High conservation value forest assessment

Category 4

Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion

Key question 12

Does the forest provide a significant source of drinking water? Answer = YES

Definitive question

Is there a sole available and accessible source of drinking water? Answer = NO

Guidance question

Are there watershed or catchment management studies that identify significant recharge areas that have a high

HCVF attributes

- Forest managers must determine whether or not incorrect actions or management could cause serious cumulative or *catastrophic* impacts to basic services provided by the forest, such as drinking water.
- Areas are considered a HCVF where potential negative impacts on human communities from forest management activities are *so significant that they lead to significant loss of productivity or sickness and death, with no alternate sources of drinking water*.
- The importance of the eastern slopes of Alberta for the water supply and health of aquatic ecosystems has been recognized for over 100 years. This is indicated by legislation and policy documents including:

- the Federal Dominion Forest Reserves Act (1906);
- establishment of the Green and White Areas in 1948
- formal establishment of the Rocky Mountains Forest Reserve in 1964;
- the Eastern Slopes Policy (established in 1977 and revised in 1984);and
- more recently Alberta's Water For Life Strategy and the implementation of the Land-use Planning Framework

- The SLS FMA falls within the Red Deer and Bow River basins. The rivers are considered snowmelt rivers, with the majority of water supplied by precipitation falling and accumulating in the Rocky Mountains and Foothills during winter months. A series of peak flows occur during the spring and summer, related to progressive melting of snowpacks at low, moderate, and high elevations. Water flow declines over the late summer, fall, and winter. Glacial melting provides some water to flows during late summer and fall, while groundwater is the primary source of discharge during winter months. Peak flows generally occur during June, with minimum flows in January.
- There are many fresh water springs, small ponds and lakes, emphemeral, intermittent, and permanent streams, as well as major sub-basin rivers providing water to the

Bow River (645 km)
- The largest tributary of the South Saskatchewan River, contributing approximately 43% of the average annual combined flow.
- The most highly populated river basin in Alberta, with more than 1.1 million people, with the Calgary region representing 80% of that population.
- Downstream flows are highly altered due to hydro electric dams, water withdrawals, diversions, irrigation canals, and wastewater discharges.
- Approximately 40% of the basin's total annual natural flows are altered, making the Bow River the most regulated river in Alberta.
- Major sub-basin rivers and streams include: the Ghost River, Waiparous Creek; Jumpingpound Creek; the Elbow River; Fish Creek; the Highwood River; and the Sheep River.
- The City of Calgary is the largest municipal user of water in the Bow River Basin. It stores drinking water from the Bow and Elbow Rivers in the Bearspaw and Glenmore reservoirs, respectively. Calgary supplies Airdrie and Chestermere. Cochrane and Morley draw water from the Bow River.
- The Elbow River, which supplies approximately half of Calgary's drinking water to the Glenmore Reservoir, also supplies water for the Tsuu T'ina Nation and the community of Bragg Creek.
- The Sheep River supplies Turner Valley, Black Diamond, and Okotoks.
- The Highwood River supplies Longview and High River.
- The upper reaches of the major rivers and streams associated with the FMA are considered to have healthy riparian zones and very good water quality (BRBC, 2005).

Red Deer River (724 km)
- Forms the largest sub-basin of the South Saskatchewan River (50,000 km^2). The upper Red Deer River crosses the FMA / B9 area southwest of Sundre.
- Population estimates indicate over 267,000 people living in the Red Deer River watershed. The City of Red Deer is the largest urban area in the watershed (~ 83,000 people). The Town of Sundre, located east of the North FMA, has ~ 2,500 residents.
- Significant tributaries within the FMA/ B9 include: Burnt Timber Creek; Williams Creek; the Little Red Deer River; Atkinson Creek; Dogpound Creek; Fallen Timber Creek; Grease Creek; and Harold Creek.
- The upper reaches of the major tributaries associated with the FMA are considered to have healthy riparian zones and very good water quality (RDRWA, 2009).

main stems of the Bow and Red Deer Rivers along the foothills. Therefore, there is no *sole source* of drinking water on the FMA and no foreseeable circumstances where forest operations could eliminate all of the potential sources of water for drinking.

