Water Resource

Introduction

The Hemlock Elk Fuels Reduction and Forest Health Project is located along the east facing slopes of the Swan River Valley. Historic movement of continental glaciers is the primary process responsible for the current configuration of the aquatic systems. These glaciers scoured the valley bottom from south to north. The valley bottom is relatively flat with numerous hummocky areas with many ponds and wetlands. The ridges of the Mission Mountain Wilderness to the west of the project area are very rocky, with numerous alpine lakes such as the Cold Lakes Complex. Streams are most dense in the high elevations, but most of these flow seasonally. Most perennial reaches are located along the flatter valley floor.

Elevations for the watershed range from than 3800 feet to 8600 feet. Weather systems move predominantly from the west to the east, depositing the most precipitation at the highest elevations in the form of winter snow. Snow melt is the primary form of water input and storage, and the major influence on the area's runoff regime. Peak flows normally occur during the first weeks in June, augmented by warm spring temperatures and rain; although, an earlier smaller peak usually occurs in early to mid May.

The Swan River is a very dynamic system, changing its course frequently in response to spring runoff and other high water events. A portion of a low elevation flight over the river in 2004, compared to the mapped route of the river from 1969, shows major changes most likely caused by record runoff years. (Project File Exhibit K-1). This comparison would indicate wide variations in annual flow and sediment regimes.

Analysis Area

Spatial Bounds

The major watersheds in the Hemlock Elk Analysis Area where activities are proposed to occur were analyzed for different aspects of the water resource and aquatic health. These watersheds include Glacier (35,805 acres), Elk (16,608 acres), and Cold Creek (21,562 acres). Map 3-2 displays the watersheds, or catchments, analyzed for the Hemlock Elk Fuels Reduction and Forest Health Project. These catchments will be used for indirect and cumulative effects of the proposal. Any wet or streamside areas will be considered for potential direct effects within the entire Hemlock Elk Analysis Area when specific activities are proposed.

These watershed areas, or catchments, were chosen to analyze potential effects to the water resource because they are good representatives of aquatic health, and are considered an appropriate size to analyze field survey data, models and other tools used to consider potential effects from forest management. These were also chosen to represent potential affects because watersheds of the next order of size, namely the Swan River Basin, are so large they would make detection of changes difficult or impossible. This has been demonstrated in recent studies in the areas, such as Determining Nutrient and Carbon Loading in the Swan River, Montana (Project File Exhibit K-3). This is because the river's water volume is so large, fluctuates so vastly, and has so many inputs nutrients, water and sediment, that potential variations originating from the Hemlock Elk Analysis Area would be undistinguishable from changes caused by natural variation.

Temporal Bounds

The selected temporal bounds for potential effects on the water resource are different for water quantity and quality. This is because of the ways runoff and sediment (and nutrients) react to changes in the physical environment. For sediment or nutrients, the potential changes are analyzed for a time span of 5 to 10 years. This is the most common time frame used for predictive models for sediment recovery. This is also the span of time determined to best detect changes from wildfires in local studies, such as Effects of Wildfire on Nutrients and Carbon Dynamics of Streams in Glacier National Park and the Flathead National Forest Associated with the Red Bench Fire (Project File Exhibit K-4).

Water yield changes and recovery in watersheds has been linked to changes in vegetative cover with a direct correlation to curves that are used in growth and yield models developed here in Montana. Most of the models allocate most of the water yield recovery to the first 15 to 20 years. This is the period when there is a surge of growth of herbaceous plants and shrubs. The final stages of recovery are linked to re-growth rates of conifers with total recovery limited to the areas left unoccupied by trees such as road beds. It is predicted that some habitats and climates may take from 80 to more than 100 years to return to pre-management water regimes depending on the forest habitat type. This is figured into the calculations for past management (Project File Exhibit K-5).

Data Sources, Methods, and Assumptions

The Flathead Geographical Information System (GIS) Library was used to assemble information on past management in the Hemlock Elk Analysis Area. This information includes past harvest, by harvest type and year on all NFS lands. Much of the management activities on private industrial timber lands were acquired directly from information provided by PCTC. Other areas were digitized from aerial photos, with the management type and year of harvest extrapolated from nearby areas where information was known.

Water Quantity:

Harvested areas were converted to Equivalent Clearcut Areas (ECA). These were estimated based on a relationship between type of harvest and the percent of total canopy cleared. This value was then recovered based on values commonly used for growth and yield models for different types of habitats in Northwest Montana. The area cleared for roads was calculated based on the width of the road and roadside clearing. All calculations were derived with the use of an Excel spreadsheet created by DNRC, and calibrated with the coefficients used in other water yield models on the Flathead National Forest (Project File Exhibit K-6).

