Post-wildfire Watershed Rehabilitation in BC

June 8, 2005

Okanagan University College
Kelowna, BC

Workshop: Post-wildfire Watershed Rehabilitation in BC

Okanagan University College, Kelowna, BC June 8, 2005

Purpose:

The purpose of the workshop is to bring together people with an interest in post-wildfire watershed rehabilitation techniques to share information and explore the subject in a British Columbia context. Although the focus of the workshop is on water and soil resources, other issues germane to the successful application of rehabilitation techniques in BC will be discussed.

Workshop Objectives:

1. Provide background on the effects of wildfire on ecosystems, watershed processes and vegetation.
2. Present BC case studies on the effects of wildfire on watershed processes focusing on soil (sediment production) and water resources.
3. Exchange information regarding the efficiency and types of rehabilitation techniques applied in BC and examine the efficacy of post-wildfire rehabilitation techniques used in other jurisdictions (i.e., PNW USA).

Agenda

7:30 – 8:25 a.m. **Registration**

8:25 a.m. **Welcome and Workshop Overview**
Rob Scherer, Okanagan University College

Fire Effects on Watershed Processes

8:30 – 9:00 **Wildfire Effects on Ecosystems and Vegetation**
John Parminter, BC Ministry of Forests

9:00 – 9:20 **Overview of Aquatic Ecology and Biodiversity Issues Related to Wildfire and the Need for Rehabilitation Practices**
Brian Heise, Thompson Rivers University

9:20 – 9:40 **Effects of Wildfire on Soil and Water – An Overview**
David Scott, Okanagan University College

9:40 – 10:05 ***Nutrition Break / Posters***

10:05 – 10:35 **Kuskonook Creek Debris flow of August 2004: Water Repellent Soils, Erosion and Mass Wasting**
Peter Jordan, BC Ministry of Forests
Mike Curran, BC Ministry of Forests

10:35 – 11:35 **Wildfire Hydrology: British Columbia and Alberta Case Studies**
Dan Moore, University of British Columbia
Rita Winkler, BC Ministry of Forests
Uldis Silins, University of Alberta

11:35 – 12:00 **Effects of Wildfires on Ecosystem Function: A Biogeochemical Approach**
Jeff Curtis, Okanagan University College
Adam Wei, Okanagan University College

12:00 – 1:15 ***Lunch (Provided) / Posters***

Post-Wildfire Rehabilitation

1:15 – 1:45 **Tools, Treatments, and Effectiveness: What Managers Need to Know** *Peter Robichaud, US Forest Service*

1:45 – 2:15 **Post-Wildfire Recovery: Linking Treatments to the Emergency**
Carolyn Napper, *USFS, San Dimas Technology and Development Center*

2:15 – 2:35 **Evaluation of Fire Site Rehabilitation Methods in Controlling Erosion and Sedimentation**
David Scott, Okanagan University College

2:35 – 3:05 **Effectiveness of Post-wildfire Rehabilitation in the Cariboo, Kamloops and Southeast Fire Centres**
Chris Oman, Forest Practices Board

3:05 – 3:30 ***Nutrition Break / Posters***

3:30 – 4:00 **Maintaining Habitat Structure and Diversity during Rehabilitation Operations and Salvage Harvesting of Large Wildfires in the Southern Interior Forest Region**
Walt Klenner, BC Ministry of Forests

4:00 – 4:20 **Post-Fire Rehabilitation Planning Framework**
Patrick Daigle, BC Ministry of Water, Land and Air Protection

4:30 p.m. **Closing Remarks**

Financial and In-kind Support:

This workshop is supported in part by the BC Ministry of Forests through: the Forest Investment Account, Forest Science Program; FORREX; Okanagan University College; BC Ministry of Water, Land and Air Protection; and the Capital Regional District Water Services.

