LECTURE 2_9:
FEB. 4, 2014

FORESTS

ENVIRONMENTAL & SOCIAL IMPACTS OF FOREST MANAGEMENT PRACTICES

Text Reference: Dearden and Mitchell (2012), Ch. 9, pp. 302-320.

T. Randall, Lakehead University, WA 2014

Recall from Last Lecture

- Forest Management Practices
  - Commonly practiced silvicultural methods in Canada {Clear-cutting; Seed tree; Shelterwood; Selection}

Silviculture Systems

- Primarily clear-cut logging in Canada; increasing fraction of which over time …

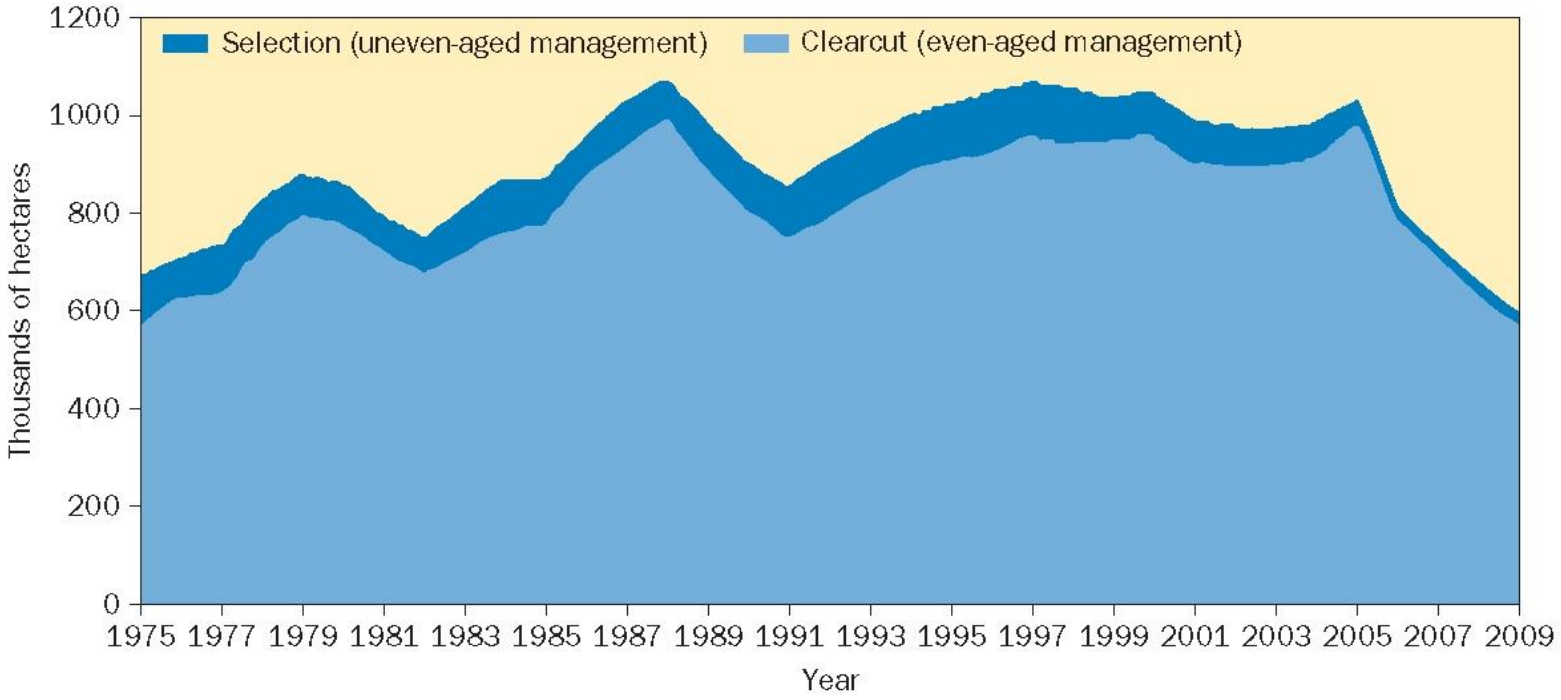


Figure 9.4 | Silviculture: Area harvested, 1975–2009. *Source: National Forestry Database, Silviculture—National Tables, at: nfdp.ccfm.org/silviculture/national_e.php.*

From: Dearden and Mitchell (2012)

Clear-Cutting

(*top-left*) **Elaho R. valley** (near Squamish, BC) (~1994, credit: TR); (*top-right*) **Hunaechin Creek, Coastal BC** – note heli-cutblocks regenerating (~1995, credit: TR); (*right*) **generic clear-cut** credit to Dearden and Mitchell (2012)

Clear-Cutting – environmental challenges

Outline

From: Dearden and Mitchell (2012)

- Environmental Impacts of Forest Management Practices
- Social Impacts of Forest Management Practices
- *Compare/Contrast with "New Forestry" practices*
- **Case Study:** Peel River watershed (YK)
  - Conservation efforts; challenges

Envir'l Impacts:

Natural Disturbances (Fire, Insects)

- Fire leaves trees in wet areas (→ refuge habitat for wildlife; seed source for re-gen);
- Fire an important part of reproductive cycle of many coniferous species, increases soil fertility, and kills pathogens in forest ecosystems

Clear-Cut

- All trees (and related nutrients) removed;
- Along with fire suppression, can allow pathogens to survive
- Leads to soil compaction (heavy machinery) and soil erosion

Envir'l Impacts (1): Forestry & Biodiversity

- Old growth forests have attributes that are typically absent from harvested or managed forests;
  - Age (usu. with trees spanning several centuries; contain high value timber and large amounts of carbon)
  - Varied tree sizes/spacing; contain high-value timber
  - Accumulated deadfall as well as standing trees;
  - Large reservoirs of 'genetic material'
  - Habitats for many species;

Old growth forest - Slovakia

Envir'l Impacts (1): Forestry & Biodiversity

- Managed and logged forests;
  - Monoculture re-plantations; seedlings typically derived from same genetic base (thus, a direct reduction in genetic diversity);
  - Lower genetic diversity makes forests …
  - *More susceptible* to pest infestations and disease
  - *Less able to adapt* to future environmental change
  - *Less capable* of supporting the diversity of animal and bird species currently found which requires characteristics of old growth forests → species decline and possible extirpations;

Managed forest – thinning and limbing enhances growth in this stand of Birch. Source; Dearden and Mitchell (2012)

Envir'l Impacts (2): Forestry & Site Fertility

Nutrient Removal Comparison – depends on kind and extent of harvesting (Selection vs Clear-cut approaches)

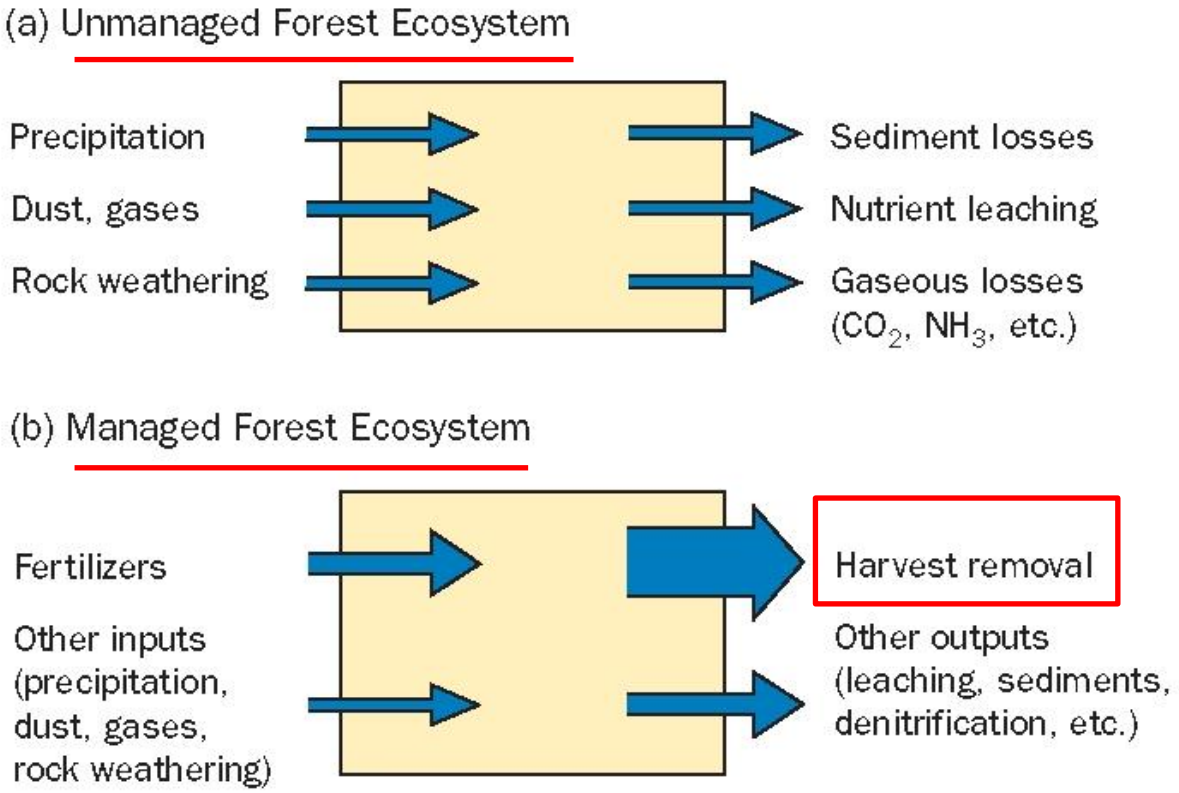


Figure 9.9 | Nutrient inputs and outputs from managed and unmanaged forest ecosytems.

From: Dearden and Mitchell (2012)

Envir'l Impacts (2): Forestry & Site Fertility

- The amount of nutrients removed by harvesting is influenced by tree species, age, harvesting method, season of harvesting, and other factors

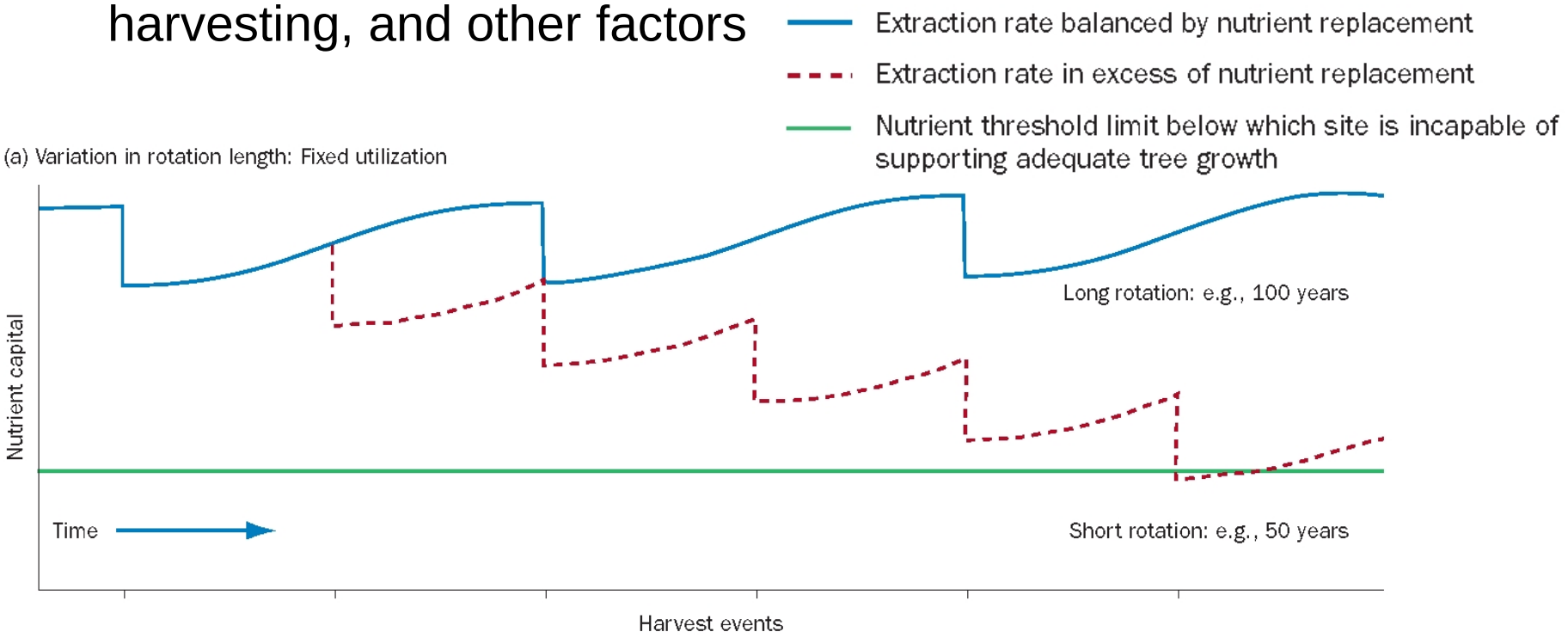


Figure 9.10 *Shows effect on site impoverishment with varied rotation length between forest disturbances.* *From: Dearden and Mitchell (2012)*

Envir'l Impacts (2): Forestry & Site Fertility

- **Whole tree harvesting** (most common technique in Canada) – stem, branches and top all removed from site, while **stem harvesting** takes only the stems