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Category 4

Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion

Key question 12

Does the forest provide a significant source of drinking water? Answer = YES

Definitive question

Is there a sole available and accessible source of drinking water? Answer = No

Guidance question

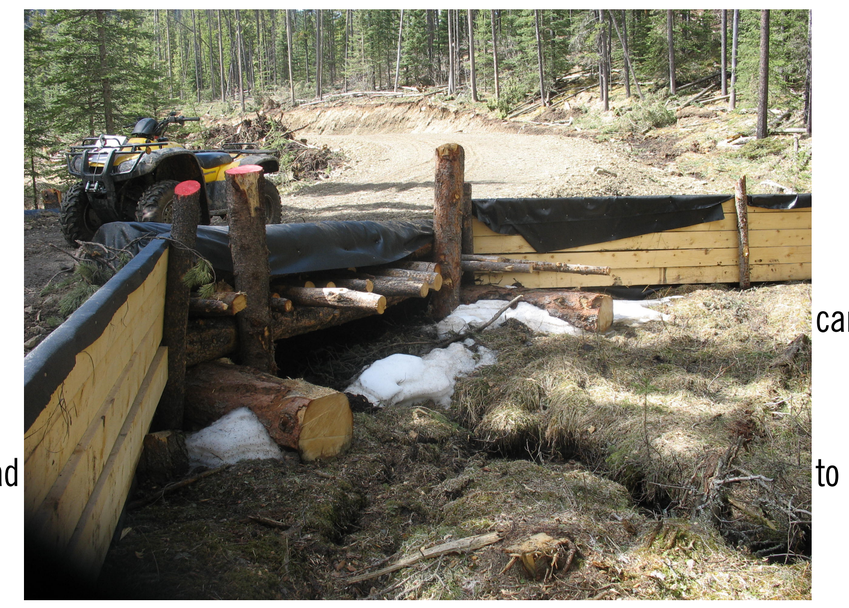
Are there watershed or catchment management studies that identify significant recharge areas that have a high

HCVF attributes

- Recharge areas represent the portion of precipitation or runoff that percolates into the ground and eventually reaches an aquifer or water-bearing zone under the ground surface. Recharge zones are often found in elevated areas and include small depressions in the landscape and temporary or ephemeral wetlands, which collect rainwater and snowmelt and release a proportion of this accumulated water into the groundwater aquifer.

- Groundwater flows in the subsurface and eventually emerges as discharge into springs, streams, wetlands, and other surface water bodies. This process can take from days to many years, depending on the scale of the aquifer system and its hydrogeological properties.
- Recharge or discharge areas often indicate where the groundwater table is close to the surface (i.e. freshwater springs) and where soils are generally more permeable. These areas can be at greater risk of becoming negatively impacted by forestry, agriculture, industrial activity or development.

- All of the recharge and discharge areas on the FMA /B9 area play an important role in the hydrological system and require adequate management strategies to mitigate potential negative impacts to drinking water. No *specific* or *significant* recharge / discharge areas have been identified that have a high likelihood of affecting drinking water.



Potential Impacts of Forest Management Activities

- In general, the greatest risk of impacts to water quality associated with forest management activities are related to road construction and stream crossing installations.

- Soil exposed for road building increases potential for erosion and the transport of sediment to streams. Ditch lines can result in concentration of flows, with associated erosion and sedimentation in streams if ditchwater is allowed to enter streams.

- Improper installation of stream crossings has negative impacts to water quality and poor road maintenance can lead to problems over time.