Channel Stability:

Pfankuck Stream Reach Inventory and Channel Stability Evaluation, originated by Pfankuck in the 1970s (Project File Exhibit K-7), was used to help track and document changes in stream flows over time. The surveys have been repeated in the same stream segment or reach, especially when they are documented with photographs (Project File Exhibit K-8). The focus of these surveys considered rock or gravel size in the stream banks, potential recruitment of large woody debris, and stream bottom armoring. Changes between periodic surveys repeated at the same sites can be used to predict changes in channel condition and morphology caused by variation in water yields and peak flows.

Measurement Indicators

Changes in water quantity and the potential for related changes in channel stability are the main focus for analyzing impacts of the Hemlock Elk Fuels Reduction and Forest Health Project. The

following describes the primary measurement indicators used to assess the risk of impacts to the streams and other water bodies in the Hemlock Elk Analysis Area.

Water Quantity (also known as Water Yield):

The amount of water flowing from a catchment or true watershed is directly influenced by the volume of precipitation a catchment receives and the amount of water that runs off the land in the form of streams. The watersheds in the Hemlock Elk Analysis Area receive a large range in precipitation from less than 30 inches annually to over 80 inches annually, depending on elevation and the influence of the mountains. The amount of water running off the hillsides is influenced by the porosity of the local soils; how much moisture is contained in the soils from year to year; and the amount of vegetation cover present in the watershed. The vegetation influences the water by up taking it for growth. The vegetation also intercepts precipitation, allowing the water to evaporate from its leaf surfaces before it can reach the ground and soak in. Where the vegetation cover is changed through forest management or other activities that change the overall forest cover, the amount of water running out of the watersheds will change in quantity, and, in some cases, may change runoff timing.

As stated above, the relationship to water quantity changes in streams has been found to be influenced by:

- Vegetation cover resulting from land conversions from forests to pastures and lawns;
- Forest harvesting for timber production or fuel reduction to reduce the risk of large forest fires; and
- The amount of clearing along roads.

In the watersheds of the Hemlock Elk Analysis Area, forest cover is greatly influenced by the amount of area contained in the Mission Mountains Wilderness, with its myriad of lakes and wetlands that moderate the water quantity that runs off of these systems in the highest precipitation zones. This greatly affects the influence that human-caused forest manipulations can have on the water quantity in streams and rivers.

The amount of desirable change in water quantity running out of a watershed is influenced by regional guidelines, depending on different needs in a specific area. In some cases, people consider it beneficial to increase the amount of water running out of the mountains to provide water to populated areas. Desires to increase water quantity is not the case in other places, where water is abundant and increases in water quantity running through stream courses can cause damage to aquatic habitat or organisms, such as native fish. In the case of the Flathead Forest and the rest of Region One, it is suggested that streams in most geologic types are capable of handling increases of water runoff of about 15 percent without having detrimental effects to aquatic resources (Project File Exhibits K-9 and K-10). Therefore, a 15 percent increase in water quantity in each watershed analyzed for changes in aquatic health will be used as an indicator for the Hemlock Elk Project.

In conjunction with increases in water quantity, changes in total openings are often used as a corresponding measurement indicator. Changes in canopy opening are part of the calculation that predicts increases in water quantity, and is displayed as changes in ECA. Research has found that when over 30 percent of a watershed is in an ECA condition, there is a risk of creating changes in timing runoff and quantities of water that can create detrimental affects on aquatic habitat primarily and changes in stream channel stability (Project File Exhibit K-11). Some areas with landforms prone to extensive landslides, such as along the Pacific Coast, have been found to react to intense rainstorms at much lower levels of harvest. Others are much more resilient and have been found to remain stable over 30 percent (Project File Exhibit K-12). In Northwest Montana, the 25 percent level has most often been used since the ECA measurement was conceived in the 1970s. It will be displayed along with the resulting changes in water quantity as part of the indicator to assess the potential risk of implementing the Hemlock Elk Project.

