Background

The following provides the eligibility criteria for Forest Carbon Initiative (FCI) road rehabilitation projects and guidance on the conditions that would increase the likelihood of achieving greenhouse gas (GHG) emission reductions.

Typically, road rehabilitation projects serve to restore natural drainage patterns, de-fragment habitat and help achieve carbon objectives, among others. Given the costly nature of these projects, cost sharing between a variety of funding sources helps make these projects feasible and aligns with regional priorities. Where the proponent of a project is a District office it is expected that District staff will coordinate activities to ensure efficacy of operations that meet the objectives of the project.

Further information can be found in the various guidance documents listed at the end and also in the individual talks from the 4 part Silviculture Road Rehabilitation Webinar that will be posted online in early June 2020 (link: https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/natural-resources-climate-change/natural-resources-climate-change-mitigation/forest-carbon-initiative).
And the Resource Roads website: https://www2.gov.bc.ca/gov/content/industry/natural-resource-use/resource-roads

A Qualified Registered Professional (QRP) needs to be involved in most stages of road rehabilitation projects. Involvement of other specialists, such as soil scientists and silviculturalists may be frequent during the developing stages of projects but would be expected to taper off with increasing familiarity with local conditions and the development of treatment strategies for steps like topsoil identification/handling and seedling microsite creation.

FCI Eligibility Criteria:

- The restoration of natural drainage patterns is the most critical aspect of road rehabilitation. Therefore, for a project to be eligible, a QRP must develop and implement a rehabilitation prescription that addresses the restoration of natural drainage patterns;
- Only non-status roads, permitted roads or Forest Service Roads that have no existing obligations and are not needed for future operational forestry or industrial activities will be eligible for FCI funding;

Reconnaissance Survey

- A reconnaissance survey must be conducted indicating there is less than 5 % woody vegetation (>1m) on the running surface (including all shrubs, commercial and non-commercial tree species). Advanced regeneration and shrubs sequester carbon, so they should not be cleared if they exceed 5% cover (percent cover charts are available in various data collection field guides like Land Management Handbook (LMH) 47; Curran et al. 2000).

- The knock down of advanced regeneration or shrubs is only acceptable when a road or network of roads has been identified for rehabilitation beyond what will be knocked down. The area of knockdown must not exceed 5% of the total road network; a reconnaissance survey can be done using aerial photos or video taken from a helicopter or drone, video taken with a GoPro camera on a quad, or photographs and field notes on the ground. The results of the survey must be submitted to the regional Forest Carbon Specialist for their review to determine that the road is eligible for rehabilitation.
- Exceptions to the 5% cover criteria may be considered where survey data and subsequent modelling indicate there would be a significant carbon benefit. Detailed survey data will be gathered indicating the number of stems per hectare for all commercial and non-commercial tree and shrub species (e.g. alder and willow would be considered acceptable species from a carbon perspective) plus the site index and site series of the adjacent stand. Road sections at or near minimum stocking (including shrub species) will not be eligible;

Planning considerations

- Projects that involve First Nations in the planning and implementation are preferred;
- Projects with significant co-benefits such as enhancing wildlife habitat to protect endangered species are preferred;
- Piling and burning are not acceptable practices for FCI Road Projects and should be avoided by not treating more vegetated road segments or sidecast/fill areas or using the resulting slash as surface cover on the resulting soil surface.
- Roads proposed for rehab should have suitable pullback material (top soil) or subsoil to provide a planting medium that approaches the local Site Index (see next section);
- Where available and existing plantations or adjacent forests won't be damaged, coarse woody debris adjacent to the road section could be pulled back to create favourable microsite conditions, if these are desired for seedling establishment or obstacle planting is required to reduce cattle or wildlife damage;
- Wildlife projects may require an element of functional restoration where trees are felled across a road or other barriers are placed to inhibit predator movement.

Signs, Barricades and QRP Requirements

- All road rehabilitation projects must have a budget for posting signs that inform the public of the objective to grow trees in an undisturbed environment, and warn users of the deactivation; deterring the use of the road and by explaining the purpose of the project;
- All road rehabilitation projects must have a budget for barricading the road surface in a clearly visible manner to prevent access by motor vehicles, creating a very difficult section for the first 100m may also be desirable in heavy off-road use areas.;

- All road rehabilitation or deactivation prescriptions and activities must be approved and supervised by a QRP.

Examples leading to a designation of FCI ineligibility

- Projects that identify candidate roads that may meet co-benefit objectives but are occupied by sufficient natural regeneration.
- Projects that have justifiable opposition from First Nations or other stakeholders;
- Projects that do not demonstrate there will be a significant GHG benefit achieved for the dollars being spent.

