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March 23, 2000

Ed McWaters
J.S. Jones Timber Ltd.
Boston Bar Division
Box 265, Boston Bar, BC
V0K 1C0

Re: Nicoamen River Watershed, Hydrologic Review

Dear Ed McWaters,

Integrated Woods Services Ltd. is please to submit a copy of the 'Nicoamen River Watershed, Hydrologic Review.'

Three changes have been made to the initial version. The changes are as follows:

1. Page 7, Paragraph 4- The ECA index numbers for the South Sub-basin have been replaced with the ECA percent to be consistent with Table 2 and the text.
2. Page 8, Sentence 1- The acronym 'FDP' has been replaced with 'proposed development in JS Jones' and Lytton Lumber's 1999-2003 Forest Development Plans' for clarification.
3. Appendix C- The map now shows the locations of proposed development that were assessed.

As well two copies have been delivered to Ken Waite at the Lillooet Forest District. One copy is for the Ministry of Forests and the other copy is for the Ministry of Environment Lands and Parks.

Yours truly,
INTEGRATED Woods Services Ltd.

S. Henderson

per Stephen Henderson

cc Ken Waite Lillooet Forest District – Lillooet, BC
Donna Romaine Lillooet Ministry of Environment, Lands and Parks – Lillooet, BC

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August 26, 1999a

FINAL REPORT

Ed McWaters
J.S. Jones Timber Ltd. Boston Bar Division
Box 265, Boston Bar, BC
V0K 1C0

Re: Nicoamen River Watershed, Hydrologic Review

Dear Ed McWaters,

Integrated Woods Services Ltd. was contracted by J.S. Jones Timber Ltd. Boston Bar Division, to complete a comprehensive hydrologic review of the Nicoamen River Watershed and proposed harvesting within this drainage. The following is a summary of the assessment.

This project was funded by J.S. Jones Timber Ltd. Boston Bar Division.

Objectives

The objectives of the review were to: 1) field assess the current stream channel conditions, 2) assess the sensitivity of the stream channels to impacts from land-use activities, 3) determine the hydrologic impacts of logging, and ultimately 4) provide recommendations regarding future forestry development within these watersheds.

Methodology

The methods utilized were based on the Watershed Assessment Procedure, (BC Government,1999). The procedure included office based assessment, ground based field assessment and a helicopter overflight of the watershed. Components of the assessment included a review of road conditions, sediment sources, mass wasting events, riparian conditions, a Geographic Information System's exercise and a channel assessment.

Watershed Characteristics

Nicoamen River, with a drainage area of 149 km^2, is a tributary to the Thompson River near Lytton. Elevations within the catchment basin range between 200 m and 2040 m, which represents a relief of 1840 m. The H^{60} line is at 1220 metres (m). The river generally flows northward through mountainous terrain of moderate slopes.

Melting snow is the main source of streamflow with supplementary contribution from rainstorms. