GLADE COMMUNITY
WATERSHED ANALYSIS

GLADE CREEK MUNICIPAL WATERSHED

BY

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GLADE COMMUNITY WATERSHED ANALYSIS

GENERAL DESCRIPTION

The Glade Creek watershed is 29 sq. km in size, orientated toward the west-northwest flowing into the Kootenai River south of the community of Glade. The Glade Community Irrigation Association has over 100 connections for domestic water use. This is the sole source of water for the community with a sizable investment in the dam, chlorination and distribution system.

The watershed is a very steep sloped high gradient basin going from an elevation of 1500 feet at the river to 7605 feet at Siwash Mountain. This is an elevation difference of 6100 feet in less than 5 miles horizontal distance. This is an average loss of 1200 feet per mile or 23% slope drop. The stream system drops at a rate of over 10°.

The watershed is characterized by high elevation cirque basins that have steep rock headwalls and shallow to nearly flat bottoms composed of meadows, wetlands, bogs and lakes, these are the high snow catchment zones that are the storage basins for the watershed. These are the areas that control the input of water for year around use especially during the dry summer months. As the water flows out of these high zones and flows under the

surface it is filtered by the soil and the microbial activity in the organics and the top soil. They are concave land forms that extend from Siwash Mountain at 7605 foot elevation down to approximately the 6700-6500 foot elevation depending upon the location in the watershed. The concave cirque basins transition into a rounded convex land form with moderate slopes at an elevation level between 6500 and 5900 feet. This narrow elevation band is very important in the water management of the drainage. This is where springs come to the surface and become live perennial streams. This is the area that controls the flow of water to the stream system and eventually to the water supply system for the community of Glade. The microbial activity and undisturbed forest floor is very important here to the water quality and the timing of the release of water from its subsurface movement to the surface and to live streams. This zone has many small springs moving water that eventually form up with the main branches of Glade Creek.

Below approximately 5900 elevation the watershed is characterized by long steep straight to convex slopes with very steep gradient incised streams. The streams are parallel and closely spaced, an indication of instability due to the lack of internal structure and water handling capability.

Stream System

There are two main forks to Glade Creek; the most northerly fork begins at Siwash Lake, flows northwest, turns to a southwest direction and then in a westerly direction at the main stem of

Glade Creek.

The Southern branch begins with one fork at a small unnamed lake and the other fork at a wetland pond swampy area. Both branches were flowing good volumes of water when I viewed them at approximately the 6100 foot elevation. The Southern branch has one fork flowing northwest and one entering after flowing southwest. The stream flows northwest until meeting the North branch at elevation 2500 and turning directly west.

These are high gradient "A2" and "A3" stream types (Rosgen typing) made up of boulders and small cobbles. The steams in the 6000 elevation zone are stable but very fragile. The step-pool nature of the stream is downcutting to adjust to the highly incised steep stream reaches down slope. The stream will adjust by down cutting up slope. At present the streams are stable and in equilibrium through the area of proposed activity. However, due to steepness, the streambed material size and shape, and the incised nature of the stream, it would take very little impact to become unstable.

As the South Fork of Glade progresses downslope it becomes more incised as the gradient becomes steeper. There are places with past bank cutting and slumps into the stream in this area. The characteristics of "A" channels are a steep gradient, active head cutting, incised, meaning there is no floodplain or sediment storage areas. Any increase in sediment would result in bank cutting and an increase in bedload transport and resulting damage downstream. Also, any increase in water yield out of the

headwater streams will result in mass failures and the collapse of steep banks due to undercutting by the stream. The stream is forced into the high steep banks with increases to the peak flows that result from removing vegetation in the headwater reaches. This is a very fragile stream system under the best of natural conditions (see appendix for Rosgen channel typing).

Geology and Soils

The soils and geology have been mapped and described in a report "Terrain Survey of the Headwaters of Glade Creek Watershed with Interpretations and Recommendations," by Wehr and Salway for ATCO Lumber Co. My field and aerial photo reviews found the material very similar to the description in the report. However, I do disagree with the interpretations and recommendation. I will discuss this more fully.

The basic geology is the result of past glaciation and the action of water and gravity since the Glacial period ended. The upper elevations where the steep headwall cirques are found is the result of alpine glaciation that could have lasted well past the continental glaciation into fairly recent times. These cirques have developed wetland organic soils in the flatter area that are water storage areas with surface water or a very high water table. There are a few talus slopes or rock falls that have resulted from colluvial activity. This is the weathering of the rock and movement downslope by gravity. Much of the project area has colluvial material covered by a veneer of soil. Most of the soil has been wind deposited (loess) on top of the rock. These

slopes are very unpredictable as to how they handle water. This was observed in the field where I found water on slopes where it would not be expected.

Downslope from the project are the morrainal features of over steep side slopes, gullying and very unstable conditions. The parallel first order streams and gully development are indicative of the instability. These areas are below or downslope from the project area and could be impacted from the upslope activity. Generally speaking, in the project area the ridgetops are granite bedrock and weathered rock. They are dry and would be stable areas for road construction. The north facing slopes from the ridge tops to the creeks are very steep off the ridges and show evidence of past radial slumping. These short slopes are very unstable. The south and west facing slopes are variable from wet to dry with many areas of spring, bog, and seep development with many indicators of a high water table through out the project area in blocks 3,4 and 5 and the connecting proposed road system.

SEDIMENT YIELD TABLE

BLOCK	MASS WASTING	SED YIELD	DELIVERY	EROSION
2A	L-d	M	M	M
3	L-d	H(M)	H	H(M)
4	L(M)V	M	L	M
5	M-d (H-CV)	M	H	M
6	H or M	M	M	M
ROADS BETWEEN BLOCKS				
2A-3		M	H	M

3-4	M or H	M or H	H
4-5	M	H	M & L

From Selway report and ATCO maps.

The area that is downslope is mostly in the H-H-H although the maps show most of this as moderate. I disagree, but it may be only in the definitions used in the mapping there is some that is in the high category. Many of the moderate area in the lower slopes I believe should be in the high category as they are very steep and unstable. and have oversteep landforms going directly into the streams that are highly incised.

It is easy to see that the geologic unstable areas are around block # 3 and over to block # 4 and part of block # 5. I found live water in block # 4 that was not included in this report and would change the ratings at least for part of block # 4. This is the area where a road or cutting can not be accomplished without impacting the water supply system.

Proposed Activity

ATCO Lumber Co. has the license for CP41 (Glade), the road locations and the cutting blocks have been laid in and flagged. ATCO plans to access the area through the Erie and Granite Creek road systems. The proposed road goes from Granite through a low Saddle into the South Fork Glade Creek and traverses through Glade Creek drainage at the 6000-6500 foot level. The road ends on the main ridge separating the Siwash Lake branch (North Fork) from the rest of Glade Creek. There are 4 cut blocks (3, 4, 5, &

6), and possibly 2A within the Glade watershed.

The PHSP'S that were presented on January 13,1994 give an explanation and description of the work that is to be proposed in each block.

Block 3

This is a proposed 15 ha clearcut that will be divided into two parts 8,2 ha to be tractor logged with conventional equipment and 6.8 ha that is to be cable logged. There are two tributaries to Glade Creek that flow within this block. They will be cut over. The compaction risk is high on the whole unit and the overall sensitivity is moderate to high.

Block 4

This is a 15 ha clear cut that is to be tractor logged with conventional equipment. The compaction is high and overall sensitivity is moderate to high. The phsp states that there is no water in this block but my field review showed that there were tributaries to Glade Creek.

Block 5

This is a 23.6 ha clear cut that is divided into a 11.5 ha unit to be cable logged and a 12.1 unit to be conventional tractor logged. There is a tributary to Glade Creek on the South boundary of this unit. This is a very wet unit and should not be given a moderate rating for sensitivity.

Block 6

This is a 16.4 ha unit that has 13.4 ha to be cable and 3 ha to be tractor. This is very steep 70 % slope with a high

sensitivity rating. There are problems with the concept of cutting this unit, it is nothing more than timber mining.

Field Observations

A field review was accomplished by following the flagged road location and taking side excursions along string lines into the cut blocks as they are presently laid out.

The cut blocks are limited in size on the downslope side by old fire activity (1930) that has removed the mature timber resulting in an immature pine stand. This boundary and elevational zone of the proposed activity also closely follows the elevational zoning of the transitional zone between the concave cirque topography and the convex to straight sloped topography downslope. This transitional area is very important from a water management prospective and should be protected.

My observations in the field substantiated that these are very wet sites because it is the elevational band where the subsurface water traveling downslope out of the cirque and from slope storage begins to surface or travel under the soil very close to the surface. Many very wet areas were encountered along the proposed road location. The wet areas discussed are from Glade Creek (most Southerly branch) through block 3, with seeps, running water and several streams that are not shown on the map. The road location was wet north past string line 25 into block 4. For the most part block 4 is dry and stable due to its high ridge location.

The road location from string line 28 to the next branch of Glade Creek near string line 29 is an oversteep slope with evidence of past radial slumps. Road construction could be tough on this slope with some failures. The road location from string line 29 (Glade Creek) through block 5 is very wet, the proposed landings are in areas of standing water, running water, and a high water table near string line 35. The road location reaches some dryer sites above the junction with the spur in block 5B. The road follows the ridge line into block 6 which cuts a block of timber on a very steep slope on the ridge south and to the West of Siwash Lake. The road location stayed on the ridge, this is a dry and stable location. The cutting of block 6 will spoil the scenic value from the lake and is on a steep North slope that will be very difficult to regenerate at this elevation. This block will become a snow trap. In block 5B there were occasional wet bog areas.

Interpretation

Due to the long linear distance of wet area that the road will cross, there will be water brought to the surface by construction. Any removal of soil will probably result in surface water. The way to prevent bring the ground water to the surface is by filling across the landscape instead of cutting into the slope, the water is very near the surface and would be bought up with a very shallow cut. This additional water will have to be handled along with the sediment resulting from the

construction. I have not seen the use of mitigation measures to control sediment off of construction sites or have I seen any mention of their use in the proposed activity. The road location is not far upstream from the steep unstable slopes that were previously described. Bringing this water to the surface and putting it into a culvert will put water on unstable slopes unable to handle the additional flows and will result in possible mass wasting and slumping. If the water is collected in the road ditch and moved directly into the creek it will be enough additional flow to destabilize the stream system and introduce the sediment from the construction directly into the stream and directly to the Glade water system.

I worked last fall on a case just like this near Nelson for a logger that brought a spring of good flow to the surface by turning his skidder on a small stump . The resultant muddy water has caused problems for his water supply and his neighbors' water supplies. He now has a new creek on his property to deal with that was flowing subsurface before driving the skidder over the site. It took very little impact, there were not the indicators that are in evidence on the Glade creek sites.

I found two possibly three unstable slopes the road crosses and 2 long sections (previously described) of very wet sites. The wet area around block # 3 would be very difficult, I would say impossible to cross without impacting the Glade water supply. Without this section of road the other blocks 4,5 and 6 would not be accessible.

It would be possible to road and log this ares if it was not a domestic watershed and water quality was not a concern, but this is not the case. It would also be possible to log this area while protecting the water quality with some innovative and expensive methods.

I looked at the type of common road building and cutting practices utilized in the surrounding watersheds, it would not be possible to protect the Glade domestic water system with the current construction practices.

On Erie and Granite Creeks I observed water running in ditches and down road surfaces, and a high degree of erosion from road surfaces running directly into live streams. Roads that have slumped due to buried slash and erosion from running water. Log landings were located in live water with evidence of oil changes and equipment repairs in areas that now have water running through the landing, polluting the water with hydro-carbons. The roads have been built to low standards and are very steep with very little water handling capability or sediment mitigation.

The main concern in this proposal is additional surface water and how to handle it, there are no good methods available that are not expensive and require a level of sophistication in engineering and construction practices that are above the scope of this project. The way to construct a road across these areas is to fill across with a french drain or tile drain system as part of the construction. This means building up the road on top of the soil without cutting into the soil and having all the

construction above the surface. These sites do not have the fill material available to utilize this type of construction nor are the timber values present to pay for this expensive of road building.

WATER YIELD FROM CUT BLOCKS

Water yield can increase up to 40-50 percent of the preharvest condition from a mature forest. Studies in Idaho and Colorado substantiate these increases. (Harr, King, Megahan,Troendle, and Isaacson) The increase in water yield from these cut blocks can be increased even more by a mid-slope road below or through the cut block. This not only collects the ground water increase from cutting but the natural ground water making its way down slope between the soil and geology. One study in Idaho (Megahan) showed up to 20 times increase in water with the combination of a cut block and a road at the bottom of the block over the natural runoff from the test site.

Harr in 1986 reanalyzed his earlier conclusions and stated: "1) Higher peak flows can directly affect routing in first and second order watersheds. Material that would not have been moved previously is now available for movement with higher flows and velocities. 2) When increased peaks from subdrainages reach a point downstream they can have a cumulative affect in even third and fourth order streams (Chistner and Harr 1982)." Harr (1986) concluded in his recent studies that his conclusions are different than those previously reported (J. A. Isaacson 1987).