- The DFMP aligned with higher level plans (i.e. IRP)
- Annual Plans and approvals
- Avoidance of wetland sites and proper road and crossing location selection
- Activities subject to various legislation (e.g. Federal Water Act, Navigable Waters Act, etc.)
- Riparian zone buffers
- SLS and ASRD road inspections
- Road use integration with other users
- Operational Ground Rules provide day to day guidance (e.g. erosion control measures, soil disturbance limits)
- Equipment operator training and supervision
- Roads constructed for short term use with reclamation after silviculture activities are complete

Measures to Mitigate Impacts

- Aquatic monitoring was completed in the McLean Creek area on 12 streams between 1997 and 2007 to develop a framework to allow the identification and evaluation of changes in aquatic resources over time. Biological diversity of benthic macroinvertebrates, presence or absence of sport fish, stream habitat measurements and stream classification, and temporal patterns in selected physicochemical characteristics of surface water data were collected and analyzed. Statistical significant differences were not identified when comparing the streams associated with logging and the controls.

- Additional disturbance from fire and MPB
  - Increased flow or changes in timing of peak flows
- Climate change and warming trends
  - Smaller % of precipitation as snow in winter, resulting is less snow available for spring melt
  - A decreased peak flow, earlier in spring
  - Higher winter flows due to more rain
  - Reduced glacial meltwater
  - Impacts to spring and summer flows when demand is high (e.g. crop irrigation)
- Rapid population growth placing demands on the water supply

Future Considerations

- In summary, all streams, rivers, lakes, wetlands, and riparian areas on the FMA are considered high value resources and receive special management through normal operations. The intent of the question is not to designate all water features as a HCV. There is no sole source of drinking water and no

High conservation value forest assessment

Category 4

Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion

Key question 13

Are there forests that provide a significant ecological service in mediating flooding and or drought, controlling stream flow regulation, and water quality? Answer = YES

Definitive question

Are there high risk areas for flooding or drought? Answer = YES

Guidance questions

Are there particular forest areas that potentially affect a significant or major portion of the water flow (e.g. 75% of water in a larger watershed is funneled through a specific catchment area or river channel)?

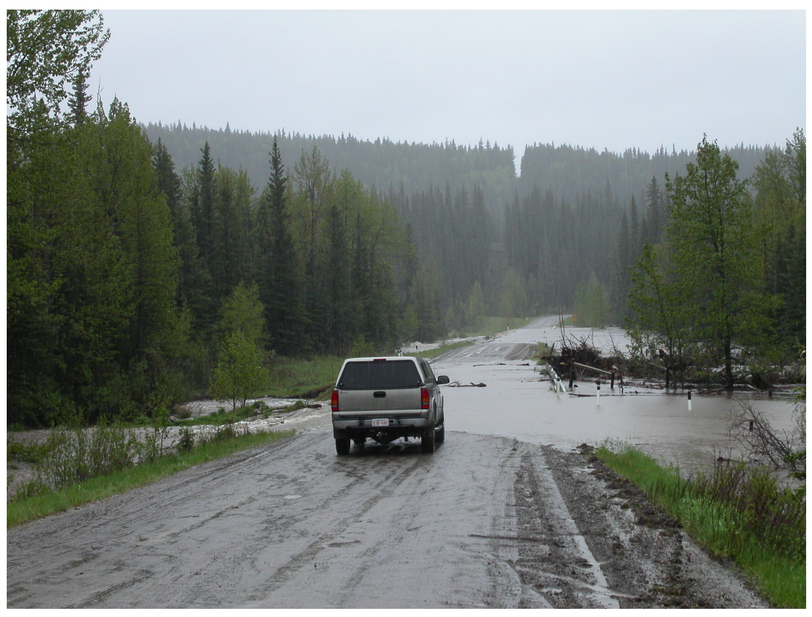
Does the forest occur within a sub-watershed that is critically important to the overall catchment basin?

Are there particular forest areas (i.e. a critical subwatershed) that potentially affect water supplies for services such as reservoirs,

HCVF attributes

- Forests play a critical role in maintaining water quantity and quality. HCVF designation is considered where a potential breakdown of this service has *catastrophic* impacts or cannot be replaced.

