland plateaus. There is no physical means for soil erosion to travel horizontally and then enter the floodplain. Unit 13 is located on the valley floor, but it is 580 feet from the nearest point of Lion Creek and outside the active floodplain (100-year floodplain). This unit slopes gently towards Lion Creek, but it would be extremely unlikely that erosion could travel 580 feet or that Lion Creek could migrate 580 feet over to the unit. The INFISH DN noted that sediment delivery is highly variable, but it rarely travels more than 300 feet (USDA Forest Service 1995). Local monitoring after a post-fire salvage project, which is considered more vulnerable than salvage in unburned areas, found no erosion rills that traveled through INFISH buffers (USDA Forest Service 2004). Therefore, any risk of sedimentation from this unit is discounted.

Units 4, 6, and 8 propose to salvage within 100 to 125 feet of Lion Creek using cable equipment. No ground-based equipment would enter the valley floor, and therefore, there would be no risk of compaction and rutting from tire tracks. However, as the logs are dragged away, ground scarification would be inevitable. Due to the level valley floor characteristic within these units, there would be no means for the erosion to travel. Even if Lion Creek meanders across the valley floor towards these scarified grounds, the amount of sedimentation as a result from new channels scouring through the floodplain would completely obscure any sediment on top of flat ground.

Some sedimentation into Trickle and Tumble Creeks is expected with the implementation of Unit 6. These alternatives propose to cable yard out much of the jack-straw blowdown trees from over and beside the streams, leaving behind 10 trees per 100 foot of stream length. Full suspension of the logs is not expected and one end would drag. The amount of scarification is expected to be slight due to heavy amounts of existing slash and limbs on the ground caused by the wind event. The District Hydrologist estimates that only a small amount of erosion would actually enter the channels. At the same time, BMP application on an existing road would curtail ongoing sedimentation into Trickle Creek. It is not implied that the BMP work completely mitigates the logging practice (since it is not possible to calculate erosion from logging), but it is recognized that BMP work does offset some sedimentation into Trickle Creek. Trickle and Tumble Creeks are fishless, and they both sink underground as they enter the flat Lion Creek valley floor. There is no means for any sedimentation within these streams to reach Lion Creek.

Water Temperature

Factors that influence water temperature include elevation, climate change, exposure to solar radiation, and changes to groundwater inputs. Alternatives B and C would have no impact to elevation or climate conditions in the Lion Creek Watershed. Furthermore, the alternatives are not expected to expose Lion Creek to further solar radiation. Since there is no anticipated increase of water yields, the channel width would not increase. Furthermore, no standing, green trees near the stream would be

removed, and they help shade the stream from solar radiation. Toppled trees over the channel would be left, and they could also continue to shade the stream.

Finally, no change to Lion Creek's groundwater input is expected. The majority of the proposed units are located in upland terraces, which contain few wetlands or riparian landtypes (Sirucek and Bachurski 1995); thus, they would be unlikely to have groundwater near the surface and not vulnerable to impacts. The valley floor around Lion Creek likely has considerable shallow groundwater movement. Portions of Units 4, 6, 8, and 13 are located in areas where groundwater is probably near the surface. In these sensitive areas, Frissel (1999) cautions against activities that could warm the soil temperatures (i.e., clearcut logging), or compact the soil or trigger excessive sedimentation into downwelling locations. Alternatives B and C would not warm the soil temperature or compact the soil in the valley floor. The only known location of downwelling is the terminus of Trickle and Tumble Creek. Sedimentation from blowdown salvage over these streams would be expected, as described earlier. However, it seems unlikely that the sedimentation would be so severe that it seals the streambed and blocks infiltration into the hyporheic zone under the streambed. This conclusion is based on the professional judgment of the District Fisheries Biologist, since it is difficult to model sedimentation and impossible to model hyporheic flows. Thus, it is concluded that Alternatives B and C are unlikely to impact groundwater inputs but it cannot be discounted altogether.