Workshop Organizers:

Robin Pike, FORREX
Rob Scherer, FORREX
Dave Scott, Okanagan University College
Joel Ussery, Capital Regional District Water Services
Patrick Daigle, BC Ministry of Water, Land and Air Protection

Posters

Where: Upstairs in the Sun Room (120) near cafeteria
When: Coffee breaks and Lunch

- **Cedar Hills Post-Fire Flood and Landslide Investigation**. *Bill Grainger, Grainger and Associates Consulting Ltd., Salmon Arm, B.C. and Kevin Turner, Geotechnical Engineer, BC Ministry of Forests Kamloops, BC*

- **City of Kelowna, Okanagan Mountain Fire 2003** *Alex Bursac, Watershed Coordinator*. *City of Kelowna*

- **Linbir - Wildfire Rehabilitation Services: A look at implementation of rehabilitation in a community watershed during and after wildfire**. *Garnet Mierau and Tom MacKenzie, Kamloops, BC.*

- **Post fire Recovery in Okanagan Mountain Provincial Park, Kelowna, BC.** *Kathryn Bockhold, Okanagan University College, Kelowna, BC.*

- **Seeding to Control Noxious Weed Invasion on the Strawberry Hill Fire.** *Reg Newman, Research Range Ecologist, Ministry of Forests, Research Branch. Kamloops*, *BC.*

- **Soil Water Repellency Distribution Following Wildfire in Eucalyptus Plantations, Portugal.** *Gemma Leighton-Boyce, Komex International Ltd. Calgary, AB, Stefan H. Doerr, Rick A. Shakesby, Rory P.D. Walsh Department of Geography, University of Wales Swansea. UK*

- **Some Factors to Consider from Recent Fire Seasons, Abnormal Weather and Government Policies - Should hazard assessment reports prepared for subdivision and building permit approvals and the protection of existing residential development consider possible fire effects and climate change?** *Dwain Boyer, Senior Flood Hazard Management Engineer, Ministry of Water, Land and Air Protection, Nelson, BC and Doug Nicol, Road Geotechnical Engineer, Ministry of Forests, Nelson, BC.*

- **Testing Methods for Controlling Post-Fire Erosion** *Skye Thomson, Undergraduate Research Assistant and Dave Scott, Okanagan University College, Kelowna, BC.*

Key Points from Presentations

Wildfire Effects on Ecosystems and Vegetation

***John Parminter**, Research Ecologist*
Research Branch, Ministry of Forests. Victoria, BC.
john.parminter@gems7.gov.bc.ca

Key Points:

- Variations in fire type and fire behaviour as determined by fuel, weather, and topography make each fire a unique event and potentially result in a wide range of ecological effects at different scales.
- Fire regimes describe the long-term relationships that have developed between ecosystems and fire.
- The effects of fire on plants varies due to fire intensity, burn severity, duration of combustion, soil heating, time of year, and elapsed time since the previous fire.
- Plant tissue mortality is a function of time and temperature and plant mortality of the combined effects of fire on crowns, stems, and root systems. When plants are killed, vegetation recovery is accomplished by various sprouting or seeding mechanisms.
- Post-fire vegetation dynamics depend upon the characteristics of the plant species, their ability to resist the heat of a fire, their recovery mechanisms, post-fire weather, post-fire animal use, and plant competition.
- Post-fire rehabilitation needs may be anticipated and assessed if the response of plant communities to fire can be predicted with some degree of certainty, both before and after the fire.

Additional Resources:

1. Brown, J.K. and J.K. Smith (eds). 2000. **Wildland fire in ecosystems – effects of fire on flora.** USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. RMRS-GTR-42-2. 257 pgs. **http://www.fs.fed.us/rm/pubs/rmrs_gtr42_2.pdf**
2. Graham, R.T., S. McCaffrey, and T.B. Jain. (eds). 2004. **Science basis for changing forest structure to modify wildfire behavior and severity.** USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. RMRS-GTR-120. 43 pgs. **http://www.fs.fed.us/rm/pubs/rmrs_gtr120.pdf**
3. Miller, M. and J. Findley. 2001. **Fire effects guide – chapter VI, plants.** National Wildfire Coordinating Group, Boise, ID. 31 p. **http://www.nwcg.gov/pms/RxFire/FEG.pdf**
4. Ministry of Agriculture, Food and Fisheries. 2004. **Fire Effects on Rangeland Fact sheets. http://www.agf.gov.bc.ca/range/factsheets.htm - fire**