Channel Stability:

Channel stability is an indicator of overall aquatic health for how a stream channel is functioning in relation to the amount of water and sediment it is carrying. The stability ratings are derived from field surveys assessing the condition of the upper slopes above the stream channel where large woody debris, and potentially landslides, can influence stream dynamics. The upper channel conditions indicate how well the stream is handling bank full, or peak flow runoff. The lower channels represent conditions at low flow periods. Stability surveys are based on protocol outlined in Stream Reach Inventory and Channel Stability Evaluation, commonly referred to as Pfankuch ratings (Project File Exhibit K-13). Fifteen individual conditions of a stream are assessed by this process. Many reflect the parent geology of the watershed, and the vegetation adjacent to a stream. Others focus on visible changes in stream channel conditions, such as increased fine material in pools. An “Excellent” rating, even in an unmanaged area would most likely occur only where streams carve their way through bedrock, in mature forests, that have had little or no disturbance in many years. In contrast, a “Poor” rating would most likely occur where channels are formed in fine sands or fine moveable gravels, the stream banks are covered with grasses or small shrubs that allow undercut banks to form and collapse, and there is little or no potential for large woody debris to be incorporated into the stream network. This system speaks directly to the stream characteristics, and may give ratings that are contrary to fish habitat.

Channel Stability Surveys are most useful when used to document trends, therefore when repeated over time. These trends are then most useful for an assessment of potential effects of a management proposal when compared to modeled water yield values. The first series of surveys were conducted in the late 1970s on the Flathead National Forest. They have been repeated sporatically across the forest as time and personnel became available. Within the Hemlock Elk Analysis Area, 15 surveys have been conducted from 1976 to the summer of 2005.

Affected Environment

Historic Condition

The Hemlock Elk Analysis Area is located on the east-facing slopes of the Mission Mountains in the southern portion of the Swan Valley. The Swan Valley has been used by humans for 100s and perhaps 1000s of years. Overall, the Swan is known to have been a travel route for the Native Americans. Within recent history, the land has been developed for ranches and managed for commercial timber harvest. An indepth description of the existing and historic condition of the geology, hydrology, and multiple facets of hydrology in the Upper Swan Valley are described at length in the Upper Swan Valley Landscape Assessment (Project File Exhibit K-14).

Existing Condition

Water Quantity: Water quantity is a value that reflects the precipitation that falls on different elevations of a catchment or watershed, and converted to runoff given soil and other geologic factors, along with the ECA. Cleared areas have been adjusted for regrowth of the vegetation, given management date and the land use plan. Forests are regrown in the ECA model based on localized growth and yield models for different tree species. Subdivided areas and pasturelands that are not anticipated to be reforested are not given a regrowth coefficient.

The following table displays the natural water quantities flowing from three catchments in the Hemlock Elk Analysis Area and the modeled existing condition for the three major watersheds.

TABLE 3-?

NATURAL WATER QUANTITIES IN THE HEMLOCK ELK ANALYSIS AREA

Watershed	Total Annual Water Runoff (Quantity in Acre Feet)	Increase Water Runoff (Quantity in Acre Feet)	% Increases in Water Quantity
Glacier	81,727	5,727	6.6
Elk	43,050	152	0.3
Cold	41,292	1,816	4.4

Data for past harvest, wildfire, and conversion of forested lands to openings for human habitation were used to calculated the ECA for Glacier, Elk, and Cold Creeks. Additional clearing was incorporated for openings created for roads. Areas managed for forest management were assigned a recovery value related to common forest types of the area, with no delayed recovery. This assumes that some type of vegetation would begin to grow shortly after the initial disturbance. Areas that have been converted to yards, pastures, or other openings that would be maintained an unforested area were delayed from recovery for 200 years, since it is unlikely that they would return to a functioning forest, hydrologically, in the near future.

The following table provides information on the overall existing condition of the three watersheds:

TABLE 3-?

EXISTING CONDITION OF THE GLACIER, ELK, AND COLD WATERSHEDS

Watershed	Total Area (Acres)	Total Area with Changes to Forest Canopy*	Percent Area Affected	Total Equivalent Clearcut Area (ECA in Acres)**	Total Equivalent Clearcut Area (ECA in Percent)
Glacier	35,805	17,768	50	5,545	15%
Elk	16,608	1,348	8	575	0.4%
Cold	41,292	13,914	34	4,594	4.4%

* These values represent the area has had some change in forest canopy since the early 1950s. This includes logging, logging roads with their associated roadside clearing, forest fires such as Crazy Horse, and homestead development.

** The ECA is the percentage of forest canopy removed, assuming the area had 100 percent forest coverage before management. It also includes a recovery factor based on forest regrowth except for areas that have been permanently converted, such as roads and homesteads.