- Flooding is a natural occurrence in all streams and lakes in Alberta, with the largest floods occurring as a result of combined snowmelt runoff and heavy rainfall events.
- Beneifits of natural flooding include flushing sediment and plant material, redistributing sediment and nutrients, depositing coarse woody debris for fish habitat, creating new channels and undercut banks, and recharging alluvial aquifers.
- Negative impacts include changes to fish habitat, hardship to communities along floodplains, property damage, lower drinking water quality with increased treatment costs, and loss of life in severe cases.



- Studies on the effects of forest harvesting on peak flows in large watersheds greater than 200 km^2 were unable to identify statistically significant relationships between level of harvest and the effect on peak flows (Duncan,1986; Stork et al., 1995, Thomas and Megahan, 1998).

- This is due to a number of factors including the increased influence of subsurface flow on delivery of runoff to streams in large watersheds, natural decreases in variability in peak discharge with increasing drainage area, and the effects of runoff occurring at different rates with a greater distribution of aspects and elevations in a large watershed.

- Schnorbus and Alila (2004b) indicated that there was a low likelihood that timber harvesting on low elevation forested slopes would significantly affect peak discharge in alpine dominated watersheds, where the alpine area accounts for at least 30% of the drainage area.

- The Ghost Lake, Bearspaw, and Glenmore Reservoirs mitigate flooding effects for downstream communities, including the City of Calgary, by controlling flows downstream of the reservoirs. Glennifer Lake provides a similar function for the City of Red Deer and surrounding areas.
- Small lakes and wetlands across the FMA help to filter water and reduce flood impacts.

- Forest management activities at the stand and watershed level can potentially impact water quantity in several ways. Large stand replacing fires or MPB disturbance may have similar effects.
  - Watershed scale effects of forest disturbance can be difficult to quantify due to natural variations in climate, soils, and topography.
  - In general, harvesting leads to more snow accumulation with accelerated spring melting, increasing the amount of water available to recharge groundwater, surface runoff, and stream flow.
  - Removing the forest canopy decreases transpiration and the amount of precipitation intercepted by trees prior to reaching the ground.
  - Less precipitation remains stored in the litter layer, and there is a potential for an elevated water table.
  - The greatest impact is often associated with harvesting at high elevations.
  - The increase in water yield and peak flows combined with the duration of these flows most likely impacts channel processes and sediment movement through associated floodplains.

High conservation value forest assessment

Category 4

Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion

Key question 13

Are there forests that provide a significant ecological service in mediating flooding and or drought, controlling stream flow regulation, and water quality? Answer = YES

Definitive question

Are there high risk areas for flooding or drought? Answer = YES

Guidance questions

Are there particular forest areas that potentially affect a significant or major portion of the water flow (e.g. 75% of water in a larger watershed is funneled through a specific catchment area or river channel)?

Does the forest occur within a sub-watershed that is critically important to the overall catchment basin?

Are there particular forest areas (i.e. a critical subwatershed) that potentially affect water supplies for services such as reservoirs,

HCVF attributes

-Equivalent Clearcut Area (ECA) modeling was completed for the FMA / B9 by Dr. Uldis Silins, a forest hydrologist with the University of Alberta to predict the cumulative effects from forest harvesting and the potential change in water yield, and the associated rate of hydrologic recovery over time.
-ECA is an area based representation of the “hydrologically effective disturbance” area that either new or recovering disturbances represent on the landscape. This can be described as the absolute area in hectares or the % total area for the planning unit.

- As forests grow, the rate of snow accumulation and rapid melting is reduced. This reduction is identified as hydrologic recovery. The relationship between tree height and crown closure can be used to estimate percent recovery for fully stocked stands. Fully stocked stands that reach a crown closure of 50 -70% can expect a recovery of 90% once the trees are more than 9 meters tall. Yield curves used to prepare the DFMP indicate that the average age of stands meeting this criteria is approximately 55 years.