Management Indicator Species

Alternatives B and C would not impact the bull trout population of Lion Creek. There would be no direct impact to habitat conditions and only a small, uncertain risk to long term-large woody debris recruitment. Design Criteria for Units 3, 4, 6, 8, 10, and 14 restricts any logging activity during the month of September when spawning bull trout are most vulnerable to disturbance (Table 2-14). These units were selected because of their proximity to Lion Creek (closer than 300 feet), and the potential for noise and movements to be observed by spawning bull trout. Even with this consideration, there is some possibility that a secretive species, such as bull trout, may still hesitate to ascend Lion Creek for spawning. To prevent poaching, another Design Criteria is that all logging operators would be reminded about Lion Creek's closure to all recreational fishing (Table 2-14). Thus, the only potential impacts to bull trout would be if Lion Creek migrates widely across its floodplain and is shortchanged of some woody debris or if bull trout are disturbed by the actual implementation. These scenarios mean that any possible impact to bull trout is likely to be localized and short-term. It would not be anticipated to result in a measurable impact to the population.

Cutthroat trout could also be indirectly harmed if Lion Creek migrates across its floodplain and is shortchanged of woody debris. Cutthroat trout require woody debris for cover and channel complexity just like bull trout. There is no other potential direct or indirect impact to cutthroat trout. They are far less sensitive to noise and disturbance during their springtime spawning effort. Thus, these alternatives could have just small potential impacts to cutthroat trout, but not likely to have a measurable change to the population.

Alternatives B (Proposed Action) and C Cumulative Effects

Large Woody Debris

As reviewed earlier, past land management activities have had only trivial impacts on large woody debris. The only impacted area is on private land where the landowner appears to have cleared some wood in order to protect a privately-owned bridge. This is a small area and had minor impacts on the overall fish habitat. The blowdown event would gradually add a substantial amount of woody debris. These alternatives would not directly alter this natural process. There is a possibility that if Lion Creek meanders across its floodplain, these alternatives would curtail the amount of woody debris available

to the stream. The overall amount of wood in the channel would still increase due to unsalvaged areas, but it could be less that what would have happened in Alternative A.

There are no reasonably foreseeable actions that would hinder large woody debris. Thus, it is concluded that while Alternatives B and C could or could not have a small, indirect effect on large woody debris; there would be no cumulative degradation to Lion Creek's large woody debris. Large woody debris in this stream has closely followed natural patterns and would remain so.

Pools

As reviewed earlier, past land management actions have had no known impacts to pool habitat frequency or quality. The amount and location of road construction and vegetation management in Lion Creek has had no impact to channel morphology and trivial impact on large woody debris. Due to the 2008 wind event, the amount of woody debris would gradually increase, and this in turn would create some new pools. Alternatives B and C would not have any measurable or meaningful impact. There are no reasonably foreseeable actions that would hinder or affect pool habitat. Therefore, there would be no cumulative effects to pool habitat in Lion Creek.

Sedimentation

Past road construction and possibly one harvest unit completed in 1987 contributed a small amount of sedimentation to Lion Creek. A very small amount of chronic sedimentation is still underway from hiking trails, horse fords, and road/stream crossings. However, the primary cause of high amounts of sediment in Lion Creek is thought to be a natural condition. Alternatives B and C would not contribute any sediment to Lion Creek, nor have any meaningful reduction of ongoing sedimentation. There is no reasonably foreseeable action that would be expected to increase or decrease sedimentation to Lion Creek. Fine sediment levels in Lion Creek would likely remain high but only a small portion of that is due to cumulative effects of land management.

Water Temperature

There are no known past or present land management activities that could have impacted Lion Creek's water temperature. The stream's exposure to solar radiation, groundwater input and elevation has not been impacted by any past road construction, vegetation management or any other activity. The only possible future change could be global climate change. Riemen et al. (2007) caution that bull trout are vulnerable to global climate change; especially near the fringes of their range (the Swan Lake population is not considered a fringe). No reasonably foreseeable project in Lion Creek or anywhere else in the Swan River Valley is anticipated to contribute to global climate change, but it may happen nonetheless. Alternative B and C would be unlikely to impact water temperature and, therefore, would not add to any cumulative effects.