Notes:

Overview of Aquatic Ecology and Biodiversity Issues Related to Wildfire and the Need for Rehabilitation Practices

Brian A. Heise
Thompson Rivers University. Kamloops, BC.
bheise@tru.ca

Key Points:

- The effects of wildfires on the aquatic invertebrates living in streams are usually felt during spring freshet or large summer rains, in the year following the fire.
- Stream organisms are most affected by physical disturbance of the stream bottom accompanying flooding and debris movements, which alter channels and the distribution of sediment.
- Fires change the type of food available to aquatic insects, and so the proportion of functional feeding groups in burned watersheds can change following fire.
- I studied three streams in the McClure wildfire of 2003 which varied in burn intensity.
- The abundance and diversity of aquatic invertebrates was significantly reduced in the intensely burned stream during spring freshet of 2004, compared to the unburned control.
- Three months later the burned streams had completely recovered, with abundances in the intensely burned stream being significantly greater than the control stream.
- Recovery of the burned streams appeared to occur via re-colonization by drifting insects from upstream reaches

Notes:

Effects of Wildfire on Soil and Water – An Overview

David Scott
FRBC Research Chair of Watershed Management
Okanagan University College
dscott@ouc.bc.ca

Key Points or Take Home Messages:

- All **fires** are not equal. There are good reasons to expect wildfires to differ from each other and, in particular, from prescribed burns. Each fire needs to be considered individually.

- Soil water content and the water content of litter/duff at the time of the fire will be critical in determining the nature of fire effects. This is a result of the strong positive relationship between water content and both thermal capacity and conductivity.

- Other important variables that influence fire severity are fuel load, fuel properties and arrangement, and fire weather.

- The vulnerability of a burned site to erosion has three main components, namely,
  1. The amount of litter remaining after the fire (litter serves to insulate soil from heating during fire and provides physical protection to erosive forces after the fire),
  2. The effect of soil heating on soil erodibility (severe heating increases erodibility), and
  3. The presence and extent of fire-induced water repellency in the soils.

- Regardless of the vulnerability of the site, a large rainstorm is still needed to drive erosion (hence, you "dodge the bullet" if don't get a large storm in the first year or two after the fire.)

Additional Resources / Links to Information:

- DeBano, LF, 2000. The role of fire and soil heating on water repellency in wildland environments: a review. *Journal of Hydrology,* 231-232: 195-206.

Notes:

Kuskonook Creek Debris flow of August 2004: Water Repellent Soils, Erosion and Mass Wasting

***Peter Jordan**, Geomorphologist*
BC Ministry of Forests, Nelson BC.
Peter.Jordan@gems4.gov.bc.ca

***Mike Curran,** Research Soil Scientist*
BC Ministry of Forests, Nelson BC.
Mike.Curran@gems5.gov.bc.ca

Key Points:

- The Kuskonook Creek debris flow of August 6-7, 2004, near Creston, BC, was an unusual natural disaster resulting from post-wildfire water-repellent soils.
- The debris flow event happened as a result of overland flow during a localized heavy rainstorm, almost a year after the 2003 wildfire.
- Water-repellent soils were found in localized areas of most severe burn. Fire severity mapping done later corresponded well with field observations.
- The Kuskonook Creek fan was previously mapped as being at risk from debris flows, and the 2003 fire was identified as having a high downslope erosion/mass movement risk.
- Knowledge gaps about wildfire-related erosion events include:
  - How common is severe water repellency following fires?
  - How long does water repellency, and erosion risk, persist?
  - How do pre-fire soil, weather, and fuel conditions affect water repellency?
  - Would physical rehabilitation of affected areas be effective for risk reduction?
  - Would warning systems, or defensive structures, be effective for risk reduction?
  - How can information on risk be communicated to residents?