Suitable soil and site conditions[i]

- Soil conditions can sometimes be estimated from existing soil mapping or remote sensing techniques, but field verification is required (LMH 47 (Curran et al. 2000) contains information on describing soils, including the identification of unfavourable subsoils.)
- Soil and site conditions will vary along a road segment and plans/prescriptions will need to recognize and describe this variation and how it will be treated.
- If several candidate sites exist, the most suitable soil and site conditions would be those likely to yield the greatest carbon sequestration; whereas the opposite is true for the most severe sites (example soil suitability tables exist in Part 2 of Mike Curran's presentation in the Silviculture Road Rehabilitation Webinar Series, link at the start of this Appendix).
- The most suitable soils are deeper developed, medium and coarse textured with lower coarse fragment content.
- The most suitable sites are gentler slopes and lowland sites with adequately drained soils.
- Moister BEC sites and slope positions will be the most productive whereas the driest ones will be the least productive.
- Unfavourable subsoils are described in Curran et al. (2000) and include ones that may be okay to treat based on local soils experience (e.g., coarse sands and gravels) versus ones that are generally not suitable to treat (e.g., rocky sections, fragmental soils with over 70 % coarse fragments, dense clays, poorly drained soils, and of greater concern: calcareous, high pH limestone/dolomite derived soils that may actually release CO2, etc.).

Best Management Practices

- Work with engineering staff to ensure the road does not have any existing obligations and that it is not going to be needed in the future to access other areas;
- Ensure there has been adequate consultation with First Nations and other user groups such as guides, trappers, recreational clubs, miners and the Wildfire Branch; educate road users about why the rehabilitation is being done to gain social acceptance;
- Have a well-developed rehabilitation plan prepared by a QRP that addresses any safety concerns, erosion control, the restoration of natural drainage patterns, the potential for mass wasting (landslides) or any other factors that may destabilize the road prism.

- Erect hazard warning signage in advance of and through the completion of road deactivation activities to explain purpose and warn potential users of hazards.
- Upon completion of silviculture road rehabilitation activities, install signage to warn potential users of road deactivation.
- Have a plan and budget for the removal of culverts or other stream crossing structures to ensure they are not left on site once the road is rehabilitated.
- Drainage control needs to be planned and built into the resulting restoration, including pull backs in creek/draw and gulley areas, and open waterbars regularly spaced on slopes.
- Avoid ripping roads with a significant slope as this will cause water to channel and may create sedimentation and erosion issues downslope;
- On slopes, de-compact out-sloping to ensure slope drainage is restored and subsurface water will not be channeled along the old running surface.
- Based on consultation with local soils expertise, have a plan regarding the identification and handling of "topsoil" and subsoil layers to restore the soil profile, microsite and surface organic matter conducive to growing trees.
- Have a well-developed silviculture prescription prepared by an RPF that identifies the appropriate decompaction method (as required), tree species, planting density, potential for natural regeneration and brush competition. Winter roads may not require decompaction and could potentially be planted without any site preparation.
- Grass seeding can be effective for controlling invasive species (weeds) and erosion, but it is discouraged in areas that are targeted for reforestation as it will limit natural regeneration and/or compete with newly planted seedlings; therefore, grass seeding should be limited to areas where it is required for erosion control or in circumstances where grass is a more suitable species;
- In the interior of the province, planting at higher densities (2,000 stems/ha) is recommended on sites where tree establishment is expected to be difficult; however, planting densities on the coast may be lower (1,000 stems/ha) due to the expected ingress of natural regeneration. The availability of seed and nursery capacity may be limiting factors when prescribing planting densities and making sowing requests for road rehabilitation projects.
- The rehabilitation of roads through wetlands should be avoided where it is likely that the site preparation may damage the wetland and seedling establishment is likely to fail;
- Pull back topsoil and coarse woody debris where available to create suitable planting microsites. In some cases, such as wetter sites, mounded microsites may be helpful (microsites should be based on advice from local silvicultural experts).

Monitoring

- In addition to "as-built" type inspections and QRP assurances, consideration should be given to monitoring the success of the rehabilitation practice effectiveness and success of drainage control, soil restoration and reforestation successes and failures.

- An adaptive management framework should exist or be developed to capture local practical experience and document success/failure and extend the new knowledge to practitioners through updates to policy, guidance documents and Best Management Practices.
- Ideally, research trials should be established, and retrospective studies/old research trial remeasurements should be undertaken, to test the assumptions and practices being used by the FCI program and in silvicultural road rehabilitation in general. However, this would be contingent on funding which may not be available.

