Water Quality Effectiveness Evaluation Results (2008-2012): Results and Opportunities for Continued Improvement

FREP

Extension Note #29

December 2013

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Introduction to the WQEE

The Water Quality Effectiveness Evaluation (WQEE) Protocol is designed to assess government policy that supports a "Results Based" management style. The methodology requires an on-site evaluation of potential sources of fine sediment that may impact water quality. This in turn can provide road managers with greater flexibility and cost effectiveness than government regulation of sediment and erosion control.

As a summary of FREP Report 35, this extension note summarizes the data collected between 2008 and 2012 and provides recommendations to reduce water quality impacts of Forest and Range use in British Columbia.

The target audience for this note is natural resource managers, water purveyors and government monitoring staff. The purpose of the document is to describe the results of water quality monitoring (sediment potential) conducted over the last five field seasons, and highlight opportunities for improvement.

Background

The WQEE Protocol evaluates the propensity of forestry- disturbed sites to generate and transport fine sediment to natural water bodies (Figure 1).

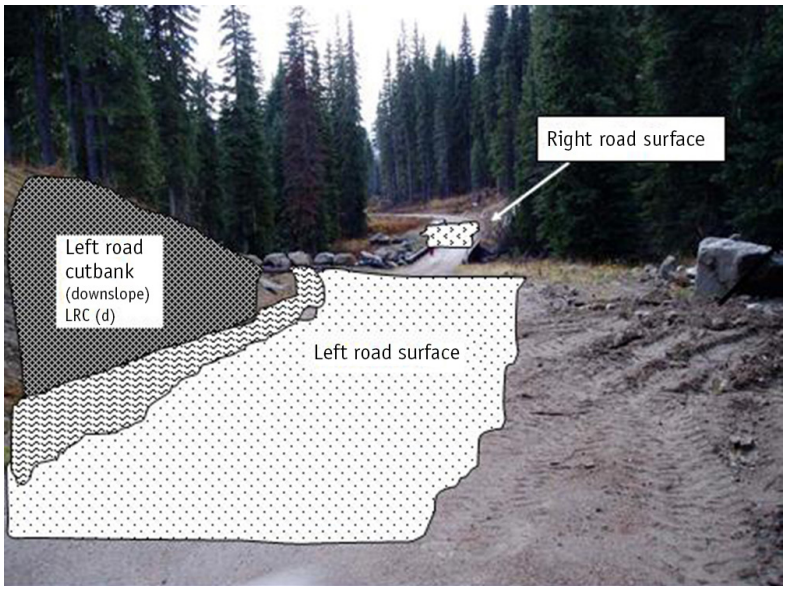

Figure 1. *The WQEE investigates in a systematic way where sediment is being generated at a site and how much will reach the natural drainage.*

Key message: Everyone involved in designing, building, maintaining and deactivating roads has a role to play in sediment management. The importance of addressing fine sediment reduction is critical through all stages of a road's life, starting with surveying the road's location and ending only when the road is permanently deactivated.

The FREP Mission:
To be a world leader in resource stewardship monitoring and effectiveness evaluations; communicating science-based information to enhance the knowledge of resource professionals and inform balanced decision-making and continuous improvement of British Columbia's forest and range practices, policies and legislation. *http://www.for.gov.bc.ca/hfp/frep/index.htm*

British Columbia

Sites rated "Very Low" are recognized by all experts to not generate significant amounts of sediment. They are flagged as dark green (Figure 2). Sites rated as "Low" are generating some sediment, but still within background turbidity levels normally found in streams, are flagged as light green. While these sites are not considered to require remediation, they might occasionally be of interest to water purveyors with intakes immediately downstream.

Total Volume of Fine Sediment generated at site (WQ Index)	Site Sediment Generation Potential Classes (based on consensus of field practitioners)	Associated General Level of Management of Site
<0.2 m^3	Very Low	Good ↕ Poor
0.2-1 m^3	Low	
1-5 m^3	Moderate	
5-20 m^3	High	
>20 m^3	Very High	

Figure 2. *The WQEE provides a means of ranking sampled sites into 5 water quality impact classes ranging from "Very Low", to "Very High". Generally, the higher the adoption of best management practices, the lower the water quality impact.*

Sites with "Moderate" levels of sediment generation resulted in more discussion between experts and a lower degree of certainty when assigning threshold values. The levels of increased sedimentation generated at "Moderate" sites would be measurable and often of interest to watershed managers. Such "Moderate" sites are flagged as yellow. As with the traffic signal, yellow indicates caution. Of particular importance is the concurrent need to address specific stream values downstream from the site be they fish or drinking water. If a drinking water intake or a critical salmon spawning bed is located immediately downstream from the site, thresholds of impact might be lower and the site may require further consideration. At present, the assessment of specific downstream consequences for a particular site is beyond the scope of the WQEE.