Additional Resources:

1. P. Jordan, M. Curran, and D. Nicol. 2004. **Debris flows caused by water repellent soils in recent burns in the Kootenays.** Aspect, vol. 9, no. 3, pp. 4-9. Division of Engineers and Geoscientists in the Forest Sector, Association of Professional Engineers and Geoscientists of BC.
2. M. Curran, B. Chapman, G. Hope, and D. Scott, 2005. **Soil erosion and flooding after wildfires: understanding the soil conditions**. B.C. Ministry of Forests, Technical Report (in preparation).

Notes:

Wildfire Hydrology: British Columbia and Alberta Case Studies

***Dan Moore**, Prof. Forest Hydrology, Univ. of British Columbia, Vancouver, BC.* rdmoore@geog.ubc.ca
***Rita Winkler**, Forest Hydrologist, BC Ministry of Forests, Kamloops, BC.* Rita.Winkler@gems7.gov.bc.ca
***Uldis Silins**, Prof. Forest Hydrology, Univ. of Alberta, Edmonton, Alta.* Uldis.Silins@ualberta.ca

Key Points:

- Depending on burn severity and hydrogeologic setting, wildfires can result in shifts in the magnitude of stand-scale water and energy exchanges, hillslope- and channel-scale erosion processes, alterations in water quantity, regime and quality at the watershed outlet, and consequent effects on aquatic ecology.

- Wildfires increase water input to the hydrogeomorphic system as snow and rain, in some proportion relative to the reduction in forest cover.

- The timing of peak snow accumulation, the onset of melt, and the date of snow disappearance are advanced relative to those for mature and regenerating forest cover, as well as for open sites. The amount of water accumulating as snow may also increase relative to both forests and clearcuts, depending on pre-fire cover, location and year. These changes are thought be the result of changes in both snow interception and the streams of energy through the canopy.

- Nutrient concentrations in stream water increase during the first measurement season post-fire. Following the Crowsnest Fire, nitrate and sediment concentrations and yields increased significantly during high stormflow events and were somewhat elevated during snowmelt. Mercury levels in stream water samples were also elevated. Nitrate concentrations were also higher in streams within the area burned by the McClure Fire relative to those draining unburned reference catchments. However, nitrate concentrations remained below standards for drinking water quality.

- Current case-studies in BC and Alberta clearly demonstrate the limitations to scientific inferences that can be supported in the absence of “true” climatic/hydrologic control because paired-catchment climatic controls are rarely possible for wildfire impacts. Other options are neither simple nor inexpensive.
  - Post-wildfire (retrospective) designs may need many representative replicate catchments, both burned and unburned (difficult to find).
  - Case-study approaches (one or more treatment catchments compared to one or a small number of unburned reference catchments) require concurrent process-oriented sub-watershed scale research to identify the causes of observed effects at the watershed scale.

- There is a crucial need to carry out BOTH response-oriented (i.e., effects on streamflow and/or water quality) and process-focused research to establish the cause of observed wildfire effects and enable the extrapolation of results to other areas and scales.

Notes:

Effects of Wildfires on Ecosystem Function: A Biogeochemical Approach

Jeff Curtis
Okanagan University College
Kelowna, BC.
JCurtis@ouc.bc.ca

Adam Wei,
Okanagan University College
Kelowna, BC.
awei@ouc.bc.ca

Key Points:

- The flow of water and other materials in ecosystems is perturbed by wildfires.
- Yields of water increase because of reduced evapotranspiration and reduced storage.
- Yields of nutrient elements increase because wildfires directly and indirectly increase mineralization of elements in forest biomass and because the capacity to assimilate inputs of new materials into biomass is reduced.
- Loss of soil organic matter may limit the rate of recovery of ecosystem function.