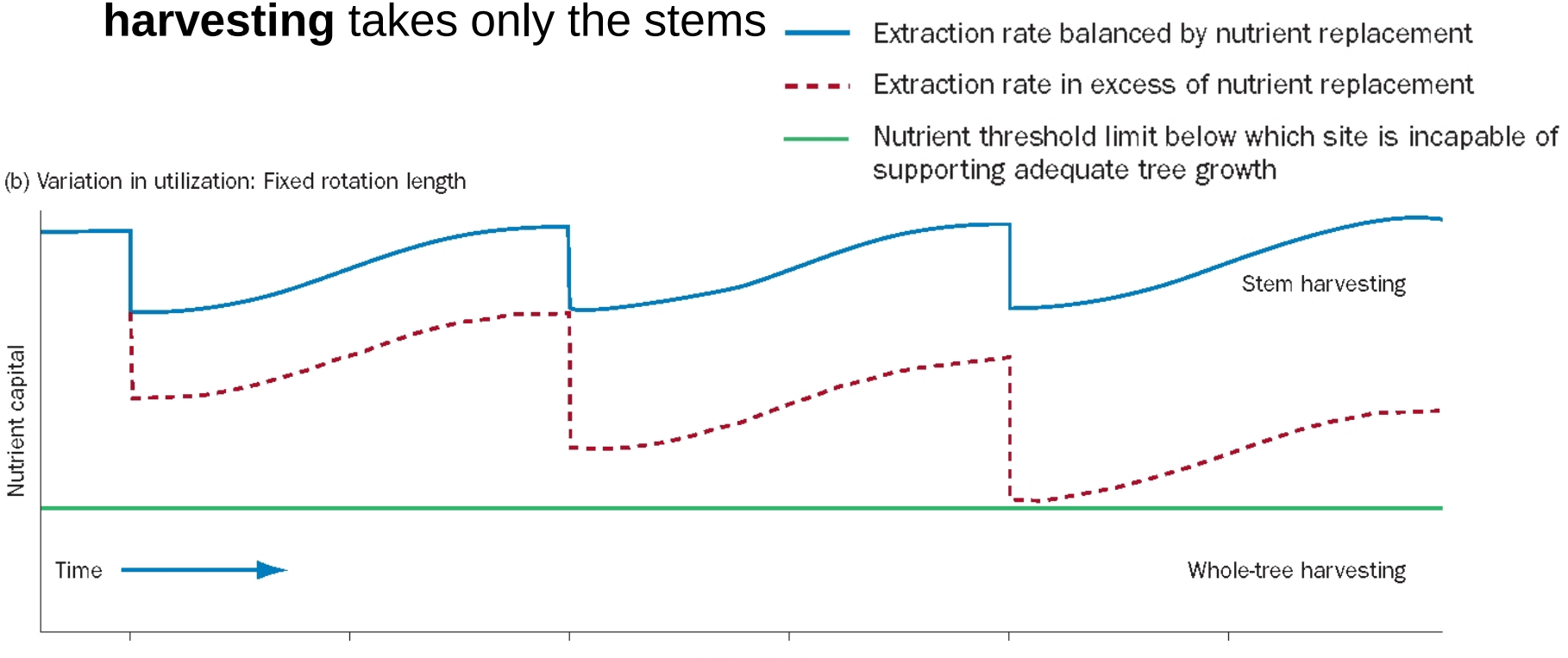


Figure 9.10 *Shows effect on site impoverishment with varied utilisation (whole-tree vs stem harvesting).* *From: Dearden and Mitchell (2012)*

Envir'l Impacts (2): Forestry & Site Fertility

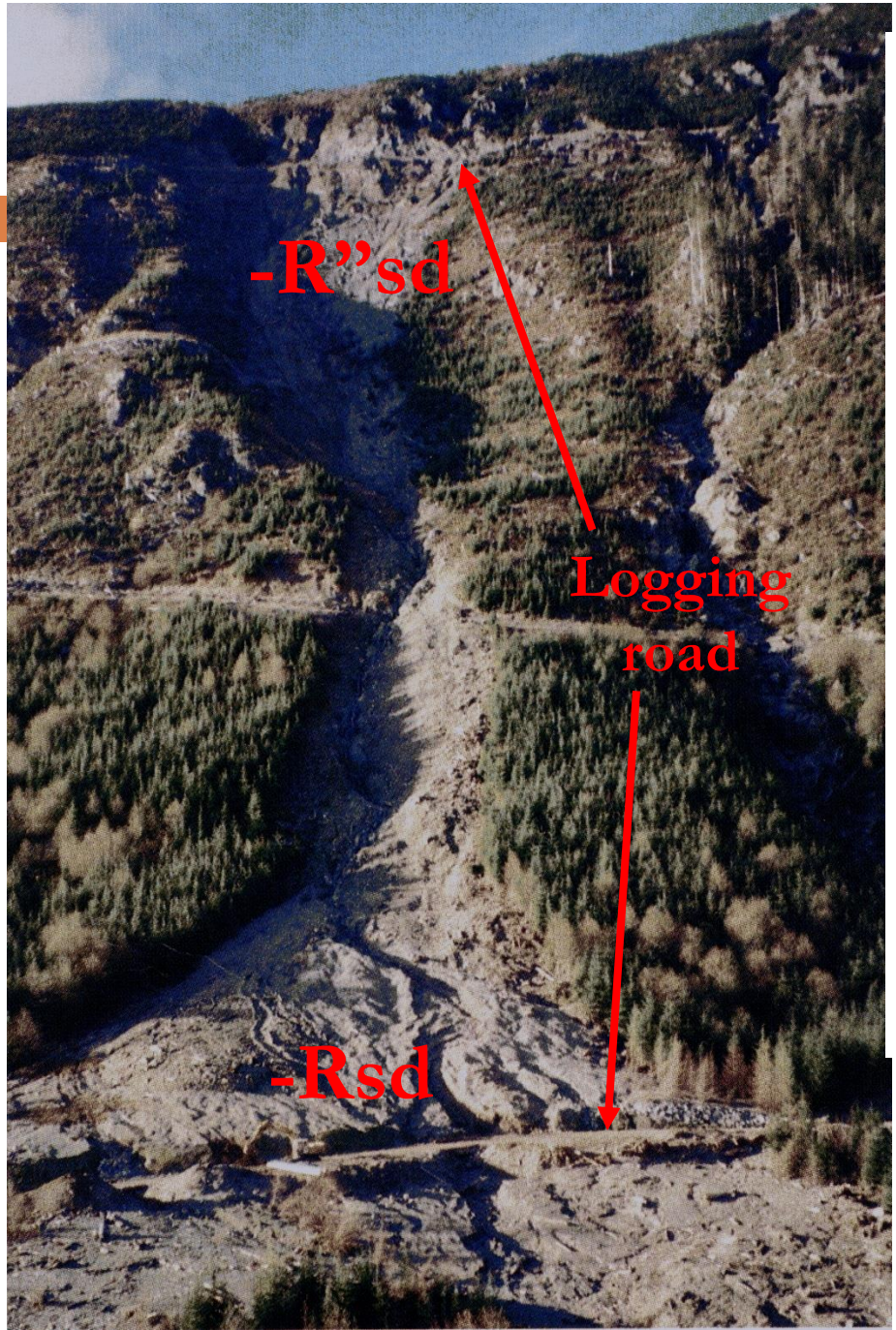
- Study by Freedman (1981) in Nova Scotia:
  - c.f. whole-tree and stem harvesting methods
  - 35% increase in biomass taken
  - Increased nutrient losses (e.g., 99% increase in Nitrogen, 93% for Phosphorus, 54% for Calcium, etc.)
  - NS recently announced it will ban 'whole-tree' harvesting
- Considerable nutrient loss also occurs through '**leaching**' – dissolved nutrients moving downwards into soil, groundwater and as surface runoff (hence lost)
- These lost nutrients can take many decades for them to be replaced through natural processes (like nitrogren-fixation);