Channel Stability : Pfankuck surveys were conducted along key stream reaches in the Hemlock Elk Area in the summers of 2005 and 2006 and documented with photos. Several of the stream reaches had also been surveyed in the early 1980s, so comparisons could be made for longer-term trends. These changes are an important factor when predicting a stream's ability to withstand increases in water or sediment without undergoing major changes in channel size or form. This transition is important because the current shape of a stream channel is a reflection of the amount of water it is receiving. When water volume increases, its erosive force can scour stream banks to make room for more water. Eroded material is in the form of fine suspended sediment, rock, or gravel, which is then deposited as bars downstream.

The following is the current channel stability rating for streams in the Hemlock Elk Area and an interpretation of the primary factor contributing to that rating.

TABLE 3-?.

CHANNEL STABILITY RATING

Watershed	Historic Pfankuck Rating	Current Pfankuck Rating	Interpretation of Rating And Stream Observations
Glacier	Fair	Good	Streams in the headwater of Glacier Creek flow through a series of small alpine lakes and scoured rocky basins. When originally surveyed in the early 1980s, the channels were showing signs of somewhat recent scour and channel movement. It was assumed at that time that these characteristics were relic of the high runoff or floods of the late 1960s and early 1970s. Improvement in channel deposition size and bank scour suggests further healing.
Elk	Fair/Poor	Good	Many of the same characteristics of Elk Creek improved, as they did with Glacier Creek. The flat wetland areas in the lower elevations have helped increase channel stability.
Cold	---	Good	Since no historic surveys exist to compare with the current one, interpretation is not possible

Environmental Consequences

As discussed above, changes in water quanitity and channel stability are the main indicators used for analyzing impacts of the Hemlock Elk Fuels Reduction and Forest Health Project .

These indicators will be addressed under the Water Quality and Channel Stability headings for Alternative A and all action alternatives. All alternatives will be compared to the existing condition for the direct and indirect effects for the specific management practices, and then combined with all other foreseeable actions within the analysis area to address the cumulative effects.

Alternative A – No Action
Direct and Indirect Effects

Alternative A provides a baseline to evaluate the effects of the Proposed Action. The effects on the Water Resource will be discussed as water quantity, and water yield that can affect water quality through channel scour. These are discussed by how they would change over time, and cumulatively as the streams join the Swan River and flow towards Swan Lake.

Water Quantity

With Alternative A, none of the proposed forest management actions would occur in the Hemlock Elk Analysis Area at this time; therefore, there would be no increases in water quantity produced from vegetation manipulation, but the Purpose and Need of the proposal would not be met. There would be no treatments to reduce the risk of insect and disease infestations and reduce the amount of forest fuel buildup adjacent to other public and private lands. With no fuel reduction activities, the size, intensity and spread of wildfires may increase, with potential effects to water quality as described below.

By not reducing fuel levels, it is likely ingrowth of shade tolerant trees would continue to increase, thereby increasing the rish of a severe wildfire. This in turn may increase the risk of a temporary, negative effect to water quality by increasing overland flow and fine sediment. As more and more stands fill in with dense, shade tolerant tree species, the risk of elevated flows and sediment levels

would also increase. Based on the information in the Fire and Fuels Section of this EA, it appears that existing ladder fuels and fuel loading in the analysis area has increased over historic conditions, at least partially due to the effective fire suppression that has occurred since the 1940s. Under the No Action Alternative, the fuel and vegetation analysis in this chapter indicate that larger, more intense fires are now more likely and, with no action, the risk of such fires would likely increase. Due to increased fuel loadings, such fires would remove a higher percentage of vegetation than would have historically been the case when more frequent low intensity fires occurred. To the degree such fires occur they would likely have direct effects of: increasing water yield, likely changing the timing of runoff; increasing suspended sediment after such events; and possible effects on channel morphology in proportion to their size and dependent on their location with the watershed.

The general health of the areas proposed to be treated would also not be improved. Areas that were harvested in the past grow most vigorously when they do not have to compete for water or nutrients. In areas not treated, the competition for water and nutrients would remain resulting in growth rates being reduced. This in turn slows the hydrologic recovery.

Channel Stability

The general health of the forested areas proposed to be treated would also not be improved. Areas that were harvested in the past normally grow most vigorously when they are thinned and do not have to compete for water. Since the current condition of the channels is considered good channel stability, there would likely be only a slight chance of change in channel stability under the No Action Alternative.

Invasive plant and noxious weed populations would not be treated at this time with the No Action Alternative. This would likely allow weeds to spread more rapidly along roads and watercourses. Weeds have been found along watercourses at an increasing rate, replacing native plants, that have historical helped stabilize stream banks. This may decrease the overall stability on stream banks, and a related decrease in stability related to instream erosion.