- Ten Planning compartments on the FMA with planned harvest blocks were simulated over a 200 year horizon. The projected range in maximum ECA was from 18.4 to 29.5% over the 200 year horizon. The first 25 years of the DFMP indicated a much lower range from 8.2 to 19.2%. Maximum ECA was maintained below 30% of the compartment area, which is a common upper limit used for management plans in Canada, and harvest levels are expected to have minor impacts on water yield.

- Water yield projections were based on long term average climatic conditions for the region, to separate out large variations associated with annual precipitation, which in turn affects annual stream flow. This facilitated the examination of changes in water yield produced solely from disturbance and recovery over time, and allowed separation of the changes associated with variability in climate.

- Representative hydrometric and annual precipitation data was assembled. Variations in the mean annual precipitation and stream flow were identified between the areas north and south of the Bow River. Values are generally lower (less precipitation and less flow) north of the Bow River. Therefore, long term average regional precipitation and water yields were calculated separately for each portion of the FMA (i.e. north and south of the Bow River). Annual water yield increases (% increase over baseline averages and absolute increases in mm/yr) were projected for the 200 year planning horizon in the 10 FMA compartments.

- Water yield projections generally reflected differences in ECA % among the compartments, however, projected water yield increases were greater in the north compartments, ranging from 8.2 to 12.2% above baseline over 200 years and 4.7 to 11.3% for the first 25 years of the plan. In comparison, the projected water yield increases in the south area were considerably lower, ranging from 3.1 to 4.1 % over the 200 year horizon and 1.6 to 2.7% in the first 25 years of the plan.

- Larger % yield increases in the north compartments (an area with lower precipitation and water yield) were attributed to the increased role of evapotranspiration in this region. While water yield (mm) increases on a unit area basis were still generally lower in the south compartments, these stream flow increases per unit area ECA are generally higher, reflecting higher precipitation and run-off.

- Overall, projections for the increase in water yields were all less than the 15% threshold used by ASRD over the 200 year planning horizon.

High conservation value forest assessment

Category 4

Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion

Key question 13

Are there forests that provide a significant ecological service in mediating flooding and or drought, controlling stream flow regulation, and water quality? Answer = YES

Definitive question

Are there high risk areas for flooding or drought? Answer = YES

Guidance questions

Are there particular forest areas that potentially affect a significant or major portion of the water flow (e.g. 75% of water in a larger watershed is funneled through a specific catchment area or river channel)?

Does the forest occur within a sub-watershed that is critically important to the overall catchment basin?

Are there particular forest areas (i.e. a critical subwatershed) that potentially affect water supplies for services such as reservoirs,

Hcvf attributes

- Due to the long and narrow geographic extent of the FMA boundary (from Sundre in the north to the southern end of Kananaskis Country), there are no specific forest areas that affect a major portion of water flow to a significant watershed (i.e. 75% of water through a channel). For example, approximately 30% of the area of the Elbow River sub- basin is included in the FMA.

- No significant impoundments, diversions, or infrastructure is located on the FMA itself.

- Melt water from the Foothills provides the recharge for rivers that supply irrigation on the prairies to the east. In the absence of irrigation, the agriculture industry in Alberta would be severely hampered or non existent. Again, the intent of the question is not to designate all water features as a HCV.

- The Elbow River is significant in that it supplies 45-50% of the drinking water for the City of Calgary, stored in the Glenmore Reservoir, and it's sub-basin is only 1/25th the size of the entire Bow River basin. The river is naturally braided, with a number of channels separated by transitory gravel bars or islands. Braided rivers are subject to rapid and unpredictable abandonment of channel segments, with this characteristic displayed regularly in the Elbow riparian area.
- The alluvial aquifer refers to the gravel and sand deposited by recent or historic river processes, usually located under, and on at least one side of the river. It is very permeable and hydraulically connected to the river. Groundwater from the alluvial aquifer flows into the river during periods of low river flow and river water flows into the aquifer during times of high river flow. Groundwater flow often moves sub-parallel to the river.
- The interconnectedness of the river and aquifer has only recently been recognized, with the groundwater and surface water being considered a single resource. Therefore, land use on the aquifer has the potential to directly impact water quality.