Additional Resources:

1. Lamontagne, S., R. Carignan, P. D'Arcy, Y. T. Prairie & D. Paré. 2000. **Element export in runoff from eastern Canadian Boreal Shield drainage basins following forest harvesting and wildfires**. *Can. J. Fish. Aquat. Sci*. 57(Suppl. 2):118–128.
2. Schindler, D.W., R.W. Newbury, K.G. Beaty, J. Prokopowich, T. Ruszczynski, & J.A. Dalton. 1980. **Effects of a windstorm and forest fire on chemical losses from forested watersheds and on the quality of receiving streams**. *Can. J. Fish. Aquat. Sci.* **37**: 328-334.
3. Minshall, G.W., C.T. Robinson & D.E. Lawrence 1997. **Postfire responses of lotic ecosystems in Yellowstone National Park, U.S.A**. *Can. J. Fish. Aquat. Sci*. 54:2509-2525.
4. FORREX Watershed Management Links: **www.forrex.org/waterlinks.asp**

Notes:

Tools, Treatments, and Effectiveness: What Managers Need to Know

***Peter R. Robichaud**, Research Engineer.*
U.S. Department of Agriculture, Forest Service,
Rocky Mountain Research Station, Moscow, Idaho, USA.
probichaud@fs.fed.us

Key Points:

- Postfire erosion happens and its rate varies spatially and temporally. This is due to variability in: precipitation characteristics, soil properties, and burn severity. Erosion rates are the highest during the first postfire year and generally decrease by an order of magnitude for successive years.

- A probabilistic modeling approach has been used in our latest Erosion Risk Management Tool (ERMiT) for predicting postfire erosion and treatment effectiveness.

- Postfire hillslope erosion can be reduced for some precipitation events with various treatments; however, no treatment will stop all erosion. Rainfall intensity is a driving factor in determining treatment effectiveness. High rainfall intensity events often overwhelm treatments such as contour-felled log erosion barriers.

- Ground cover treatments generally provide greater protection for hillslope erosion than barrier-type treatments. Preliminary results suggest that mulches with long fibers provide good cover and are not easily moved by overland flow or raindrop impact.

Additional Resources:

1. **http://forest.moscowfsl.wsu.edu/fswepp/**

2. Robichaud, P., J. Beyers, and D. Neary. 2000. **Evaluating the effectiveness of postfire rehabilitation treatments.** USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. RMRS-GTR-63. 85 pgs. **http://www.fs.fed.us/rm/pubs/rmrs_gtr63.pdf**

Notes:

Post-wildfire Recovery: Linking Treatments to the Emergency

Carolyn Napper, *Soil Scientist,*
USDA Forest Service, San Dimas Technology and Development Center
cnapper@fs.fed.us

Key Points:

- USDA Forest Service has identified a hierarchy of values at risk from a wildfire that include threat to life or human safety and adverse effects to property such as damage to transportation infrastructure, campgrounds, and minor facilities. Values at risk also includes identification of threats to critical natural and cultural resources including soil health, water quality, heritage resources, threatened and endangered species, and noxious and invasive plants.

- USDA Forest Service Burned Area Emergency Recovery (BAER) teams are responsible for identifying if the fire created an emergency through an assessment of values at risk. Key components are a clear understanding of the watershed response to the fire and understanding of how various treatments might mitigate those responses.

- Treatment types include land, channel, road/trail and protection/safety. The BAER team links the appropriate treatment to the emergency knowing the values at risk.

- Land treatments including straw mulch, seeding, erosion barriers, and scarification are used to reduce erosion and sedimentation. Land treatments such as seeding reduce noxious and invasive plants establishment. Mulching and other erosion control products are used to disguise and protect cultural resources. The effectiveness of these treatments varies based on location, implementation, and storm intensity and duration.

- Channel treatments include check dams, grade stabilizers, in-channel felling, and channel debris clearing. These treatments are designed to protect water quality, downstream beneficial uses and property. Monitoring helps identify the limitations of these treatments in reducing the emergency.