Guidance Documents cited here and in the Webinar Series Presentations

Research publications can be found by searching under Ministry Scientist names or using the detailed publication search available on this page:
https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/research/flnrord-research-authors?keyword=research&keyword=publications&keyword=authors

SITE DESCRIPTION, STRATIFICATION AND SOIL DISTURBANCE HAZARD KEYS:

Curran, M., I. Davis, and B. Mitchell. 2000. **Silviculture prescription data collection field handbook: Interpretive guide for data collection, site stratification, and sensitivity evaluation for silviculture prescriptions.** BCMOF Land Management Handbook No. 47. 156 pp. Includes forms FS39A and B. http://www.for.gov.bc.ca/hfd/pubs/Docs/Lmh/Lmh47.htm (accessed March 13, 2011)
(includes **Forest Floor Displacement and Mass Wasting [cut/fill failure] disturbance hazard keys**;
the Plot card, form ***FS-39A contains ALL soil disturbance hazard keys*** and is shown starting on page 123)
Form FS-39A: https://www.for.gov.bc.ca/isb/forms/lib/FS39A.PDF

Province of British Columbia. 1999. **Hazard assessment keys for evaluating site sensitivity to soil degrading processes guidebook,** March 1999. Forest Practices Code of British Columbia. B.C. Forest Service and B.C. Min. Environment, Victoria, B.C. (was being updated as part of the new soil conservation framework LMH, mentioned below)
http://faculty.forestry.ubc.ca/bendickson/FOPRLibrary/Library/M%20o%20F%20Guidebooks%20&%20Pubications/Soil%20&%20Windthrow/Hazard%20Assess%20Keys.pdf
(contains **Compaction, Displacement and Erosion hazard keys** which are also summarized in form FS-39A, link above)

HARVESTING STRATEGIES (includes background on compaction, displacement and soil moisture at time of operations)

Curran, M. 1999. **Harvest systems and strategies to reduce soil and regeneration impacts (and costs).** Pp. 75-111 In: Impact of machine traffic on soil and regeneration. Proceedings of FERIC's Machine Traffic / Soil Interaction Workshop, held at Edmonton Alberta, Feb. 1999. FERIC Special Report No. SR-133. Link: https://www.fs.fed.us/eng/techdev/IM/soil_compaction/Curran_Harvest_strategies.DOC

ROADS AND REHABILITATION OF TEMPORARY ACCESS

BC Timber Sales Kootenay Region BCTS Supplement Guide to Minimizing Soil Disturbance (includes a list of rehab expectations): https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/bc-timber-sales/ems-sfm-certification/business-area/kootenay/tko-soil_disturbance_guide.pdf

Bulmer, C.E. 1998. Forest soil rehabilitation in British Columbia: a problem analysis. Land Management Handbook 44. B.C. Min. For., Victoria https://www.for.gov.bc.ca/hre/pubs/pubs/0400.htm

Bulmer, C. and M. Curran. 2000. **Establishing an Operational Trial of Soil Rehabilitation: Two Examples** BC Forest Service, Nelson, BC Forest Sciences Extension Note EN-047 http://www.for.gov.bc.ca/hfd/pubs/RSI/FSP/Nelson/ENN047.pdf

Bulmer, Chuck, Jim Archuleta, and Mike Curran. 2007. **Restoring and enhancing productivity of degraded tephra-derived soils.** Pp 121-135 In: Page-Dumroese et al. Volcanic-Ash-Derived Soils of the Inland Northwest: Properties and Implications for Management and Restoration. 9-10 Nov. 2005, Coeur d'Alene, ID. Proceedings RMRS-P-44: Fort Collins, CO: US Dept. Agric., Forest Service, Rocky Mtn Res. Stn. http://www.treesearch.fs.fed.us/pubs/26218

Bulmer et al. 2002. **Soil conservation and rehabilitation in British Columbia**. Brochure No. 70. "INFO-FLIP" available on the internet at http://www.for.gov.bc.ca/hfd/pubs/Docs/Bro/Bro70.htm. (accessed March 7, 2011)

Chapman, B., S. Thompson, C. Bulmer, and S. Berch. 2014. **Temporary access structures: considerations for site plans and post-harvest assessments.** BC Min. Forests Lands and Natural Resource Operations, Forest and Range Evaluation Program, Victoria, BC EXTENSION NOTE #28 Revised January 2014 https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/frep/frep-docs/frep-extension-note-28.pdf?fileName=frep-extension-note-28.pdf

Curran, M.P. 1998. **Skid trail rehabilitation (video).** 53:02 min. BCMOF Research Program, Nelson, B.C. Includes Field cards for summer and winder skid trail construction and rehabilitation

Gillies, C. 2015. The Construction and Rehabilitation of Purpose-Built Skid Trails on Steep Slopes: Discussion Paper; FPInnovations Technical Report No. 3 (March 2015)
Brochure summary here: https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/bc-timber-sales/ems-sfm-certification/business-area/kootenay/tko-skid-trails-on-steep-slopes-best-practice-guide.pdf