Sites with a "High" or "Very High" rating are considered to generate unacceptable levels of fine sediment and would have a significant impact on water quality in a watershed. These sites, flagged as orange or red, are considered highest priority for site remediation.

WQEE EVALUATION RESULTS FROM 2008-2012

The ratings of 4033 site assessments completed between 2008 and 2012 are provided in Figure 3 below.

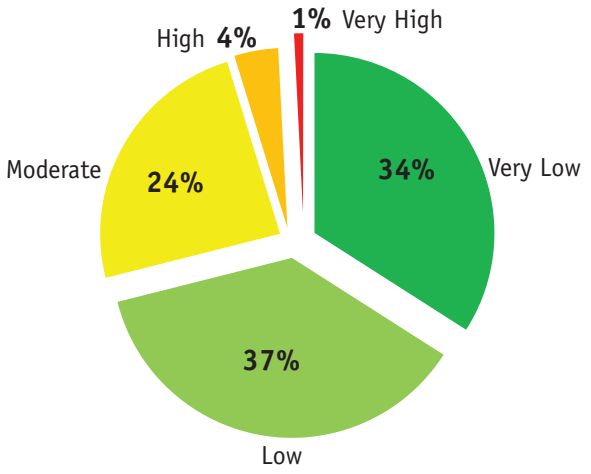

Figure 3. *4033 sites have been evaluated using the WQEE protocol since 2008. This figure shows the portion of total provincial sites with given water quality impact rating.*

The WQEE provides specific recommendations to reduce water quality impacts at sites with a "Moderate" "High" or "Very High" Rating — 29% of all sites evaluated (Figure 4). The importance of addressing fine sediment reduction is apparent through all stages of a road's life, starting with surveying the road's location and ending only when the road is permanently deactivated.

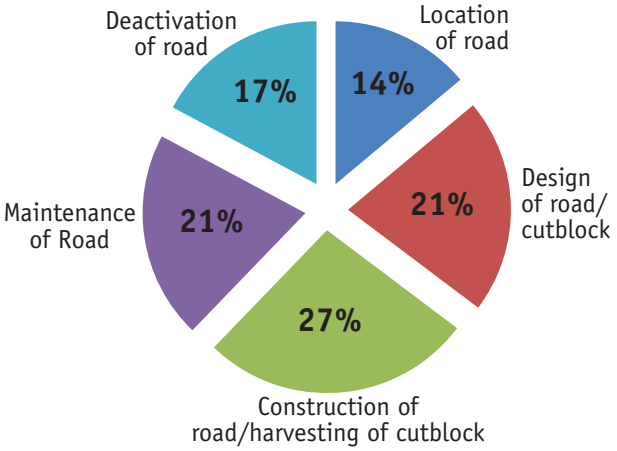

Figure 4. *Breakdown of activities on forest roads evaluated where management has impacted water quality. Everyone involved in designing, building, maintaining and deactivating roads has a role to play in sediment management.*

Problems and Opportunities for Reduction of Water Quality Impact Associated with Road Networks are Focused on Five Operational Areas:

PLANNING ROAD LOCATIONS

Sites with road location problems were recognized at 14% of sites where higher rates of sedimentation were observed. The majority of these sites were associated with road alignments built more than 20 years previously when neither water quality standards nor road construction standards were as stringent as they are today. At a minimum, 50% of the sediment generated by roads closely paralleling a stream will reach the stream and impact water quality. Road managers inheriting such roads are limited in options for reducing fine sediment impacts on such sites. Sometimes changing the road location is the only option but for practical reasons cannot be implemented. The frequency with which a precarious road location is recognized as a problem impacting water quality emphasizes the ongoing need for vigilance in the layout of future roads and cutblocks near water bodies and/or along unstable slopes. Such sites can continue to produce substantial fine sediment loads, in some cases even when the road is abandoned.