Alternative A – No Action
Cumulative Effects

Past timber sales and associated activities have modified some conditions within the Hemlock Elk Analysis Area. In addition, some of the past actions, such as stream crossings, have been a source of sediment delivery to channels. Findings of this assessment conclude that activities considered could have some cumulative effects to the Water Resource. Vegetation management and private land development including the construction of roads, clearing of vegetation, construction of residences, and installation of improvements can create a variety of changes to the landscape. Vegetation management and land development on private land may contribute to peak flow increases in the analysis area and increase sediment delivery to channels. As identified earlier, most of the private lands occur in the lower portions of the watersheds. Since vegetation and road activities are regulated by State laws, it is expected that the impacts would occur at levels that would not cause water quality or aquatic habitat changes or affect the support of beneficial uses. In some cases, there could be an overall improvement to water quality if more roads are surfaced and re-engineered to reduce direct inputs of sediment and water to streams.

Alternatives B, C, and D
Direct and Indirect Effects

Water Quantity

The Water Resource analysis focused on aquatic health as it relates to changes in annual water quantities flowing from a watershed and any related foreseeable changes that may affect channel

stability for the management practices listed for the Proposed Action (Alternative B - See Chapter 2). This alternative involves the most management activities, and would represent the most impact. Potential effects of vegetation change on water quantity for Alternative B is compared to the existing condition (Alternative A) using the ECA model. Only the Proposed Action (Alternative B) was modeled because it involves the most manipulation of the forest canopy, approximately 739 acres, and would represent the most potential for changes in water quantities. Each harvest unit in each alternative has been individually planned and would have site-specific BMPs (Appendix B) and Design Criteria (Table 2-?) applied in order to ensure that water quality would be protected and that beneficial uses would be protected by state definition. This assumes that all BMP's are properly implemented and maintained though the sale period.

As previously stated, the ECA Model uses the baseline condition as a fully forested or closed canopy conditions within the watershed to compare the "natural condition" to the existing condition and potential changes from the proposed activities. It is acknowledged that this is only an assumption used for modeling purposes because in fact, this condition would not truly represent the historic conditions in this part of the Swan Valley. Frequent low intensity fires kept stands open, thereby allowing snow to accumulate in the openings. Other areas, such as rock outcrops in the upper basins, would never support a mature tree due to shallow soils. Nevertheless, these predicitions are useful in assessing potential change to the runoff regime in the three major watersheds of the analysis area. See Chapter 2 for summaries of alternative treatments to the forest canopy.

With the small change in forest cover that Alternative B creates, dispersed over such a large area within the watersheds in the analyzed areas, it is predicted that there would be no more than a 0.1 percent increase in annual water stream flows from the analyzed watersheds. Table 3-? displays the water quantities resulting from Alternative B.

TABLE 3-?

WATER QUANTITIES RESULTING FROM ALTERNATIVE B

Watershed Name	Watershed Acres	2007 Percent Water Yield Increase	Proposed Action Water Yield Increase
Glacier	35,805	6.6	6.7%
Elk	16,608	0.4	.4%
Cold	21,592	4.4	4.4%

Alternatives B and C would involve 21.4 miles of BMP improvements to existing roads and Alternative D would include 21.1 miles of BMP improvements to existing roads.

Affects of the action alternatives assume completion of required BMP work on road systems used to harvest timber. This Environmental Analysis also includes analysis of several resource enhancement projects. The resource enhancement projects are not necessary to moderate effects of the proposed actions, but represent opportunities to treat existing situations in within the general project area. A description of these resource enhancements is found in chapter 2 and effects of these enhancements, should they occur, is discussed below. Actual implementation of resource enhancements is dependent on future funding. A discussion of specific affects of potential enhancement projects follows.

The only proposed Resource Enhancement Project that changes vegetation with the action alternatives is the underburning of aspen groves in Units #11 and #12. This management tool is intended to stimulate growth of aspen trees, which would maintain or slightly increase the use of water from that area.

None of the other resource enhancement projects would have direct effects to water quantity in any of the streams because they do not affect the vegetative cover in the watershed.