- Road/trail treatments are implemented to provide access, reduce threat to life, safety and property, and for water quality and T&E species. Treatments include debris control structures, road drainage modification, storm inspection/response, and overflow structures. More monitoring of the effectiveness of these treatments is needed.

- Protection/safety treatments include flood warning systems, signing, hazard removal barriers, and protective fencing. Treatments are designed to protect both human life/safety and the recovery of the burned area.

- Learn through monitoring of your own experience how treatments affect or change the anticipated watershed response to the fire and you will have linked the treatments to the emergency.

Additional Resources:

1. **http://www.fs.fed.us/eng/t-d.php.** Type in T- d for username and password. Go to watershed projects and look for updates on the BAER catalog. Provides a description of all emergency treatments.

Notes:

Evaluation of Fire Site Rehabilitation Methods in Controlling Erosion and Sedimentation

David Scott
FRBC Research Chair of Watershed Management
Okanagan University College
dscott@ouc.bc.ca

Key Points or Take Home Messages:

- Silt fence traps are being used in a trial sponsored by FSP to evaluate different methods of reducing the erosion risk on sites burned in wildfires.
- Four treatments were selected on the basis of their likely efficacy and practicality. They are straw mulch, chipped-tree mulch, needle fall and seeding. Untreated plots provide the control.
- Plots are located in five southern interior locations burned during the summer of 2003.
- The treatments are replicated three times at each location.
- The mass of sediment that is caught in silt fences at the bottom of 3 X 20 m plots is recorded, along with the continuous measurements of rainfall.
- Early results indicate that the mulch treatments (including needle fall) appear to be effective in reducing erosion.
- The study design is weakened by our dependence on natural rainfall events to drive erosion.

Additional Resources / Links to Information:

See poster paper by Skye Thomson, at this meeting.

Robichaud, P., J. Beyers, and D. Neary. 2000**.** Evaluating the effectiveness of postfire rehabilitation treatments. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. RMRS-GTR-63. 85 pp. http://www.fs.fed.us/rm/pubs/rmrs_gtr63.pdf

Robichaud, P., J. and Robert E. Brown, 2002. Silt fences: an economical technique for measuring hillslope soil erosion. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. RMRS-GTR-94. 24 pp.

Notes:

Effectiveness of Post-Wildfire Rehabilitation in the Cariboo, Kamloops and Southeast Fire Centres

Chris Oman RPF
Forest Practices Board, Victoria, BC.
Chris.Oman@gov.bc.ca or (250) 356-1329

Key Points:

- In BC, only the damage done while suppressing a fire is required to be rehabilitated.

- The *Forest Fire Prevention and Suppression Regulation* (*FFPSR*) (recently replaced by the *Wildfire Regulation*) states that a person who carries out fire control or fire suppression operations must stabilize all fire access trails, fire guards, and other fire suppression works, to ensure that natural drainage patterns are maintained and surface soil erosion is minimized.

- In summer 2004, the Forest Practices Board examined 64 rehabilitation plans and sampled 12 fires in the field to determine whether rehabilitation plans were prepared as required, and whether treatments were effective at stabilizing suppression works, restoring natural drainage, and minimizing surface soil erosion.

- Interviews with BC Ministry of Forests, fire protection staff identified a number of issues, including: the need for fire management planning; rehabilitation training; coordination of rehabilitation and salvage harvesting; access to cultural heritage information; seeding guidelines; and the need for early assignment of a person responsible for rehabilitation of a fire.

- In general, government complied with the requirements of the *FFPSR* and rehabilitation treatments were effective.

- The Board made four recommendations to government at the conclusion of the investigation and commended those involved in the rehabilitation of the 2003 fires.