Management Indicator Species

As reviewed in the Cumulative Effects Worksheet (Project File Exhibit L-2), past factors have contributed to a decline of bull trout in the Swan Valley. Historic logging practices and road construction caused a perceived, but not documented, habitat decline. However, due to improved logging practices, better road conditions and elimination of most recreational harvest, bull trout numbers began to increase in the early 1990's. Lion Creek has consistently been a vital spawning and rearing stream for the Swan Valley population, averaging about 20 percent of the known spawning effort. Past land management actions in the Lion Creek Watershed caused only trivial impacts to fish habitat quality. The most important cumulative impact has been from non-native fish species. Brook trout are widespread and have been documented to hybridize with bull trout in Lion Creek. These hybrids compete with bull trout for food and possibly spawning mates. In recent years, lake trout have become established in Swan Lake and are likely preying upon subadult bull trout. At

present, agency biologists are working to suppress lake trout numbers, and it is reasonably foreseeable that lake trout suppression would continue at least another 3 years. The District Fisheries Biologist considers that in light of these past, present and reasonably foreseeable actions, bull trout numbers in Lion Creek would remain at current levels. No further increase or decrease is expected. Alternatives B and C would cumulatively add only a small impact. The alternatives have a small risk of a short-term, localized impact to bull trout, but it would not be detectable at a population scale. Implementation of Alternatives B and C would not be expected to trigger a decline or collapse of this important spawning population.

Likewise, past actions have probably only had a trivial impact on cutthroat trout habitat, but non-native species have had a substantial impact. Brook trout juveniles compete for food and space with cutthroat trout juveniles. Rainbow trout can hybridize with cutthroat trout and reduce fitness for the remnant population. There are no reasonably foreseeable actions to address brook trout or rainbow trout in Lion Creek. Implementation of either Alternatives B or C would not add to or modify these cumulative effects.

Swan River

Alternative A (No Action) and Alternative D Direct and Indirect Effects

Large Woody Debris

Implementing either Alternative A or D would have no potential direct or indirect effect to large woody debris in the Swan River. Neither alternative includes Units 24 and 25. Alternative D does include upland salvage logging in Unit 23 with a 300-foot foot buffer from the Swan River, which is well beyond the topographical break. The upland trees have no potential to contribute to the Swan River and salvaging them would have no impact.

Pools

As described above, neither alternative would result in any loss of large woody debris to the Swan River. Furthermore, the alternatives would not cause extreme sedimentation or changes in water yield, therefore, there are no direct or indirect effects to pool habitat.

Sedimentation

There would be no risk of sedimentation to the Swan River with either Alternative A or D. Alternative A proposes no actions at all within the Swan River Watershed. Alternative D includes only Unit 23, which is upland. It is physically impossible for any surface erosion to reach the river. There is no road construction or BMP work proposed within this watershed.

Water Temperature

The water temperature of the Swan River would be unaffected by either Alternative A or Alternative D. Salvaging blowdown at least 300 feet from the stream would have no impact on shade, groundwater input, elevation, or microclimate weather. Alternative A does not propose any salvage activities.

Management Indicator Species

Alternative A proposes no activities and, therefore, no direct or indirect effect to fish species. Alternative D only includes Unit 23 and this would have no impact to fish habitat. The unit is 300’ from

the river's edge and beyond the sight and sound distance of any fish occupying the river. Therefore, there would be no direct or indirect effects to bull trout or cutthroat trout in these alternatives.