Envir'l Impacts (3): Forestry & Soil Erosion

- Harvesting method can have significant effect on soil through erosion & terrain *in*stability
- Contribute to loss of site fertility; fish habitat destruction; and flooding

Debris Slide in Cutblock; Credit: JM Ryder (no. 90)

Gullying in Thick Till, post-logging failure has occurred (red arrow). Credit: JM Ryder (no. 111)



Landslides (associated with road construction) in clearcut terrain

initiation vs runout zones

potential erosion
(from cleared areas)

Photo Credit: Innovation Magazine (APEGBC)

Identifying Areas of Potential Erosion & Instability

- Poor road design and maintenance are major culprits in erosion and terrain instability issues
- BC Forest Practices Code (discussed in last lecture) is an example of a jurisdiction implementing process to mitigate these effects, amongst other improved forestry practices.
  - E.g., preliminary mapping to identify potentially unstable and highly erodible areas *prio*r to road construction and clearing so that they are avoided.

Water Temperature, Stream Health Benefits of Forest Management Approach – e.g. Buffer Strips

http://www.ccjcin.org/ditches/franklinriparian.jpg

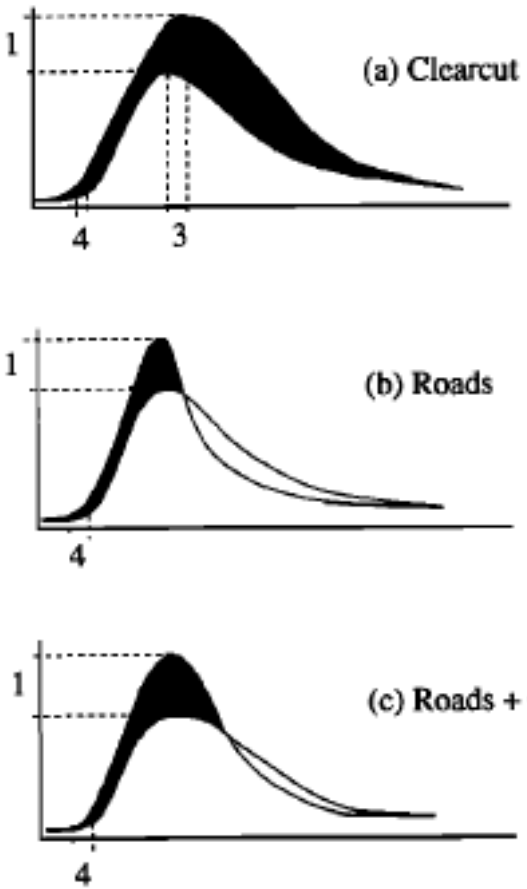
Table 3-10. Comparison of Effects of Two Methods of Harvesting on Water Quality (OR) (Hall et al., 1987)

Watershed	Method	Streamflow	Water Temp.	Sediment	Dissolved Oxygen
Deer Creek	Patch cut with buffer strips (750 acres)	No increase in peak flow	No change	Increases for one year due to periodic road failure	No change
Needle Branch	Clearcut with no stream protection (175 acres)	Small increases	Large changes, daily maximum increase by 30°F, returning to pre-log temp. within 7 years	Five-fold increase during first winter, returning to near normal the fourth year after harvest	Reduced by logging slash to near zero in some reaches; returned to normal when slash removed

The effectiveness in protecting streams from temperature increases, large increases in sediment load, and reduced dissolved oxygen (see Hall et al, 1987 referred at link following)
http://water.epa.gov/polwaste/nps/czara/images/table310.gif

Envir'l Impacts (4): Forestry & Hydrological Change

- Forestry (clear-cutting) impacts on Forest Hydrology include the following:
  - Changes to local hydrological cycle (e.g., transpiration, infiltration, surface runoff)
  - Changes to annual flood regime (downstream of cleared areas) and responses to individual storm events;



Changes to storm hydrograph because of forest disturbances. Figure (right) from Jones and Grant 1996.

(a) Increase in peak discharge (height) and storm volume (black area); and earlier onset times for basin response;

(b) Increase in peak discharge from road areas in watersheds harvested;

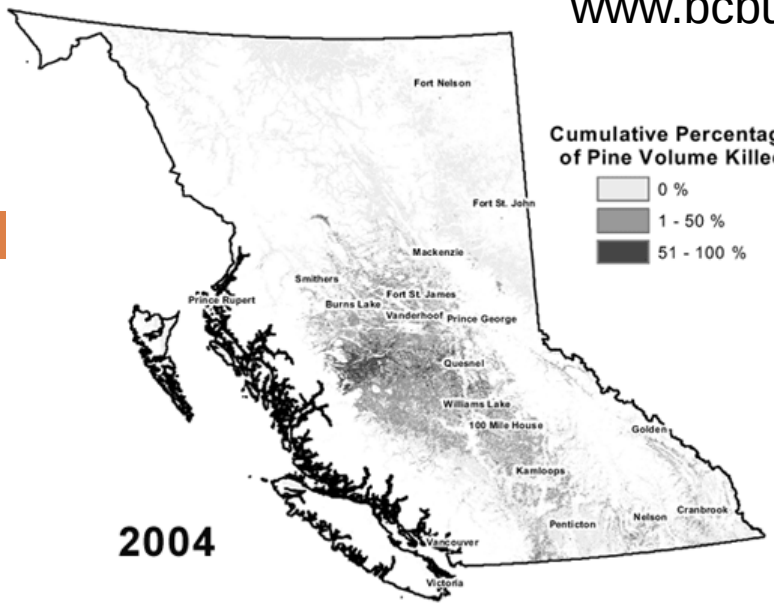
Water Management Issues Expected with Stand Mortality and Salvage Logging (relating to Mtn Pine Beetle Epidemic in BC)

- Hydrologic changes that can result from the MPB and salvage harvesting include:
  - increased peak flows and water yield,
  - increased surface erosion,
  - damage to forest road surfaces, cuts and fills, and drainage structures,
  - channel destabilization,
  - loss of fish habitat
  - increased landslide activity,
  - elevated water tables,
  - loss of soil and site productivity, and
  - loss of water quality.