Additional Resources:

1. Post-fire Site Rehabilitation: Final Report
   http://www.fpb.gov.bc.ca/special/investigations/SIR12/Fire_Rehab_Plans(SIR12).pdf

2. Post-Fire Site Rehabilitation Special Investigation: Interim Report
   http://www.fpb.gov.bc.ca/special/investigations/SIR10/SIR10.pdf

3. Forest Practices Board web site **http://www.fpb.gov.bc.ca**

Notes:

Maintaining Habitat Structure and Diversity During Rehabilitation and Salvage Harvesting of Large Wildfires in the Southern Interior Forest Region.

Walt Klenner, *Wildlife Habitat Ecologist*
BC Ministry of Forests, Southern Interior Forest Region, Kamloops, BC.
Walt.Klenner@gems7.gov.bc.ca

Key Points:

- Develop a rehabilitation and salvage harvesting plan that considers the full range of timber and non-timber values. Rehabilitation priorities include sites that were disturbed during fire suppression activities, sites that are especially prone to erosion (soil type, slope) or which are particularly vulnerable to invasion by weeds. Salvage priorities include high site index (e.g. > 15) sites that have experienced high severity (stand replacing) fires where < 10% of the trees are likely to survive, and sites with gentle slopes (e.g. < 30%) that are less prone to erosion following road building and harvesting. Avoid salvage harvesting in community watersheds or visually sensitive areas where road building and harvesting are likely to exacerbate the visual impact of the fire, or where further disturbance will likely lead to erosion and stream sedimentation. Also avoid salvage harvesting in special management areas (e.g. Parks, OGMA's, etc.) until ecologically suitable replacement areas have been identified.

- During road construction, minimize the number of permanent roads to access salvage blocks, avoid stream crossings whenever possible, avoid "stacking" switchbacks and deactivate roads following harvest and planting.

- During harvest, maintain green tree, or a combination of green, scorched and charred retention patches that represent single tree, small patch (e.g. 0.25 ha) and large (e.g. 2.0 ha) retention areas. These should be designed to provide habitat within the overall fire area, to facilitate animal movements and to mitigate visual impacts of the fire and/or salvage harvesting.

- Harvest on a snowpack of at least 30 and preferably 40cm, on frozen ground, or a combination of frozen ground and snowpack.

- Maintain the long-term genetic variability of trees on the site by using no more than 40% of the seedlings to stock large salvage blocks (> 100 ha) from any one seed orchard.

- Grass seeding of the burned area with non-native species should be confined to those areas mechanically disturbed during fire suppression operations (e.g. roads, fire guards, camp areas).

Notes:

Post-Fire Rehabilitation Planning Framework

Patrick Daigle RPF, *Science Acquisition Specialist*
Terrestrial Ecosystem Science Section,
Biodiversity Branch, Ministry of Water, Land and Air Protection. Victoria, BC.
Patrick.Daigle@gov.bc.ca

Key Points:

Take a structured approach to post-fire rehab planning. Document the planning process and rationale.

- **Get ready, before fire season.** Gather maps of WLAP values. Gather hi-level plans for your area. Know which specialists you might need to call.
- **Assess post-fire conditions.** Stratify the burned area. Assess post-fire conditions. Summarize post-fire conditions on field form -- one field form for each stratum. Take lots of photos.
- **Plan post-fire rehab**. Within Burned Area Boundary, document hi-level objectives. Consider rehab alternatives, including no action option. List & map preferred rehab options. Prioritize.
- **Plan rehab implementation.** Document clear links between hi-level goals & objectives & WLAP's recommended rehab tactics. Meet & negotiate with designated Ministry of Forests official; get sign-off.
- **Monitor rehab effectiveness.** Use existing monitoring protocols. Document findings: description, maps, photos. Learn what rehab works to effectively address goals & objectives for each site. Learn what doesn't work. If needed, for future rehab, negotiate adjustments with the Ministry of Forests.