Channel Stability

The highest increase in water quantities predicted to be generated from Alternative B is 0.1 percent. This 0.1 percent increase is predicted to occur in the Glacier Creek Drainage, which totals nearly 36,000 acres and produces 81,727 acre feet of water. As previously mentioned in Water Quantity, all streams in the analysis area are rated as having good condition for channel stability. A 0.1 percent addition to the existing volume of water would not be enough to pose a threat to channel stability or cause measurable changes in channel shape or flow configuration in streams that are currently stable, or in efficiently carrying the current amount of water quantity. Therefore, no change in stream stability is predicted to occur as a direct or indirect result of implementing Alternative B. Beneficial uses or aquatic health would be protected.

There are several instances where stream crossings would most likely be replaced or added along haul routes as part of the action alternatives. It is anticipated that there would be an improvement to channel stability in the stream segments where this work is done, because the replacements are most often driven by existing undersized culverts. An undersized culvert constricts water flow, and creates an increase in water velocity where the water exits the culverts, especially during high flow periods. Channel scour and localized channel instability results. The direct effect from larger pipes is reduced pressure flowing from undersized pipes. This is also a direct effect of installing more cross drains along the haul routes. The indirect effects would be reduced erosion and increased channel stability. These projects are part of the inherent design features of the project and the beneficial affects to stream channel stability and water quality are assumed to occur as part of the project.

Resource enhancement projects, as described above, are analyzed in this document. These potential projects are located within the analysis area, but are not directly related to the proposed action, and are not necessary to mitigate impacts of the proposed action. The projects represent opportunities to improve specific existing site specific conditions. The cumulative affect of these projects, should they occur, are considered, but funding for such projects is not guaranteed. If approved, such projects would likely occur through stewardship financing, partnerships, or appropriated funding.

Two resource enhancement projects propose to remove deteriorating native log abutments that are constricting the stream flow; both are at risk of failing. Both projects would have direct and indirect positive affects to aquatic habitat by removing tons of soil from within the area occupied by Cold Creek and a tributary of Glacier Creek. These projects would have positive effects by restoring a more natural flow pattern and preventing the abutment material from filling pools and changing the streambed material – both are attributes evaluated by channel stability surveys.

Five resource enhancement projects propose to replace undersized or other stream crossing pipes that prevent fish passage. One also includes installing additional cross drains on roads not associated with the proposed action. As with the improvements proposed for the haul routes, these projects would have positive direct and indirect effects on channel stability by restoring a more natural channel form.

Resource Enhancement Project #7 addresses road pipe problems on small streams in the Windfall Creek drainage, a tributary to Glacier Creek. These small tributaries have moved so they are no longer aligned with the culverts that were installed decades ago to accommodate their flow. This type of stream migration is normal in most stream systems, and this situation was been identified during the Hemlock Point access proposal analysis in the early 1990s. Removing the culverts and road fill would have a positive direct and indirect effect to the tributaries involved by improving channel form and function at the site and downstream.

Alternatives B, C, and D
Cumulative Effects

The Cumulative Effects Worksheet (Project File Exhibit K-15) considers and describes proposed activities in addition to the past, current, and reasonably foreseeable activities listed in Tables 3-1 and 3-2. Please refer to this worksheet for more detailed information on the evaluation of these past, present, and foreseeable activities within the Hemlock Elk Cumulative Effects Analysis Area.

Past and Present Actions:

Modeling, along with on-the-ground reviews, has demonstrated there would be no adverse cumulative effects on water quantity or channel stability from past harvest when considered with the action alternatives and all past activities within the Hemlock Elk Area. This conclusion is reached due to the small annual water yield increases resulting from approximately 20,000 acres of fire, forest management, and other types of vegetation changes on NFS, private and industrial lands from the 1950s to 2007. In addition to these forest changes, clearing associated with over 120 miles of roads was considered for potential cumulative effects to water quantity and timing of runoff. Given the current and past changes in vegetation, it has been determined that these actions should not exceed stream flow levels that would result in streambank instability or impairment of water quality.

During the scoping process for this project, a concern was expressed that past and present (and reasonably foreseeable) actions would have a cumulative effect on not only those watersheds, but on the Swan River as well. These concerns can best be address by two studies conducted on the Swan River in the past 15 years. These studies were initiated to determine if land management activities were having an effect on the river.

In 1989, an aerial photo analysis was conducted on the Swan River's geomorphology, or channel shape. This was done by comparing changes between three sets of photos; 1934, 1966, and 1985 (Project File Exhibit K-16). It was concluded that

> "(T)he kinds of changes observed during the period 1934-1985 are consistent with the type of behavior one would expect for a channel of this gradient and discharge."