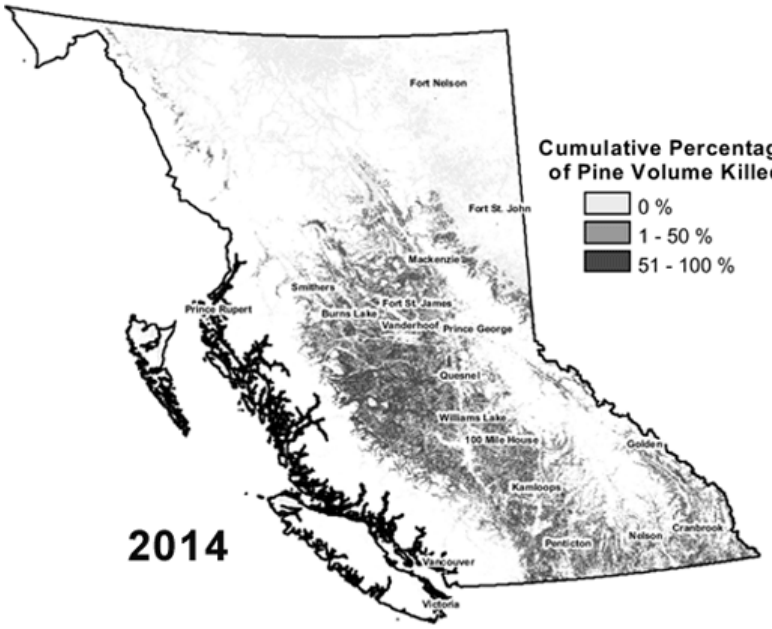
Source: BC Ministry of Forest, Lands and Natural Resource Operations
http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/stewardship/hydrology/

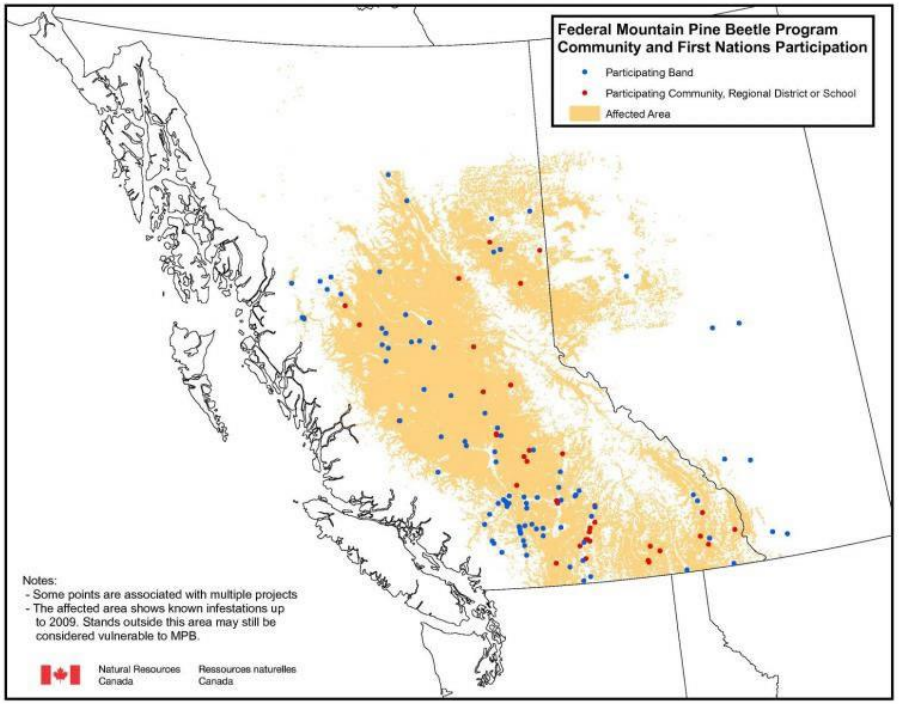
Map 1 — Mountain Pine Beetle Spread

www.bcbudget.gov.bc.ca



Map 2 — Mountain Pine Beetle Spread





http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/cfs/assets/file/1425

Envir'l Impacts (5): Forestry & Climate Change

- Forests a key part of the carbon cycle (recall disc in Chpt 4)
- Carbon liberated at harvest is either returned to roots (40-60%, an returned slowly to soil) or 'stored' as downstream forest products (paper, lumber, etc)
- Canada's managed forests were a 'net carbon sink' over the 1990 to 2009 period (see Figure 9.11), though some notable years when CO_2 emissions well exceeded removals;

Carbon Emissions/Removals from Canada's Managed Forests (in million tonnes CO_2 equivalent/yr)

Area disturbed (millions of hectares)

