TABLE 2. Suspended Sediment Yields in Unmanaged Small Catchments.

Basin Name	Location	Area (km^2)	Elevation Range (m)	Annual Precipitation	Geology	Dominant Land Forest Type	Period of Monitoring	Annual Sediment Yield ($t/km^2/year$)	References
Bambi Creek	SE Alaska	1.54	5-614	1,670	Silurian Greywacke, Argillite	Hemlock, Sitka Spruce old growth forest	1980-1982	20.0	Sidle and Campbell (1985)
Goat Creek	Pemberton, British Columbia	0.02	–	750	Metamorphic Rocks	n/a (forested)	n/a	1.0***	Slaymaker (1987)
Central Creek	Pemberton, British Columbia	2.4	–	750	Metamorphic Rocks	n/a (forested)	n/a	5.0***	Slaymaker (1987)
Jamieson Creek	North Vancouver British Columbia	3	–	1,200	Metamorphic Rocks	n/a (forested)	n/a	5.0***	Slaymaker (1987)
WS2 (HJ Andrews)	Coastal Oregon	0.6	525-1,065	2,300	Volcaniclastic Rock	Douglas-fir	1958-1988	18	Grant and Wolff (1991)
Needle Branch	Coastal Oregon	0.75	225*	2,540	Tyee Sandstone	Douglas-fir, alder	1959-1969	53	Beschta (1978); Brown and Krygier (1971)
Deer Creek	Coastal Oregon	3.04	254*	2,540	Tyee Sandstone	Douglas-fir, alder	1959-1969	97	Beschta (1978); Brown and Krygier (1971)
Flynn Creek	Coastal Oregon	2.02	300*	2,540	Tyee Sandstone	Douglas-fir, alder	1959-1969	102	Beschta (1978); Brown and Krygier (1971)
Rock Creek	Coastal Oregon	16.2	–	3,400	Basaltic lavas intruded aphanitic basalt	Douglas-fir old growth	n/a	28	Dietrich and Dunne (1978)
Lone Tree Creek	West California	1.74	300-1,500	865	Greywacke melange	Shortleaf pine forest	1972-1974	607	Lehre (1982)
Subbasin (Johnson Gulch)	Montana	0.68	1,050-2,291	680	Quartzite, Argillite	Douglas-fir, Western larch		0.056-0.102	Anderson and Potts (1987)**
Lexen Creek	Colorado	1.24	3,002-3,538	700	Glacial till, gneiss. schist	Lodgepole pine, Spruce-fir	1957-1966	2.5***	Leaf (1970)

*Average elevation.
**Undisturbed basins were selected from the studies.
***Include both suspended and bed load sediment.
n/a = not available.

TABLE 3. Summary of the Effect of Timber Harvesting and Riparian Management on Suspended Sediment Concentrations or Yields (post logging period).

Catchment	Study Location	Area (km^2)	Geology	Harvesting Treatment	Roads	Riparian Treatment	Response Variable	Post-Logging SS Yield ($t/km^2/yr$)	Treatment Effect	Recovery	Reference	Comments
Fool Creek	Fraser Experimental Forest, Colorado	2.89	Glacial till, gneiss, schist	40% of basin harvested in strip cuts; logs skidded by horses to spur roads	1.8 km/km^2; 5% of catchment area cleared	No harvest within 27 m of stream	Annual sediment yield measured at a settling pond	n/a	n/a	n/a	Leaf (1970)	No pre-impact data
Deadhorse Creek (North Fork)	Fraser Experimental Forest, Colorado	0.41	Glacial till, gneiss, schist	36% of basin harvested	3.1%	n/s	Annual sediment yield measured at a settling pond	n/a	No significant change in relation between SY and seasonal runoff		Troendle and Olsen (1993); Troendle and King (1987)	
Main Deadhorse Creek	Fraser Experimental Forest, Colorado	2.70	Glacial till gneiss, schist	10% of basin harvested	3.4%	n/s	Annual sediment yield measured at a settling pond	n/a	No significant change in relation between SY and seasonal runoff		Troendle and Olsen (1993); Troendle and King (1987)	
Baptiste Creek, B3	Stuart-Takla Fish-Forestry Interaction Project, Central Interior of B.C.	0.43	Ultra-basic intrusives mantled by glacial till	Clear-cut 55% of catchment area	0%	10-30 m buffer; all trees > 30 cm dbh harvested within 20 m from stream	Suspended sediment concentra-tion	n/a	No significant change		Macdonald *et al.* (2003)	
Baptiste Creek, B5	Stuart-Takla Fish-Forestry Interaction Project Central Interior of B.C.	1.50	Ultra-basic intrusives mantled by glacial till	Clear-cut 53% of catchment area	~1.4 km/km^2	10-30 m buffer; all trees > 15-20 cm dbh harvested within 20 m from stream	Suspended sediment concentra-tion	n/a	Increase in SSC > 100%, esp. following cuvert removal	Recovery to pre-harvest levels within 2-3 years	Macdonald *et al.* (2003)	
H.J. Andrews Watershed 1	Oregon Cascades	0.96	Altered volcani-clastics	100% clear-cut and broadcast burned; cable yarded	No roads	No buffer	Suspended sediment yield, computed from empirical relations with discharge	170	Suspended sediment yield higher after treatment	Suspended sediment yield appears to to have decreased, but not to pre-harvest levels	Grant and Wolff (1991)	Experiment confounded by landslides