Alternative A (No Action) and Alternative D Cumulative Effects

Large Woody Debris

The only past and present action that has reduced woody debris in this area is the construction and maintenance of the Piper Creek Bridge. Trees routinely get caught beneath this bridge and need to be cleared for bridge safety. But, judging from 2003 aerial photographs, the Swan River still appears to have plenty of large woody debris, primarily in clusters of debris jams. The only reasonably foreseeable action that could affect woody debris is the potential bridge replacement in 2012. The new bridge would not have a center pier and should be far less vulnerable to debris jams, allowing more natural transport of wood downstream. Implementation of either Alternative A or D would have no impact to woody debris recruitment allowing a projected, small upward trend of woody debris in the Swan River.

Pools

Pool habitat in the Swan River is thought to be within natural condition and not impacted by past or current land management activities. There are no reasonably foreseeable activities that would impact pool habitat. Alternatives A and D would not add or substrate or affect any pool habitat and thus do not create any cumulative effect.

Sedimentation

The DEQ calculates that the Swan River carries approximately 24 percent more sediment than its natural background. The primary source for the sediment is from poorly designed road/stream crossings throughout the valley (DEQ 2004), rather than erosive river banks. It is reasonably foreseeable that road sedimentation would gradually decline as more roads are brought up to BMP standards by either timber sales or collaborative efforts by the Swan Lake TMDL Group. Neither Alternative A nor D would contribute any sedimentation to the Swan River. The cumulative effect of past land management should continue to trend towards restoration and would not be impacted by these alternatives.

Water Temperature

Available information suggests that the Swan River's water temperature has not been cumulatively impacted by past or present land management activities. There is no reasonably foreseeable action that would be expected to affect water temperature. Alternatives A and D would not create any cumulative effect to Swan River's temperature.

Management Indicator Species

Both bull trout and cutthroat trout are present in the Swan River. These species use the river for foraging, winter occupancy, or migrating to other habitats, but they do not spawn in the river. The most important cumulative impact to these species has been the past legal and illegal introduction of non-native species. Bull trout numbers have been stable in the most recent decade, but they are at risk. The reasonably foreseeable lake trout suppression effort should help keep the bull trout population stable, but there is no guarantee of success. Cutthroat trout have greatly declined in both numbers

and genetic purity throughout the Swan River Drainage. Implementation of either Alternative A or D would not add to the cumulative effects to these indicator species.

Alternative B (Proposed Action) and Alternative D Direct and Indirect Effects

Large Woody Debris

Alternatives B and C include the harvest of Units 23, 24, and 25, which are located near the Swan River. Unit 23 is located on top of a bluff overlooking the river, and the blowdown trees on this bluff have no potential to ever reach the Swan River. Therefore, salvage activity in Unit 23 has no direct or indirect impact to woody debris. Unit 24 contains approximately a dozen toppled trees and is located at a user-developed boat access to Swan River. The toppled trees all fell away from the river and are partially blocking the parking area. It is possible that some of these trees could be captured by the river during a flood event and, since they are on the outside bend of the river, could be transported downstream beyond the bridge. Salvage removal of these trees would not directly reduce large woody debris in the river (since they are not in the river now), but indirectly might reduce about a dozen trees from future recruitment. Unit 25 consists of about 8 trees that were previously removed from the river, since they threatened the integrity of the Piper Creek Bridge (FRD #966). The trees are decked beside the river bank. Salvaging these trees would have no further direct impact. It also would be unlikely to have any indirect impact. If a flood were to capture these trees, they would most likely be jammed under the bridge and removed all over again. Only a few might make it to the thalweg and move beyond the bridge.

Thus, implementation of either Alternative B or C could indirectly result in a dozen less trees in the Swan River, from Unit 24 and perhaps Unit 25. Judging from aerial photos of the Swan River, the District Fisheries Biologist estimates those dozen trees could float downstream up to 2 miles until the river loses power and drops its load at a constricted location (in fact there is already a debris jam there). It is very unlikely the trees would start a whole new debris jam since the river has a fairly laminar flow until that point. The potential, indirect loss of a dozen trees to this debris jam is a minor impact to the Swan River. The debris jam would provide more overhead cover to fish, but the pool is already scoured even without a dozen extra trees.