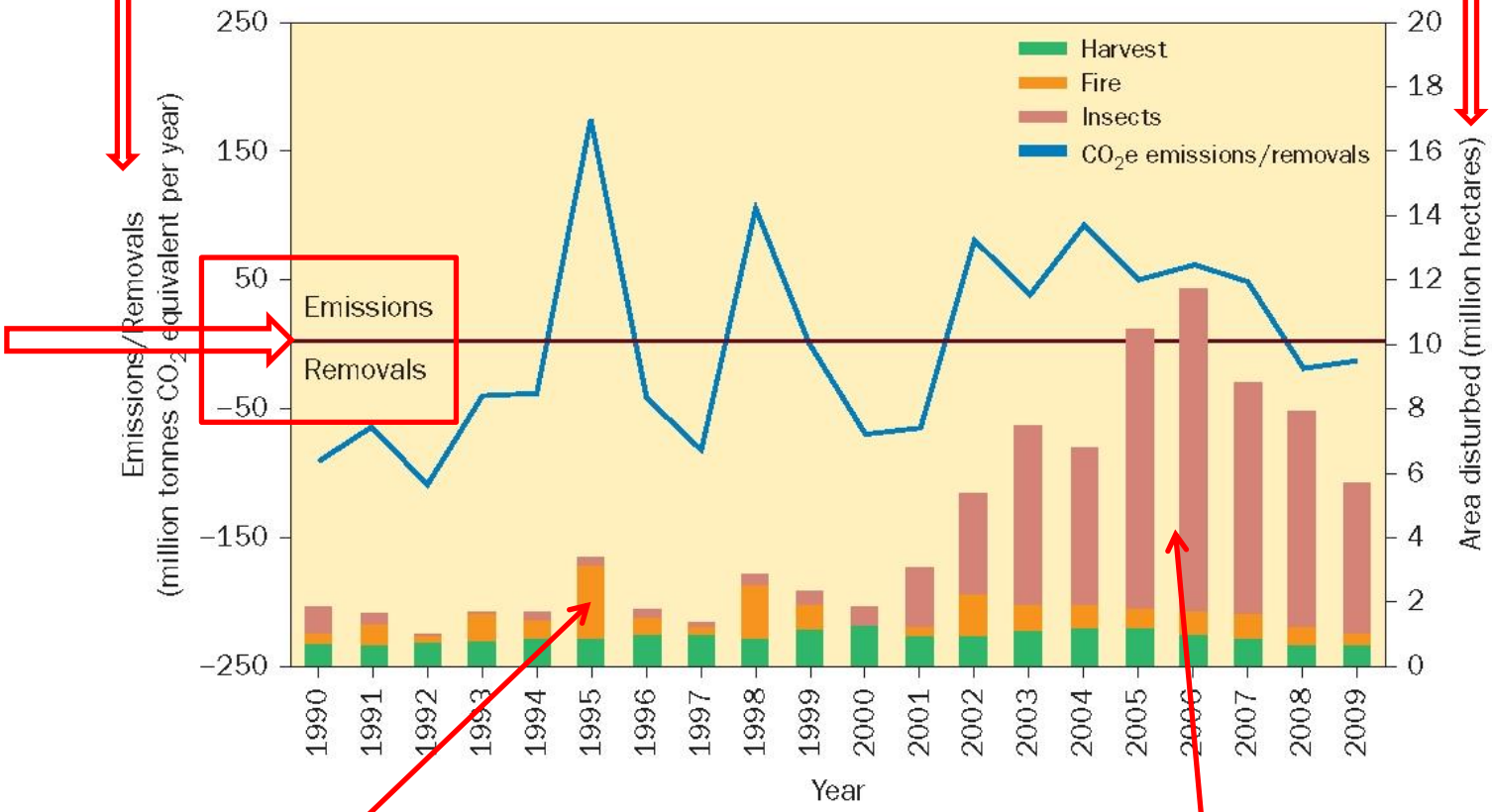


Figure 9.11 | Carbon emissions/removals in Canada's managed forests. *Source: Natural Resources Canada (2011: 29).*

High number of ha burned in **wildfires in 1995**

Mtn Pine Beetle kill – will affect carbon balance for decades

From: Dearden and Mitchell (2012)

Changing Climate effects on Forestry …

- Changing climate (e.g., changing precipitation and temperature patterns) - as discussed earlier in the term – have implications for timber supply

  (that is … the need to re-evaluate species Growth Rates and AAC)

- Carbon sequestration in timber management might become a major factor in how we manage our forests, and our embracing of a “New Forestry”

Summary of Impacts

Environmental

- Stream sedimentation – erosion, landslides
- Hydrological impacts - flooding
- Salmon habitats and those of other species
- Ecological value / Biodiversity (known and unknown) of old growth forests

Social

- Cultural value on old growth forests
- Conflicts of economic interests …
  - with First Nations traditional territories
  - With recreational values

Case Study: conflict between recreational and ecological value, value to First Nations and industrial development

Peel River Watershed(1)

Photo Credit:
National Geographic

Note (1): Thanks to S. Potter (1st year student) for bringing this issue to my attention.

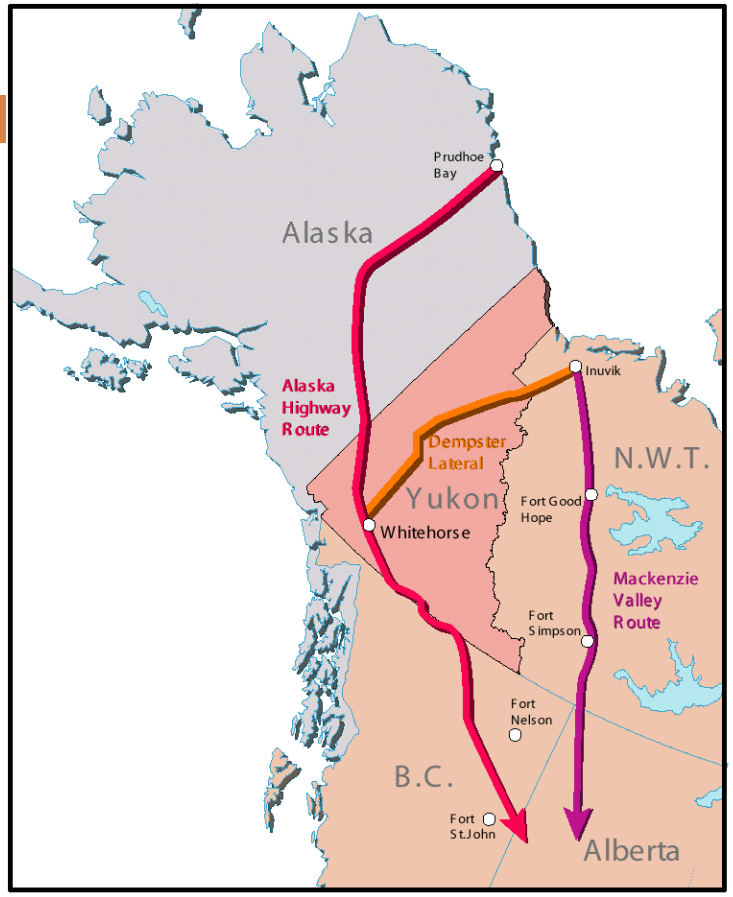
Peel River Watershed

Thomas Berger leads watershed lawsuit v. Yukon development plan

(~5 minute video clip)

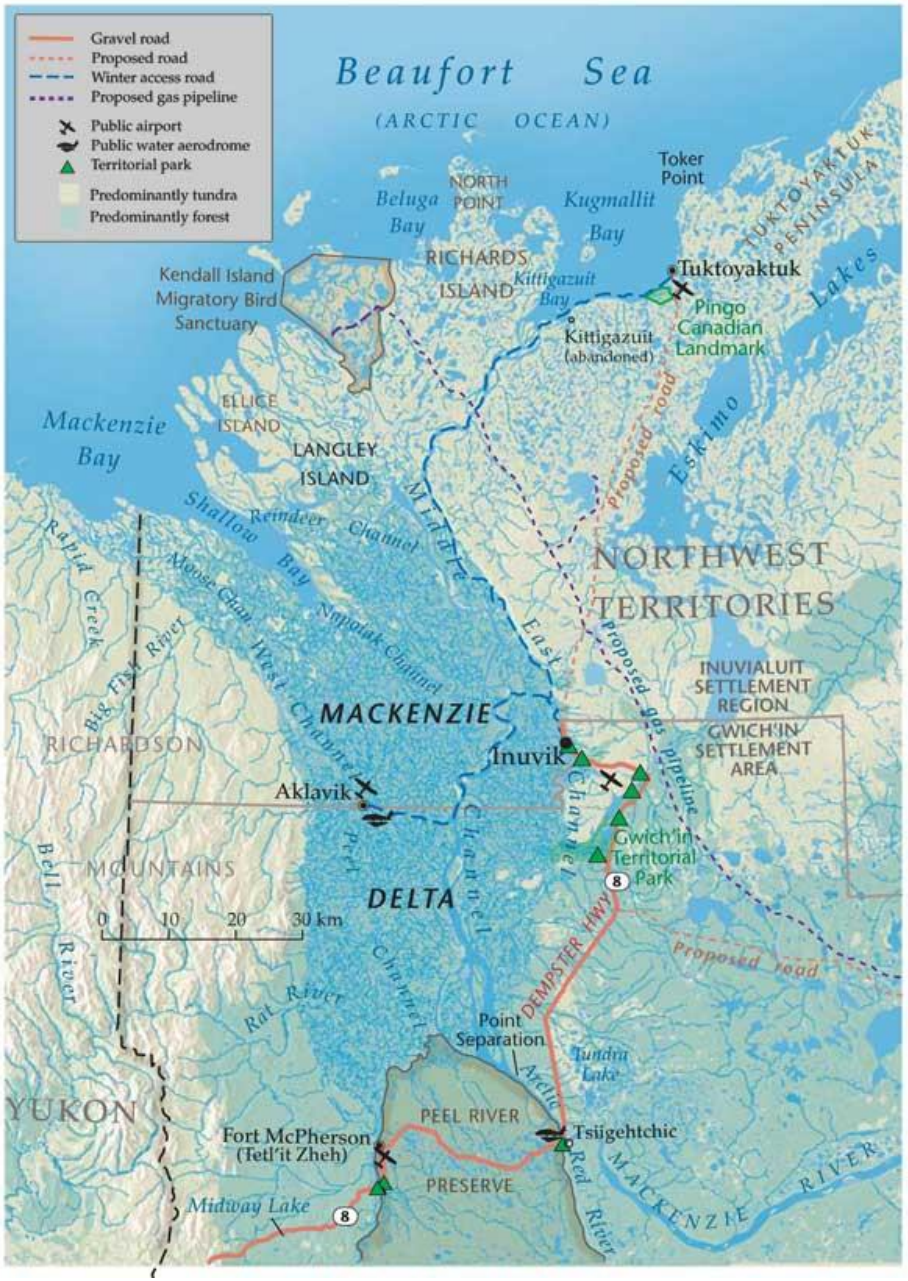
http://commonsensecanadian.ca/VIDEO-detail/thomas-berger-leads-watershed-lawsuit-yukon-development-plan/