The Swan River flows at a very low gradient (less than 1 percent slope) through unconsolidated easily erodible glacial till material. Noticeable changes in gravel bars are seen annually as peak flows scour the river's banks and deposit the recruited material in the lowest gradient areas. Because of its gradient and annual discharge, it is on the threshold between where one would expect a meandering, single channel system, and where one would expect to find a braided stream with many bars and channels. These channel types are most likely to be changed by extreme flood events such as the one experienced in 1964. Grant goes on to conclude:

> "Increased delivery of water from harvested units is unlikely as a mechanism for generating cumulative effects because: 1) snowpack melting results in only negligible increases in runoff from harvested units versus unharvested areas; 2) the drainage network connecting valley floor units with the main channel is poorly developed; and 3) there exists ample opportunity for storage and detention of runoff in the numerous lakes, ponds, and marshes along the valley floor."

Grant also points out that the glaciated landforms effectively buffer the movement of both water and sediment from the adjacent hillslopes,

> " thereby reducing the sensitivity of the channel to hillslope-induced changes in regime".

Another study, completed in 1999 by Flathead Lake Biological Station researchers, focused on water quality primarily in form of nutrients, represented by the levels of sediment in grab samples along the

course of the river. In this study, the Swan River catchment was broken into five segments. The sampling locations were placed along the river where the flows could be measured through most of the year, and water quality samples could be taken on a consistent basis. Of the locations, three are spatially located below the point where the Swan River passes along the Hemlock Elk Analysis Area.

As mentioned previously, this study confirmed that nutrients and total suspended sediment is extremely variable from site to site, from season to season, and from year to year. It also confirmed that even when the best statistical analysis techniques are used to link land management level to water quality components, it is "not surprising that we observed no statistically significant relations between human landscape disturbance and water quality" (Project File Exhibit K-3). The reason for this lack of linkage was related to:

1. The mixing and dilution of nutrients and sediment through the course of the river as tributaries entered the river,
2. The large amount and types of areas capable of storing nutrients and sediments such as the extensive flood planes and side channels, and
3. The chaotic timing of the movement of materials from storage at a range of scales in response to often episodic events.

The dilution factor is the key to predicting the potential cumulative effects of the escalating rates of land exchanges that have occurred and continue to occur throughout the Swan Valley as PCTC liquidates their inholdings. Over 10,000 acres of PCTC lands have been acquired by the Flathead National Forest since 1995. These lands are in the process of being treated for noxious weeds, revegetated with native plants, and actively treated to restore natural water flow patterns. Many other lands have been purchased in blocks and in some cases subdivided. However, with the current state of knowledge, it is doubtful that the rate of development would exceed the lands' capability to heal, and thereby have no cumulative effect on water quality.

Reasonably Foreseeable Actions:

Swan TMDL Study: The reasonably foreseeable actions most likely to have an effect on water quality would be road management, such as the restoration of the sediment sources documented in the Swan TMDL Study. These actions would help reduce the amount of sediment and water routed directly to streams at road crossings.

Plum Creek Timber Harvest: It is anticipated that PCTC would harvest approximately 800 acres (Grizzly Meadow and Stone Lake Projects) in the Hemlock Elk Project Area within the reasonably foreseeable future as allowed by the Swan Valley Conservation Agreement (Project File Exhibit Q-4). Foreseeable harvest is located in the lower elevations and precipitation zones of the valley. Alteration of the vegetation in this low runoff zone would have very little effect on the overall runoff potential of the watersheds because it is a proportionally small percent of water yield generated from snow pack considering how much runs off of the higher elevations (Grant 1989). This work would be in concert with the State BMPs, which have been found to be over 90 percent effective in protecting water quality in recent audits. Therefore, it is unlikely that harvest or associated road construction by PCTC would cumulatively contribute negatively to water quality or water quantity (Grant 1989).

Private Land Transactions and Development: This is anticipated to continue throughout the Swan Valley. As discussed above, some PCTC lands have changed hands in recent years. Recently announced potential land sales to the Forest Service and State of extensive PCTC holdings through the Montana Legacy Project could reduce private land sales and increase government ownership. Those lands transferred to the Forest Service would continue to be scheduled for restoration work as funds are available and partnerships are

established to help with those goals. Future vegetation alteration (with associated impact to water quantity and quality) would likely be at a reduced rate compared to when it was managed as an industrial forest. As with past transactions, some land would become owned and managed for private uses, but it is also unlikely that those portions of the land base managed for private uses would have a negative cumulative effect of channel stability of water quality.