Pools

There is no potential direct or indirect effect to pool habitat in the Swan River. As described above, implementation of Alternative B or C could indirectly remove about a dozen trees from the river. These trees could have otherwise travel up to 2 miles before being deposited in an existing debris jam. The debris jam has already scoured a large pool, and the extra trees would not increase the size or quality of the pool. It is very unlikely that the trees would form a new debris jam and scour a new pool due to the laminar flows up until the existing debris jam.

Sedimentation

There would be no direct or indirect risk of sedimentation into the Swan River with the implementation of either Alternatives B or C. Unit 23 is located on level, upland terrain, and there is no physical means for erosion to reach the river channel. Both Units 24 and 25 are located immediately adjacent to the river, however, Design Criteria (Table 2-14) provides that there would be no ground-based equipment operating outside existing roads or the boat launch parking area. Thus, there would be no potential for new ground disturbance in the valley floor and no risk of sedimentation.

Water Temperature

Water temperature is influenced by elevation, groundwater input, climate weather and solar radiation. Salvage harvesting the blowdown trees in Units 23, 24 and 25 would have no impact on elevation, groundwater input or surrounding climate conditions. Furthermore, the toppled trees provide no shade from solar radiation and their harvest would have no direct or indirect effect.

Management Indicator Species

Alternatives B and C would have no substantial impact on fish habitat and, therefore, do not affect fish populations. Bull trout do not spawn in the river and are not as sensitive to noise and disturbance during salvage logging.

Alternative B (Proposed Action) and Alternative D Cumulative Effects

Large Woody Debris

Judging from 2003 aerial photographs of the Swan River, it appears to have plenty of large woody debris, primarily in clusters of debris jams. The implementation of either Alternative B or C might indirectly eliminate about a dozen trees from entering the river in the case of a flood event. This could reduce the potential size of a debris jam located about 2 miles downstream of the Piper Creek Bridge. The net impact of this to fish habitat would be very small. The Swan River would still have the plenty of debris jams that provide fish cover and scour pools.

Pools

Pool habitat in the Swan River is thought to be within natural condition and unimpacted by past land management activities. Alternatives B and C would not add or substrate or affect any pool habitat.

Sedimentation

The DEQ calculates that the Swan River carries approximately 24 percent more sediment than its natural background. The primary source for the sediment is from poorly designed road/stream crossings throughout the valley (DEQ 2004), rather than erosive river banks. Alternatives B and C would not add any further sediment to the Swan River and would not add to any cumulative effects.

Water Temperature

Available information suggests that the Swan River's water temperature has not been cumulatively impacted by past or present land management activities. Alternatives B or C would not impact water temperature either.

Management Indicator Species

Both bull trout and cutthroat trout are present in the Swan River. These species use the river for foraging, winter occupancy, or migrating to other habitats; but they do not spawn in the river. The most important cumulative impact to these species has been the legal and illegal introduction of non-native species. Bull trout numbers have been stable in the most recent decade, but they are at risk. Cutthroat trout have greatly declined in both numbers and genetic purity throughout the Swan River drainage. The implementation of Units 23, 24 and 25 would not add to the cumulative effects to these indicator species.

Piper and Goat Creeks

All Alternatives
Direct and Indirect Effects

Large Woody Debris

There is no potential direct or indirect effect to large woody debris from any alternative. Alternative A proposes no actions. Alternatives B, C, and D include salvage harvesting in Unit 1 in the Goat Creek Watershed and Unit 26 in the Piper Creek Watershed. These units are in upland habitats located 300 feet from the streams. Blowdown trees in these areas could never reach the streams, and their removal would have no direct or indirect effect on large woody debris.

Pools

Pool habitat could potentially be impacted from changes in large woody debris, excessive sedimentation, or elevated water yields that, in turn, impact channel morphology. None of the alternatives would have these impacts. The action alternatives (B, C, and D) would not impact large woody debris, as described above, nor would they trigger any sedimentation, described below. Harvesting of toppled and dying trees would have no impact to water yield. Therefore, there is no potential from impact from the action alternatives. The No Action Alternative, likewise, has no impact.