Additional Resources:

1. Ministry of Water, Land and Air Protection. 2005. **Post-Fire Rehabilitation Planning Framework: Guidance for Post-Fire Assessment, and rehabilitation planning, implementation, and monitoring.** In press. Ministry of Water, Land and Air Protection, Biodiversity Branch, Victoria, BC.
2. Williams, J. and D. DellaSala (editors). 2004. **Wildfire and Conservation in the Western US**. Conservation Biology 18(4). **http://ezproxy.for.gov.bc.ca:2069/Issue.asp?IssueID=353041** Papers include:
3. Backer, D., S.E. Jensen and G.R. Mcpherson. 2004. **Impacts of Fire-Suppression Activities on Natural Communities**. in Wildfire and Conservation in the Western US. 2004. Williams, J. and D. DellaSala (editors). Conservation Biology vol. 18, no. 4, pp. 937-946(10).
4. Beyers, J. 2004 **Postfire Seeding for Erosion Control: Effectiveness and Impacts on Native Plant Communities.** in Wildfire and Conservation in the Western US. 2004. Williams, J. and D. DellaSala (editors). Conservation Biology 18(4).
5. Beschta, R.L. J.J. Rhodes, J.B. Kauffman, R.E. Gresswell, G.W. Minshall, J.R. Karr, D.A. Perry, F. Hauer; C.A. Frissel. 2004. **Postfire Management on Forested Public Lands of the Western US.** Conservation Biology, August 2004, vol. 18, no. 4, pp. 957-967(11) **http://www.cof.orst.edu/cof/fe/pdf/beschta_postfire.pdf**

Notes:

Bibliographies and Annotated Bibliographies

Hessl, A. and S. Spackman. 1995. **Effects of Fire on Threatened and Endangered Plants**: **An Annotated Bibliography.** The Nature Conservancy, Colorado Natural Heritage Program, University of Colorado, Boulder, Colorado **http://www.nwrc.usgs.gov/wdb/pub/others/1995_02.pdf**

Hourdequin, M. 2001. Linking wilderness research and management—volume 1. **Wilderness Fire Restoration and Management: an Annotated Reading List.** (Wright, Vita, series ed.) Gen. Tech. Rep. RMRS-GTR-79-VOL 1. Fort Collins, CO. USDA Forest Service, Rocky Mountain Research Station. 40 p. **http://www.fs.fed.us/rm/pubs/rmrs_gtr79_1.pdf**

Kalendovsky, M.A. and S.H. Cannon. 1997. **Fire-Induced Water-Repellent Soils: an annotated bibliography**. U.S. Geological Survey Open-File Report 97-720 **http://landslides.usgs.gov/html_files/landslides/ofr-97-720/biblio.html**

Kirby, R.E., , S.J., Lewis and , T.N. Sexson, 1988, **Fire in North American wetland ecosystems and fire-wildlife relations**: An annotated bibliography: U.S. Fish and Wildlife Services, Biological Report, v. 88, no. 1, p. 1-146. **http://www.npwrc.usgs.gov/resource/literatr/firewild/firewild.htm**

Makuch, J. 2002. **Fire, Landscapes and Water Quality - Electronic Bibliography**. Water Quality Information Center at the National Agricultural Library. Agricultural Research Service, U.S. Department of Agriculture **http://www.nal.usda.gov/wqic/Bibliographies/fire.html**

Martin D.A. (ed.) 2000. **Bibliography of Reports and Journal Articles Dealing with Fire Science** by Scientists of the U.S. Geological Survey **http://firescience.cr.usgs.gov/images/bib_doc.pdf**

McIver, J.D. and L. Starr (tech. eds.) 2000**. Environmental effects of postfire logging**: **literature review and annotated bibliography**. Gen. Tech. Rep. PNW-GTR-486. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 72 p. **http://www.fs.fed.us/pnw/pubs/gtr486.pdf**

Swengel A.B. 2001. **A Literature Review of Insect Responses to Fire, Compared to Other Conservation Managements of Open Habitat**. Biodiversity & Conservation. 2001:10(7):1141-1169.

Web Resources – Assorted Topics

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