DESIGNING ROADS

Sites with design issues were recognized at 21% of sites where higher rates of sedimentation were observed. Increasing the number and improving the placement of culverts was the single most mentioned "fix" by evaluators. On older roads, inside road ditches often flowed directly to streams, transporting all road surface, ditch and cutbank sediment generated. The deeper the ditch, the fewer the options for safely removing road surface drainage and allowing it to be reabsorbed onto the forest floor before it reaches a stream. Ensuring that road designers carefully consider how a road will impact sediment generation as the road is being laid out will have a substantial effect on improving water quality of road networks (Figure 5).

CONSTRUCTION OF ROADS

Sites with construction and harvesting concerns were recognized at 27% of sites where higher rates of sedimentation were observed. The most frequent recommendation identified was the need to armour and/or reseed bare ground as soon as possible after construction. Depending on the amount of coarse rock in a native soil, most disturbed soils eventually "self- armour" as the fines are selectively removed by erosion. Road construction in stone-free silty soils are problematic because they depend only on revegetation for natural protection. On cutbanks, such soils were found to resist revegetation because of pervasive needle ice formation and its destruction of surface vegetation. Sensitive soils require special consideration when roads are being built and other means of sediment management considered (such as interception of any generated storm flow and diversion before reaching stream) in road design. Isolated pockets of sensitive soils are difficult to anticipate before the road is actually being constructed. Using better road subgrade and capping material was also commonly recommended where presence of nearby gravel pits and quarries with good quality materials occurred. Long haul distances in some districts, mean that Licensees must sometimes resort to other means of addressing sediment problems. While the road construction phase potentially generates the highest levels of fine sediment, reducing area of disturbance, protecting surface areas that are disturbed and addressing connectivity of runoff before the road is completed can dramatically lessen the water quality impact while new roads are "hardening up".

Figure 5. *Careful consideration of anticipated sedimentation as evaluated by WQEE can facilitate a means to calculated costs and benefits associated with sediment management before any sediment has been generated.*

MAINTAINING ROADS

Sites with road maintenance concerns were recognized at 21% of sites where higher rates of sedimentation was observed. These concerns centered on grader berms and/or road ruts concentrating road surface flow towards streams. In many instances, simply breaking a berm to allow water to leave a road at a preferred location would dramatically reduce water quality impacts. Road berms are occasionally used effectively to divert road water away from streams and safely onto forest floors where both sediment and water can be absorbed. The second most cited improvement recommended in this category was the application of good quality road fill and surfacing materials. Where road subgrade permits crowning, maintenance of the crowned profile permits at least the outside half of road drainage to flow safely onto the forest floor. Problems associated with road management are mostly addressed in day to day decision made by road maintenance crews within their annual budget. As such, addressing road maintenance issues usually provides one of the best targets for immediately reducing sediment impacts in a watershed.

DEACTIVATING ROADS

Sites with deficient road deactivation techniques were recognized at 17% of sites where higher rates of sedimentation was observed. The most frequently cited improvement involved the strategic placement and design of cross ditches, water bars and properly locating spoil areas (Figure 6). The WQEE methodology quantifies how much sediment would be generated by different scenarios and thus provides a simple, direct means to choose specific locations for ditchblocks, cross ditches and waterbars. Its use is recommended while designing road deactivation plans. At the end of a road's useful life, a carefully implemented deactivation plan is an effective part of water quality management. Sometimes ongoing water quality impacts from deactivated roads are beyond the control of the Licensee. Heavy recreation use was found to be the primary reason for break down of once-functioning cross ditches and water bars.

Figure 6. *Proper location and design of cross ditches can greatly reduce sediment loads from roads being deactivated. Breakdown of once functioning cross ditches by recreation vehicles was commonly reported and exacerbates effective sediment management.*

SUMMARY

75% of all impacted sites could have been substantially improved by employing one or more of the following management options.

1. Attention to bridge location and design
2. Use of better road surfacing materials
3. Installing strategically place culverts
4. Armouring or seeding disturbed areas
5. Opening grader berms
6. Installing cross ditches and water bars on deactivation

Training workers about potential water quality impacts of their activities can allow them to prioritize their specific response and make Licensee's mitigation efforts more cost effective during all phases of a road's life. A more nuanced assignment of responsibility and authority to road managers where forestry operators may be only one of many users.

Those interested in learning more about FREP's Water Quality Evaluation Procedure can visit the website at:

http://www.for.gov.bc.ca/ftp/hfp/external/!publish/frep/indicators/Indicators-WaterQuality-Protocol-2009.pdf

A detailed report on the 2008- 2012 results will soon be available at:
http://www.for.gov.bc.ca/hfp/frep/publications/reports.htm

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