According to Missoula and Lake County Subdivision Regulations, land may be found unsuitable for subdivision due to flooding, landslides, steep slopes in excess of 25 percent, high potential for wildfire, high water table, and other features that may cause environmental degradation. Also, land located within a 100-year floodway or floodplain or land deemed subject to flooding shall not be subdivided for building or residential purposes. Limitations on home site development are restricted by the county regulations in which the property resides.

Overall, cumulative effects to water quality from the Hemlock Elk Project, in conjunction with the change in land ownership patterns, are difficult to predict. The effects of the Hemlock Elk Project itself are extremely limited and, as described in the effects analysis, even these limited affects rapidly subside within 15 years due to vegetative recovery. Land ownership changes and associated development are speculative, but it is not likely that effects from changes the ownership pattern would combine with the limited affects from the project to produce a measurable affect on the water quality of the Swan River within the period of recovery from project. Further, the impact of the land ownership changes is, in many cases, moving the lands from industrial use to less impactive practices. Overall, it is not reasonably foreseeable to predict that the landownership changes in the Swan Valley would combine with the project affects to adversely affect water quality.

In summary, there is no evidence that past, current, and foreseeable actions in the Hemlock Elk Analysis Area would have a measurable cumulative effect on water quality in the streams in this area, Swan River, or Swan Lake. A 0.1 percent predicted increase in water yield results from the activities associated with the Alternative B and would not pose a threat to channel stability or cause measurable changes in efficiently carrying the current amount of water quantity resulting in negative cumulative effects. Beneficial uses would be protected for all alternatives. However, Alternative A carries a slightly higher risk of potential cumulative impact on water quality compared to the action alternatives due to fire risk and road conditions. The resource enhancement projects discussed above, if implemented, would tend to have neutral to positive impacts on channel stability and water quality, and little if any impact on water quantity.

Regulatory Framework and Consistency

Water resources management in the Hemlock Elk Project Area is regulated by the Federal Water Pollution Control Act, the EPA's Anti-Degradation Policy, Montana Water Quality Standards, Montana State BMPs, and the SMZ Act. They are described in detail below.

Water quality standards (Section 303(c)) established in Montana for the CWA classify all waters in this area to be B-1. This means that the waters are suitable for drinking, culinary, and food preparation after conventional treatment; bathing, swimming, and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply. There are many registered water rights for consumptive use (households and stock watering) in the lower portions of the project area.

The predominant non-consumptive use of stream water in this area is the propagation of cold-water fisheries and other aquatic life. The water quality parameters of primary concern to the fisheries are fine sediment and changes in temperature. These, along with dissolved oxygen, nutrients, dissolved solids, and many other variables, have been measured at a variety of locations across the forest.

Federal agency compliance with pollution control is addressed through Section 313 of the CWA Water Act, EO 12580 (January 23, 1987), National Nonpoint Source Policy (December 12, 1984), USDA Nonpoint Source Water Quality Policy (December 5, 1986) and the EPA in their guidance Nonpoint Source Controls and Water Quality Standards (August 19, 1987). In order to comply with State and local nonpoint pollution controls, the Forest Service would apply BMPs to all possible nonpoint sources that may be due to management activities addressed in this EA. Best Management Practices are the primary mechanism to achieve water quality standards (EPA 1987).

Best Management Practices include, but are not limited to, structural and nonstructural controls, operations, and maintenance procedures. They can be applied before, during, and after pollution producing activities to reduce or eliminate introduction of pollutants into receiving waters. Usually, BMPs are applied as a system rather than a single practice. Best Management Practices are selected by site-specific conditions that reflect natural background conditions and political, social, economic, and technical feasibility. The Forest Plan emphasizes the application of BMPs "to protect or improve the quality of the water source" (p. II-40).

Wetlands are protected under EO 11990. This Act directs Federal agencies to

> "minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands."

Effects on the maintenance of natural systems, flora, fauna, habitat diversity, and hydrologic utility are to be considered when evaluating a proposed project that could potentially affect a wetland.

Most types of silvicultural activities are exempt from the 404-permit process of the CWA. Associated timber roads are exempt from the permit process only if they are constructed and maintained with the use of BMPs listed in 40 CFR 323.4(a), as well as those approved in the Montana Non-point Source Management Program (1986). The Montana SMZ Act (1992) directs wetlands adjacent to stream channels to be included within SMZ boundaries.

All action alternatives are consistent with the water quality goals, objectives, and standards described above and outline in the Flathead Forest Plan, as amended. This consistency is met primarily by application of BMPs in timber harvest areas and roads associated with timber removals.