There is a very definite cumulative effect relationship between tree cutting and road building on one hand, and the impacts of these on a stream system on the other. Ongoing research on the Kootenai National Forest by Jack King has shown that clearcutting in headwater streams has a very strong impact and causes damage to both first and second order drainages. This damage occured even when a narrow strip was left to protect the riparian of these very small streams, as it was cut during the logging or it blew over after the sale was complete.

Studies by Gottfried show there are definite increased stream flows even from timber cuts of around 20 percent of a stand. Gottfried's study is substantiated by the Idaho Panhandle National Forest, which has shown degradation of it's streams with as little as 20 percent of the drainage cut over. This was very evident where first order headwater streams were cut over and the riparian was not protected.

Studies in Washington have shown increased flows are a result of tractor logging and the amount of area that is impacted with equipment. This is due to compaction. In this proposal all the attributes are present for large increases in water flow from the cut blocks and the direct channeling into the road ditches. The subsurface water is there and the logging plan is for tractor equipment on sites with high compaction hazard. This greatly increases the peak flows and the time of bankfull discharge. The result is from increasing the surface run off system by turning the road ditches into first order streams and extending the

channel network. I observed this in the Granite Creek area while flying over in June, I then observed the same areas on the ground to substantiate the aerial view. The same would be the result in Glade Creek. More water would come off earlier and due to the dominant west-South west slopes the peak would be a much higher flow than historically in the past.

For evidence of the impacts of cutting on stream channels one does not have to look far to see the evidence. Where Granite Creek meets Erie Creek there has been a high percent of cutting by clear cut with tractor equipment in granite and no cutting in Erie above this site due to the age classes present. Granite has blown out the channel at the bottom end, there is a bar of bedload that is 3-4 feet high that is being transported out of granite and into Erie. This is the type of changes we observed in N. Idaho also from Clearcutting in the headwater segments of the stream systems.

Contributing to this is the location on the slope with shallow soils and most of the ground water flowing through the soil close to the surface where it easily would be brought to the surface with road construction.

The area proposed for harvest and road construction is the area of mature timber - the closest thing to old growth in the drainage. Presently this zone acts as a sponge and regulator for the timing of release of water collected in the higher cirque basins. This is a very important part of the water system for the Glade community. It is the time spent under the surface that

is acting as the filter to clean the water. The microbial action in old growth or mature timber is playing an important part in the water quality of a watershed. This action is not duplicated in second growth or in clearcuts for decades or longer until a mature forest with the whole ecosystem including the soil system is developed and back in place. It takes the microbes in the duff and undisturbed layers of top organic soil to accomplish this purifying and cleaning action. In a study in Norway it was shown that there are 40,000 microbes in one gram of soil under mature timber and between 2000 and 4000 individual species. The recent literature is showing that they play an important role , not fully understood but important to water quality.

This band of mature timber is important in Glade because further down the slope in the old burn the soil was burned very hot and has lost the structure and biology to handle water. As the timber grows and the site recovers there will be more water used on the slopes and an ecological system will develop, but it is not presently there and will not be for decades.

Some of the cirque flow is released as surface water in the active streams but much infiltrates and travels sub surface until it surfaces downslope several hundred to thousands of feet.

The increase in peak flow generated could cause major mass failures downstream in the steep incised channels where the stream is flowing against steep unstable slope. Some isolated instances of this are already seen in the main channel under natural conditions, with increased flows the likelihood is

greatly increased.

If these increased flows are put into culverts and sent downslope where no previous surface flows have been flowing or very small flows the result will be head cutting (gullying) and erosion of the unstable steep slopes below the project area.

WATERSHED MODELS NOT APPLICABLE

The ECA model does not apply in this situation as the cutting is concentrated into a narrow elevational band and the rest of the drainage is not touched. The ECA models would assume that the rest of the drainage would be a buffer, in Glade Creek this is not the case. The rest of the drainage cannot buffer this site specific problem of too much water from the same elevation band resulting from the proposed activity. The models only model the increase from evapotranspiration from removing the vegetation. With the amount of ground water and wet sites this would be a very minor point. A side note, research in Idaho and Colorado is showing that recovery of the increased flows is just beginning at 35-40 years after harvest. I believe MOF is using a much quicker recovery that may work in coastal rain dominated hydrology but certainly not in the high elevation snow dominated hydrology such as Glade Creek.