TABLE 3. Summary of the Effect of Timber Harvesting and Riparian Management on Suspended Sediment Concentrations or Yields (post logging period) (cont'd.).

Catchment	Study Location	Area (km^2)	Geology	Harvesting Treatment	Roads	Riparian Treatment	Response Variable	Post-Logging SS Yield ($t/km^2/yr$)	Treatment Effect	Recovery	Reference	Comments
H.J. Andrews Watershed 3	Oregon Cascades	1.01	Altered volcani-clastics	25% patch cut and broadcast burned; cable yarded	2.6 km/km^2; 6% of catchment area	No buffer	Suspended sediment yield, computed from empirical relations with discharge	700	Suspended sediment yield higher after treatment	No basis to judge	Grand and Wolf (1991)	Experiment confounded by landslides and only one year of pre-impact data
Deer Creek	Oregon Coast Range	3.04	Sandstone	25% patch cut and 8% broadcast burned	4%	30 m riparian buffer along patch cut	Suspended sediment yield, computed from empirical relations with discharge	136	Significant increase up to 400%, for two post-treatment years	Recovery to pre-harvest levels within one or two years of mass movements	Brown and Krygier (1969); Beschta (1973)	Mass movement from roads elevated sediment yield seventh year after logging
Needle Branch	Oregon Coast Range	0.71	Sandstone	82% clear-cut and broadcast burned, 10% tractor yarded	5%	No buffer	Suspended sediment yield, computed from empirical relations with discharge	146	Significant increase up, to 1,000% for five post-treatment years	Recovery to pre-harvest levels in about six years	Brown and Krygier (1969); Beschta (1978)	
Subbasin ARF, North Fork Caspar Creek	Northern Coastal California	3.84	Sandstone and shale	46% clear-cut, 24% broadcast burned, 7% tractor yarded	1.8%	n/s	Storm-based-sediment yield	50.5	15% decrease in suspended sediment load		Lewis *et al.* (2001)	Main stem
Subbasin BAN, North Fork Caspar Creek	Northern Coastal California	0.10	Sandstone and shale	95% clear-cut, 13% tractor yarded	2.6%	n/s	Storm-based sediment yields	8.5	203% increase in load	No evidence of recovery over four-year post-harvest period	Lewis *et al.* (2001)	
Subbasin CAR, North Fork Caspar Creek	Northern Coastal California	0.26	Sandstone and shale	96% clear-cut, 9% tractor yarded	3%	n/s	Storm-based sediment yields	24.0	123% increase in load	No evidence of recovery over four-year post-harvest period	Lewis *et al.* (2001)	

TABLE 3. Summary of the Effect of Timber Harvesting and Riparian Management on Suspended Sediment Concentrations or Yields (post logging period) (cont'd.).