- The Hamlet of Bragg Creek is located along the south banks of the Elbow River and has been impacted by flooding in the past.
- More recently, the flood of 2005 resulted in a voluntary evacuation order, washouts on Bracken Road, and highway closures including a road block of the Elbow River bridge and a closure of highway 66.

- Bragg Creek has been under a boil water advisory for over 20 years, with wells in the aquifer showing the presence of coliforms. Water quality problems are believed to be partly due to the groundwater –surface water interaction with private septic effluent in the alluvial aquifer.

- The MD of Rocky View has recently undertaken potable water and waste water treatment initiatives. A Master Stormwater Drainage Plan is being prepared for the Bragg Creek Area Structure Plan .

- In summary, while the Elbow River is a large watershed (i.e. >200 km2) and impacts from forest operations are expected to be minimal, the Elbow River main stem and its adjacent alluvial aquifer is considered to be a HCV attribute due to the significance of the water supply for the City of Calgary (e.g. 45-50%) and the history of floods with potential negative impacts to the Hamlet of Bragg Creek.

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Category 4

Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion

Key question 14

Are there forests critical to erosion control? Answer = YES—Localized

Definitive question

Are there forest areas where the degree of slope carries high risk of erosion, landslides and avalanches?
Answer = YES, in high elevation areas / NO, on harvest blocks with slopes < 45%

Guidance questions

Are there soil and geology site types that are particularly prone to erosion and terrain instability?

Is the spatial extent of erosion –prone or unstable terrain such that the forest is at high risk (also of cumulative impacts)?

HCVF attributes

- A HCVF designation is considered where a forest is *critical* to soil, terrain, or snow stability and where there is increased risk of erosion, sedimentation, land slides or avalanches.

- There are steep alpine slopes within the FMA that have potential for landslides and avalanches in localized areas.

- There is no requirement in Alberta for terrain stability assessments prior to harvesting and terrain stability mapping for the Province has not been completed.

- Sustained slopes > 45% were removed from the *active* land base during development of the DFMP and are not included in the Spatial Harvest Sequence. The majority of avalanche and slide paths will have been removed from potential forestry activity in this process.

- The operational planning phase includes the use of LIDAR data to further identify problematic terrain (e.g. gullies) and steep slopes (e.g short pitches) in the vicinity of harvest blocks. Road locations, with a focus on avoiding steep slopes and minimizing the number of stream crossings, are pre-planned at this stage.

- Road and block boundary locations are finalized on the ground at the pre-harvest assessment and the block layout stage. This provides an opportunity to identify localized site level erosion or terrain issues. Soils are typically coarse textured and well drained (e.g. pine sites). Site observations identify high risk soil types, water source areas, gullies, slide paths or areas with missing vegetation or where repeated events prevent the growth of large vegetation. Other soil stability indicators include jack-straw trees or debris deposits. Problem areas frequently share drainage features, which have riparian reserves. Harvest boundaries are typically located at the top of breaks in these situations. Higher risk areas are normally excluded from blocks or avoided in retention patches.

- SLS uses ground based mechanical harvesting methods that are restricted by operability limits on steep slopes.

- The climate in the foothills west of Calgary is dry and windy. Snow accumulations are limited to some degree by frequent Chinook winds through the winter months. Human dwellings in the vicinity of harvest operations are restricted to trapper's cabins and seasonal camps. The risk of loss of life or damage to property or infrastructure from a forestry related landslide or avalanches is low.

In summary, the risk of landslides, avalanches, and excessive erosion as a result of forest harvesting activities is considered low. The spatial extent of erosion prone or unstable terrain on the FMA is localized and site specific. These areas are addressed through regular planning. SLS has not observed a significant slide in the past as a result of forestry activity, nor have there been issues with excessive erosion and unstable terrain. Negative impacts and risk associated with harvesting activities is considered low. No HCVF designation has been made in relation to Key Question 14.