- Significance of Thomas Berger?
- Justice *Berger* may be best known for his work as the Royal Commissioner of the *Mackenzie Valley Pipeline Inquiry* which released its findings in 1977



NORTHERN NATURAL GAS PIPELINE OPTIONS

http://www.colorado.edu/geography/blanken/GEOG%206181%20Fall%202003/ryen/berger.html



http://www.canadiangeographic.ca/magazine/so07/indepth/community.asp

Ghosts of Futures Past – Tom Berger in the North, Canada, 2004, 52 minutes, HD

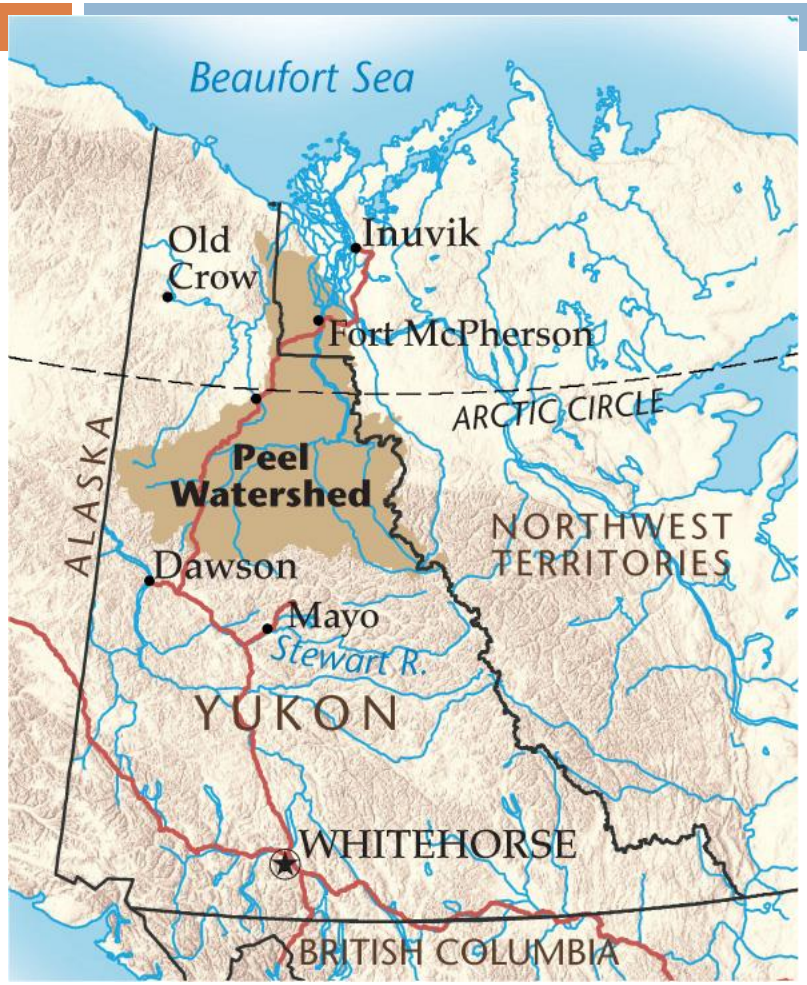
(Left to Right) Thomas Berger; Herb Norwegian Grand Chief of the Dehcho; David Suzuki

GHOSTS OF FUTURES PAST – TOM BERGER IN THE NORTH, CANADA, 2004, 52 minutes, HD

GHOSTS OF FUTURES PAST – TOM BERGER IN THE NORTH, CANADA, 2004, 52 minutes, HD
http://www.elanfilms.com/wp-content/uploads/2009/03/mackenzie-1811.jpg

http://www.youtube.com/watch?feature=player_embedded&v=H4_SSgOXNf4
(7 minute promotional clip)

Peel R. Watershed (NE Yukon)