Province of British Columbia. 1997. **Soil Rehabilitation Guidebook**. Forest Practices Code of British Columbia. B.C. Forest Service and B.C. Min. Environment, Victoria, B.C. (being updated as part of the new soil conservation framework LMH, mentioned below):
https://www.for.gov.bc.ca/ftp/hfp/external/!publish/FPC%20archive/old%20web%20site%20contents/fpc/fpcguide/soilreha/REHABTOC.HTM

SUITABILITY MATRIX EXAMPLE, ADAPTIVE MANAGEMENT AND MONITORING PROTOCOLS

Curran, M.P. Soil Risk Matrix for Off-road Vehicle Damage (Changes) to Soil: Lake Koocanusa Area – Final Version, May 27, 2010. BC Min. Forests and Range, Miscellaneous Report, Nelson, BC
http://www.for.gov.bc.ca/hfd/pubs/docs/misc/misc086.pdf

Curran, M., Dubé, S., Bulmer, C., Berch, S., Chapman, B., Hope, G.D., Currie, S., Courtin, P., and Kranabetter, M. 2009. **Protocol for soil resource stewardship monitoring: cutblock level**. Forest and Range Evaluation Program, B.C. Min. For. Ran. and B.C. Min. Env., Victoria, BC.
http://www.for.gov.bc.ca/ftp/hfp/external/!publish/frep/indicators/Indicators-Soils-Protocol-2009-May26-2009.pdf (this latest version contains general guidance on FRPA soil disturbance)
Soil disturbance type flowchart is in Appendix 1

Curran, M.P.; Maynard, D.G. 2009. **Science-based management of forest soil disturbance**. Canadian Journal of Soil Science 89(1):3–11.
https://www.nrcresearchpress.com/doi/pdf/10.4141/CJSS07061

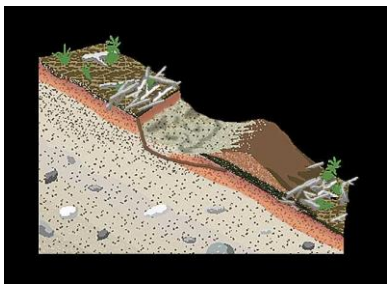
Curran, M.P., D.G. Maynard, R.L. Henninger, T.A. Terry, S.W. Howes, D.M. Stone, T. Niemann, R.E. Miller, and R.F. Powers. 2005. **An adaptive management process for forest soil conservation**. For. Chron. 81(5):717–722. https://www.fs.fed.us/pnw/pubs/journals/pnw_2005_curran002.pdf

Province of British Columbia. 2001. **Soil conservation guidebook**. Forest Practices Code of British Columbia. B.C. Forest Service and B.C. Min. Environment, Victoria, B.C. 2nd Edition. May 2001
https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/forestry/frep/frep-docs/soilconservationguidebook.pdf

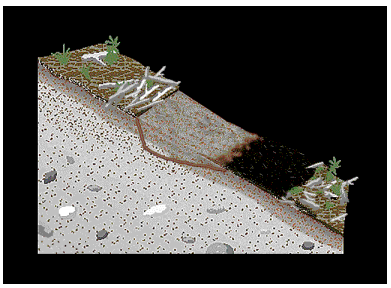
Province of British Columbia. 2001. **Soil conservation surveys guidebook**. Forest Practices Code of British Columbia. B.C. Forest Service and B.C. Min. Environment, Victoria, B.C. May 2001. (was being updated as described below but includes information on measuring roads and landings – FREP guide can be used for now until a current link found/fixed)
https://www.for.gov.bc.ca/ftp/hfp/external/!publish/frep/technical/FREP_Technical_Note_05.pdf

FIELD CARD: Skid Trail rehab from (Curran 1997):

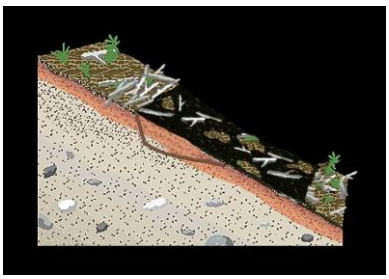
Excavated or Bladed (Skid) Trail Rehabilitation



1. Remove woody debris from running surface and decompact in an outsloping manner.



2. Replace mineral soil, subsoil first.



3. Replace topsoil\duff and place slash on top, similar to surrounding cut block.

Place deep, open waterbars to run from inner track out through the sidecast; space similar to normal deactivation.

Nelson Region Research Program
B.C. Ministry of Forests
Financial assistance from F.R.B.C.

July 1997

[i] Consult with local soils experts until comfortable with (1) what soil/slope conditions are suitable for treatment, (2) where potential topsoil is located, and (3) with the overall success of soil restoration practices.