The models are developed with a landform where the steep stream segments or "A" channels are at the headwaters and the stream grows downstream and transitions from an "A" to a "B" and finally a "C". The "C" channel has a low gradient and a large floodplain

for sediment storage and flood flows. The system can stand some increase flow. In Glade Creek the opposite is found with all the upper basin being put into a steep "A" channel with no storage for sediment or for flood flows.

The paper by Toes and Gluns "TRANSLATING SNOW HYDROLOGY RESEARCH RESULTS INTO GUIDELINES FOR FOREST MANAGERS: GAPS BETWEEN THEORY AND PRACTICE", shows that there is increased snow accumulation and also quicker melt and removal of the snowpack on a North slope site near Rossland B.C.. This is similar to what we found in monitoring in Northern Idaho, we have much more data and flow records now. That would show answers to some of their questions. The proposed activity in Glade is on South slopes which react even quicker to increased snow and quick spring melt due to the orientation to the sun. Not only the facing south or southwest but the angle of the slope to get the spring direct energy from the sun. The snow can be removed by up to 3-4 weeks quicker. This would result in a higher spring peak in Glade and lower summer flows. In some years this is already a problem, and as the pine grows back there will be less water at the intake. but one peak flow early in the spring will not help, it will hurt by removing snow that would be storage for later in the spring. A research paper from Alaska by Myron this spring 1994 shows the lose of late summer flows from cutting in a similar watershed. Below is a graph of the Rossland data from Toes and Gluns

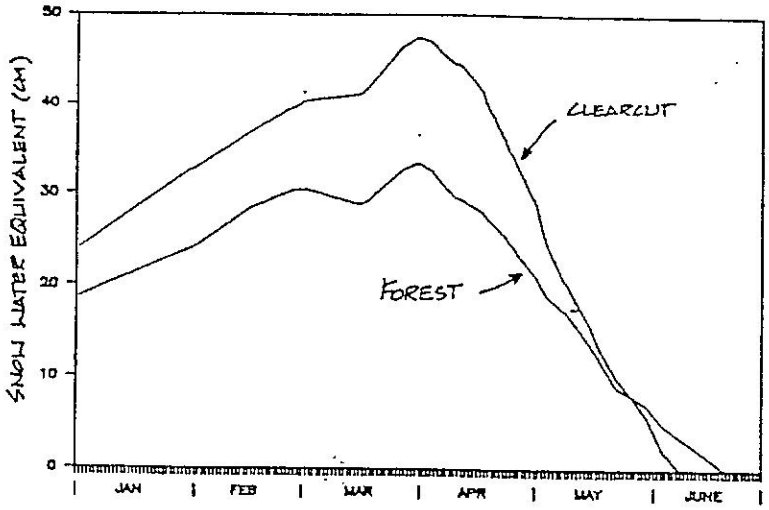

Figure 1. Average snow accumulation and ablation (1983-1987) for a north facing site at 1 375 m elevation near Rossland, B.C.

SEDIMENT

Sediment would be produced , but the sediment models would not work here for the same reasons given above.

Work in Horse Creek (Central Idaho) by Jack King showed that the sediment produced at road crossings (culvert installations) recovered in 3 years at the site, but the added sediment from in-channel erosion took several more years (7-10) to improve downstream and still has not achieved pre-activity levels.

This was a much drier site and easy landform to work on than those in Glade. The same results and higher levels of sediment would be produced, that would end up in the Glade water supply. This is caused by the introduced sediment causing a domino effect by taking channel capacity and forcing the stream to erode more sediment from the stream banks. With the wet sites and proximity to the streams there will be a high level of sediment produced

from this proposal.

RECOMMENDATIONS

I recommend the following items for the management of the Glade watershed.

1) Watersheds that have large upper basins that become confined at lower elevations into an "A" channel should not be harvested unless it is single tree salvage of less than 20 % of the canopy. This would include Glade Creek. – Blks 3 → 6

2) The wet area where there are numerous small stream tributaries and bogs should be avoided, this would include blocks #3 and #5 and part of #4. The roads not be built on these sensitive wet areas unless there is enough fill to fill across with an internal drainage system in place.

3) No clear cuts in headwater streams, the damage shows up downstream at water supplies and with impacted fishery resources.

4) Roads would have to be constructed on dry sites with good engineering principals to prevent mass failures and excessive sedimentation