Sedimentation

Alternative A proposes no action and, therefore, has no impact. The other alternatives include Unit 26 in the Piper Creek Watershed. This unit is on level ground, 300 feet from Piper Creek, and beyond a topographical break. It is physically impossible for erosion to travel horizontally outside the unit, to the bluff, and then down to the valley floor. The action alternatives also include about 1.5 miles of BMP application to existing roads. This would help curtail erosion at one particular location currently modeled to erode about 1 ton per year (DEQ 2004). This is beneficial action, but would not really result in a measurable change to Piper Creek.

The action alternatives also include Unit 1 in the Goat Creek Watershed. This unit is gently sloping towards Goat Creek. It is possible that some erosion generated from the logging operation could enter the 300-foot no-treatment buffer. However, this width is considered sufficient to capture and store any non-channelized sediment before it reaches Goat Creek (USDA Forest Service 1995). The alternatives also include approximately 1.4 miles of BMP application on an existing road. Although this road section was previously a significant source of sediment to Goat Creek, it was corrected a few years ago and any further BMP work would have trivial gain. Therefore, none of the alternatives would have any potential direct or indirect impact to Goat Creek's sedimentation.

Water Temperature

None of the alternatives propose any activity within 300 feet from the streams. This is more than enough distance to retain all existing shade (Reeves et al. 2006) that minimizes the stream exposure to solar radiation. The proposed units in the action alternatives are in upland areas and do not risk any impacts to groundwater. Thus, none of the alternatives would have any potential direct or indirect effect to Piper and Goat Creek's temperatures.

Management Indicator Species

As reviewed above, there would be no potential impact to fish habitat in Piper or Goat Creeks from any alternative. Furthermore, there would be no potential disturbance to bull trout or cutthroat trout in

Alternative A since no actions are proposed. The other alternatives include a minimum of 300-foot buffers during implementation, and this should be sufficient to protect bull trout from any noise, light, or vibration disturbance. Recreational fishing on Goat Creek would remain closed, but fishing is permitted on Piper Creek. The action alternatives would not encourage any new fishing on Piper Creek or make access easier. Thus, there is no potential impact to bull trout or cutthroat trout with any of these alternatives.

All Alternatives
Cumulative Effects

Large Woody Debris

The frequency of large woody debris in Piper Creek has not been impacted by past actions, except for about 0.4 mile (700 meters) in the lower reaches, which has been partially cleared for private home construction. Goat Creek had been substantially impacted by logging practices from the 1970's, but the stream appears to have fully recovered. The 2008 blowdown event is expected to add more woody debris to Piper Creek and to Squeezer Creek, a tributary to Goat Creek. There are no present or reasonably foreseeable actions that would change large woody debris. Implementation of any of the Mid Swan Project alternatives would not contribute to any cumulative effects. The trend of increasing woody debris, due to the 2008 blowdown, would continue.

Pools

The best available information suggests that pool habitat frequency and quality in Piper and Goat Creeks has not been impacted by any past land management activity. There are no present or reasonably foreseeable actions that could change this. The 2008 blowdown would likely cause the streams to meander across their floodplains and scour pools, but at the same time some older pools would be abandoned. Alternatives A, B, C, and D would not impact any pool habitat. Therefore, the status of pool habitat would likely be in flux for the analysis timeframe, but this is natural and unimpeded by any cumulative effects.

Sedimentation

There is no indication that past land management has lead to sedimentation in Piper Creek, but Goat Creek is considered "impaired." It is uncertain how much the elevated turbidity in Goat Creek is due to land management, but the DEQ does recommend that erosion from forest roads in the Goat Creek Watershed be curtailed. There are no present or reasonably foreseeable activities that would increase sedimentation or begin restoration. The Mid Swan Project Alternatives would not contribute any sediment and would not add to any cumulative effects.