http://www.canadiangeographic.ca/magazine/jun11/images/snakeriver_map1_lg.jpg

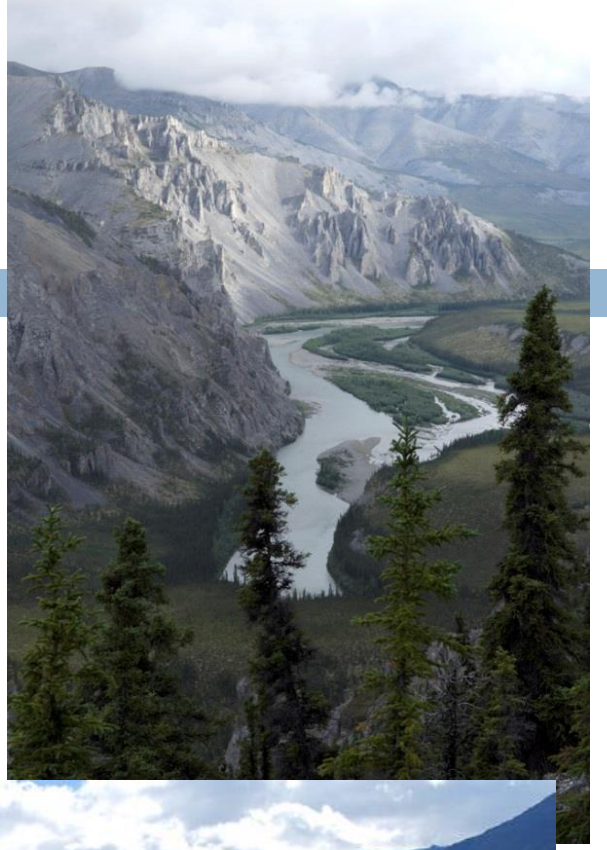
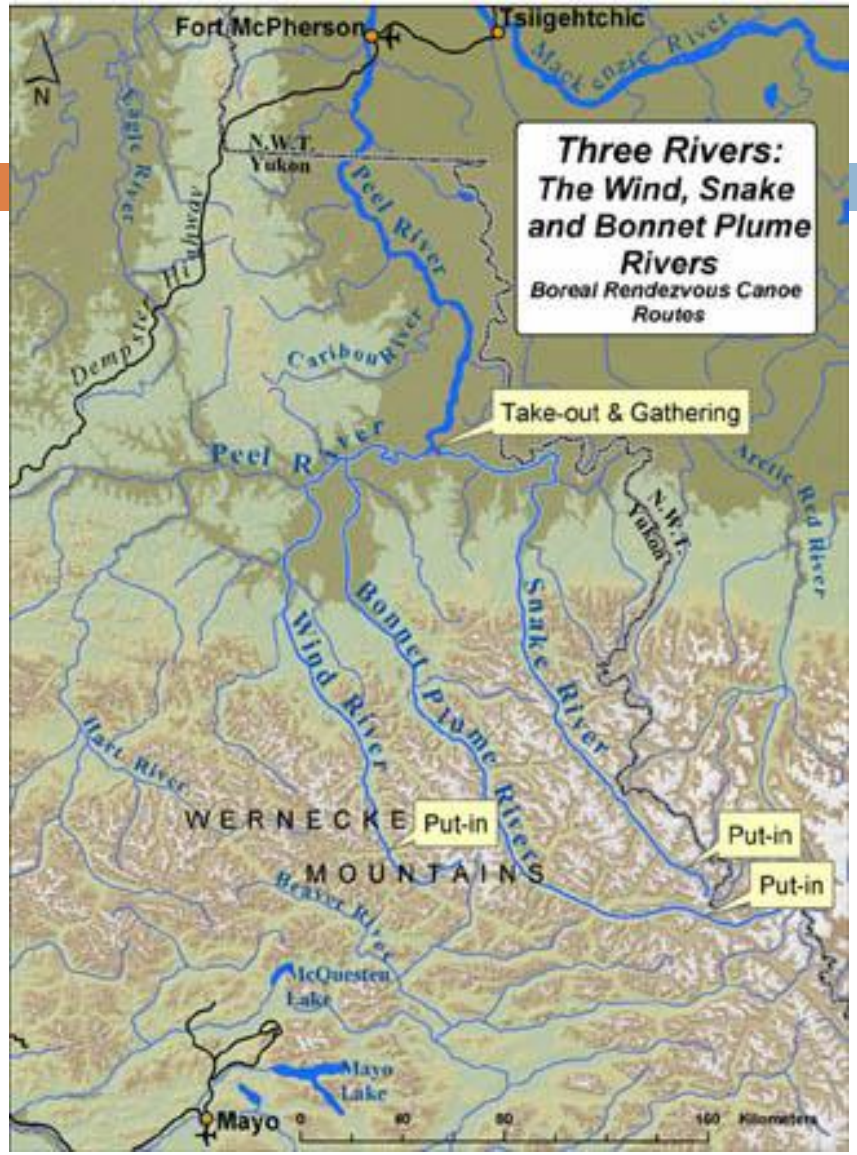


Photo credit:
Marten Berkman
Hart River

Photo credit:
Jill Pangam
Wind River



The Canadian Parks and Wilderness Society (CPAWS) lends support to Watershed Meeting in Mayo with Yukon First Nations and community elders for land use planning and protection of Peel River watershed. Its Three Rivers Campaign is set to launch a Canadian tour this April (2007), and hopes to bring further attention to this magnificent watershed and canoeing routes. The CPAWS website is an excellent resource, and provides extensive news and trip reports for the Wind, Snake, and Bonnet Plume Rivers.

http://northernwaterways.com/blog/?paged=8

Peel Commission

- Established by Yukon Territorial Government and First Nations in 2004;
- Consulted widely over a 7 year period
- In 2009, Peel Commission Recommendations:
  - 80% of watershed to be recommended to be protected
  - 20% for oil, gas, mineral development
- One of last remaining ecologically intact watersheds in N America, 7 times the size of Yellowstone National Park
- Significance:
  - People travel the world over to paddle these waters
  - Cultural significance

McPherson rallies to protect the Peel watershed

From: srj.ca - It was standing-room-only for the Yukon government's Peel River watershed land use plan meeting in Fort McPherson Feb. 12. (Photo: Mary Walden)

http://www.yukonwildrivers.ca/wp-content/uploads/Upper-Snake-R-canyon-JSP.jpg

Link to a petition that is being circulated to help protect it.
https://secure.avaaz.org/en/petition/Government_of_Yukon_Protect_the_Peel/?tDMnrab

Looking Ahead to the Mid-term Exam

Thursday, February 13th, 2014

- Type of Questions (multiple choice, map literacy question)
- Content (to be discussed on Thursday, February 6th)

Looking Ahead to the next lecture

Read ahead (Chpt. 10, 332-347, Agriculture)

“Current Agricultural Systems and their Impacts”

References

- Dearden, P and Mitchell, B. 2012. *Environmental Change and Challenge*, Fourth Edition, Don Mills, Ontario: Oxford University Press {Chapter 9: 'Forests'}
- Hicks, B.J., Beschta, R.L. and Harr, R.D. 1991. Long-term changes in streamflow following logging in western Oregon and associated fisheries implications. *Water Res. Bulletin*, **27** (2): 217-226.
- Jones, J.A. and Grant, G.E. 1996. Peak flow responses to clear-cutting and roads in small and large basins, western Cascades, Oregon. *Water Resources Research*, **32** (4): 959-974.

Hydrologic Change Expected with Stand Mortality and Salvage Logging (relating to Mtn Pine Beetle Epidemic in BC)

- A reduction in forest canopy can result in:
  - increased water reaching, stored in, and flowing from hill slopes,
  - earlier onset of spring snowmelt,
  - increased spring and total annual streamflow volumes,
  - changes in summer and fall flows, and
  - more rapid streamflow response to storms.
- The magnitude of hydrologic change will depend on:
  - the severity and time since attack,
  - presence, density and extent of understory vegetation,
  - the extent of salvage logging within stands and across a watershed,
  - the occurrence of fire,
  - the physical characteristics of the watershed, and
  - the weather.

Source: BC Ministry of Forest, Lands and Natural Resource Operations
http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/stewardship/hydrology/