Catchment	Study Location	Area (km^2)	Geology	Harvesting Treatment	Roads	Riparian Treatment	Response Variable	Post-Logging SS Yield ($t/km^2/yr$)	Treatment Effect	Recovery	Reference	Comments
Subbasin DOL, North Fork Caspar Creek	Northern Coastal California	0.77	Sandstone and shale	36% clear-cut 6% tractor yarded, 34% broad-cast burned	2.5%	n/s	Storm-based sediment yields	113.0	269% increase in load	No evidence of recovery over four-year post-harvest period	Lewis *et al.* (2001)	
Subbasin EAG, North Fork Caspar Creek	Northern Coastal California	0.27	Sandstone and shale	100% clear-cut and 98% broadcast birmed; 15% tractor yarded	4.9%	n/s	Storm-based sediment yields	71.0	238% increase in load	No evidence of recovery over four-year post-harvest period	Lewis *et al.* (2001)	
Subbasin FLY, North Fork Caspar Creek	Northern Coastal California	2.17	Sandstone and shale	45% clear-cut, 30% broadcast burned; 8% tractor yarded	1.8%	n/s	Storm-based sediment yields	53.6	3% decrease in load		Lewis *et al.* (2001)	Main stem
Subbasin GIB, North Fork Caspar Creek	Northern Coastal California	0.20	Sandstone and shale	100% clear-cut, 98% broadcast burned; 39% tractor yarded	4.2%	n/s	Storm-based sediment yields	35.8	200% increase in load	No evidence of recovery over four-year post-harvest period	Lewis *et al.* (2001)	
Subbasin JOH, North Fork Caspar Creek	Northern Coastal California	0.55	Sandstone and shale	30% clear-cut, 0% broadcast burned; 1% tractor yarded	2.0%	n/s	Storm-based sediment yields	66.7	23% decrease in load		Lewis *et al.* (2001)	Main stem
Subbasin KJE, North Fork Caspar Creek	Northern Coastal California	0.15	Sandstone and shale	97% clear-cut, 0% broadcast burned; 4% tractor yarded	7%	n/s	Storm-based sediment yields	82.1	40% decrease in load		Lewis *et al.* (2001)	

TABLE 3. Summary of the Effect of Timber Harvesting and Riparian Management on Suspended Sediment Concentrations or Yields (post logging period) (cont'd.).

Catchment	Study Location	Area (km^2)	Geology	Harvesting Treatment	Roads	Riparian Treatment	Response Variable	Post-Logging SS Yield ($t/km^2/yr$)	Treatment Effect	Recovery	Reference	Comments
Subbasin LAN, North Fork Caspar Creek	Northern Coastal California	1.56	Sandstone and shale	32% clear-cut, 20% broadcast burned; 2% tractor yarded	1%	n/s	Storm-based sediment yields	42.0	5% increase in load	No evidence of recovery over four-year post-harvest period	Lewis *et al.* (2001)	
Subbasin NFC, North Fork Caspar Creek	Northern Coastal California	4.73	Sandstone and shale	13% clear-cut, 20% broadcast burned; 8% tractor yarded	2%	n/s	Storm-based sediment yields	46.5	89% increase in load	No evidence of recovery over four-year post-harvest period	Lewis *et al.* (2001)	

n/s = Not specified.
n/a = Not available.

following harvesting reduces the internal cohesion of the soil mass, typically 3 to 15 years after logging (Ziemer, 1981; Sidle *et al.,* 1985), leading to increased probabilities of landslides.

Soil disturbance and sediment delivery to streams are commonly associated with construction of roads and landings, slash burning, and log skidding (Reid and Dunne, 1984; Christie and Fletcher, 1999; Jordan, 2001; Kreutzwiser *et al.,* 2001). The hydrologic and geomorphic effects of forest roads in particular have been the focus of many studies, given their demonstrated potential for negative impacts (Luce and Wemple, 2001). The use of tracked machinery such as hoe-forwarders may also cause soil disturbance, particularly if operated during periods of high soil moisture. Off-road vehicle use (motorcycle and snowmobile) can also generate significant surface erosion (Heede and King, 1990).

Road cut slopes and road fill can yield significant amounts of fine sediment by dry ravel, rain splash, frost, and mass erosion, particularly in the first year after road construction, as was demonstrated in Idaho (Megahan *et al.,* 2001). Most road generated sediment can originate from a relatively small fraction of the road network if there are major variations in the erosion potential of the road surfaces and cut slope (Wemple *et al.,* 1996; Henderson and Toews, 2001; Megahan *et al.,* 2001). Erosion from road surfaces appears to vary greatly depending on site specific factors such as the nature of fill materials, slope, drainage, age, usage, and maintenance. For example, Reid and Dunne (1984) found that heavily used roads generated 130 times more sediment (2,000 t/ha/year) than abandoned roads. Jordan (2001) found that the first storm that occurred following grading of road surfaces generated a significant increase in stream turbidity. On the other hand, Luce and Black (1999) found that sediment production from graded road plots was not significantly greater than from ungraded plots but that plots subjected to ditch cleaning had seven to eight times greater sediment production than graded or ungraded plots. Post-logging road treatment and removal can reduce the longer-term probability of sediment supply from road surface erosion and landside activity (Madej, 2001), although it can increase sediment delivery for one or more years following treatment (Macdonald *et al.,* 2003; Switalski *et al.,* 2004).

The significance of sediment sources for stream water quality will depend on whether they are connected to the stream by a channel, gully, or overland flow. If sources are not connected, sediment could be deposited on the soil surface before reaching a stream channel. Wemple *et al.* (1996) found that 57 percent of the road network was hydrologically connected to the stream network in the Western Cascades, Oregon.