Water Temperature

Available information indicates that water temperatures in Goat and Piper Creeks are acceptable for bull trout in the spawning areas, although not optimal near the river mouths. This is thought to be a natural condition and not due to past land management. There are no present actions that would change water temperature. It is possible that global climate change could impact bull trout streams, especially near the fringe of their range (the Swan Lake population is not considered a fringe) (Riemen et al. 2007). Thus, the trend could be towards warmer water, but none of the Mid Swan Project alternatives would increase or decrease this trend.

Management Indicator Species

As reviewed in the Existing Condition Section, the Piper Creek bull trout population tends to be small in numbers and has no clear upward or downward trend. The past introduction of non-native brook trout may be part of the reason for the low numbers. Cutthroat trout, however, appear to be in good condition and a natural cascade halfway up the drainage is likely preventing invasion of rainbow trout. Goat Creek contains a strong population of bull trout that has increased in numbers since monitoring began in 1982. Cutthroat trout are restricted to a small portion of the watershed, presumably due to natural conditions. Both Goat Creek and Piper Creek bull trout are threatened by past, illegal introduction of lake trout. Biologists have attempted to suppress lake trout numbers, and it is reasonably foreseeable this action would continue for another 3 years. The District Fisheries Biologist considers that in light of these cumulative effects, the bull trout and cutthroat trout numbers would remain about the same during the analysis timeframe, neither increasing nor decreasing. Implementation of any of the Mid Swan Project alternatives would not add or subtract to the status of MIS.

Regulatory Framework and Consistency

All of the action alternatives are consistent with all regulatory framework for Fisheries Resources. The Forest Plan determined that cutthroat trout and bull trout are MIS and prohibited “unacceptable fish losses” from land management actions. Alternatives B and C may have minor, indirect effects, but these would not result in unacceptable population losses. Alternative D has no potential impact.

In 1990, the Flathead National Forest adopted Forest Plan Amendment #3, which added more trout stream standards. In certain bull trout streams (including Lion, Piper and Goat Creeks), sediment modeling and incorporation of monitoring would be used to evaluate projects to bull trout habitat. This analysis has completed that aspect by use of modeling in the Water Resources Section and all available fish population and habitat monitoring. The amendment also requires that sediment delivery rates do not pose a significant threat to spawning or rearing habitat, and this analysis has determined no risk of sedimentation in any alternative. The third requirement is an inventory of channel conditions, which has been fulfilled with available habitat data. The fourth requirement is to open up debris barriers as necessary, but this is not needed in any stream. Amendment #3 also details the acceptable limits of riparian harvest for any stream with cutthroat trout. All of the Mid Swan Project alternatives are far more conservative than the Amendment #3 standards and do not approach the limits.

In 1995, the Forest Service adopted INFISH with the goal of recovering native fish populations. In order to achieve the goal, four riparian management objectives were established. Activities must not retard the attainment of those objectives. None of the action alternatives would retard the four objectives. Any activity within a priority watershed RHCA needs to be analyzed by a watershed analysis. Since Lion Creek is a priority watershed and Alternatives B and C propose activity within the RHCA, a watershed analysis has been completed (Project File Exhibit R-1).

Bull trout are listed as a “threatened” species under the Endangered Species Act. A Biological Assessment (BA) is required for significant Federal actions that may impact bull trout. This has been prepared and is in Project File (Exhibit L-3). The impacts of the proposed action (vegetation management) were determined to “**may affect, not likely to adversely affect**” the bull trout. Concurrence is expected from the USFWS at a later date.

Westslope cutthroat trout are listed by the Regional Forest as a “sensitive species.” A Biological Evaluation (BE) has been prepared for each action alternative (Project File Exhibit L-4). The BE determination was that Alternatives B and C **“may impact individuals or habitat but will not likely result in a trend towards federal listing or reduced viability for the population or species.”**

Alternative D was determined to have "**no impact**." Because the Mid Swan Project does not cause a trend towards Federal listing or reduced viability, it achieves regulatory compliance.