High conservation value forest assessment

Category 4

Forest areas that provide basic services of nature in critical situations (e.g. watershed protection, erosion

Key question 16

Are there forest landscapes (or regional landscapes) that have a critical impact on agriculture or fisheries? Answer =YES

Definitive question

N/A

Guidance question

Are there agriculture or fisheries production areas in the forest that are potentially severely negatively affected by changes in wind and microclimate and microhabitat (i.e. woody debris from riparian vegetation)?

HCVF attributes

- This attribute refers to forests that mediate wind and microclimates at an ecoregion scale, and which affect agriculture or fisheries production.

- The FMA and B9 Quota area lie within Alberta's Green Zone and the Rocky Mountain Forest Reserve, established for the conservation of forests and other vegetation and the maintenance of conditions favourable to an optimum water supply. Therefore, lands within the FMA and B9 Quota are not available for agricultural development (i.e.cultivation), with the exception of cattle grazing. The B9 Quota area has grazing leases and the FMA has approximately 80 overlapping grazing allotments. Both land uses have coexisted for many years. As previously described, agricultural development in the White Zone (designated for agriculture and settlement) to the east of the FMA is dependent on the Rocky Mountains and Foothills for irrigation water. Forest management activities and associated harvest levels (currently <10% of FMA area) are expected to have little or no impacts to agriculture on the prairie.

- Riparian forests play an important role in maintaining fisheries by providing bank stability and controlling sediment and some nutrient inputs to watercourses. Microhabitats are influenced through the recruitment of coarse woody debris from stream side trees. Riparian forests are addressed by the OGRs and Indicator 6.3.17 of the FSC Boreal Standard, which require reserves around water bodies to prevent forest harvesting from resulting in significant, negative effects on water quality and fish habitat.

- Rivers and streams on the FMA and B9 Quota are fast moving cold –water aquatic habitat suitable for fish species including rocky mountain whitefish (Prosopium williamsoni- Girard), brook trout (Salvelinus fontinalis - Mitchill), brown trout (Salmo trutta - Linnaeus), bull trout

- In general, streams originating along the eastern slopes of the Rocky Mountains tend to have reduced temperature, high dissolved oxygen content, and a pH close to neutral. Most of the rivers and streams on the FMA are able to support salmonid life cycles. There are no commercial fisheries or production facilities on the FMA.

- While all watercourses on the FMA are considered important, the Highwood and Sheep Rivers are instrumental in supporting cold water fish of the Bow River and a world class recreational sport fishery. The headwaters are dominated by brook trout and rocky mountain white fish. The Highwood River basin supports more than ¾ of the spawning and nursery habitat for the lower Bow River basin rainbow trout population. Bull trout spawn in the fall in the upper reaches however both bull and cutthroat trout are rare due to competition from introduced rainbow and brook trout.

- As described under Key Question 1, the westslope cutthroat trout has been listed as a threatened species in Alberta and a Recovery Team has been assembled to complete work on a Recovery Plan. Initial genetic analysis indicates that a degree of genetic independence among pure populations is present and appears to be concentrated at the individual stream level, rather than among major watersheds. Population work is ongoing with regards to barrier surveys, upstream limit of distribution, and abundance and size structures of populations. ASRD has produced a map indicating the distribution and genetic status of native populations of westslope cutthroat trout sampled between 2000 and 2008. SLS participates on the Recovery Team and will work with new information as it becomes available.

- In summary, the impacts of forest management activities on the fisheries resource can be mitigated. The Sheep River is largely surrounded by protected areas in the vicinity of the FMA. Note that the Highwood River and Red Deer River riparian areas within the nationally significant ESA have been designated as HCVFs
under Key Question 3. The westslope cutthroat trout and bull trout have been designated as HCV attributes under Key Question 1. Important stream reaches identified for westslope
cutthroat trout and bull trout, related to pure populations and spawning sites are considered HCVFs.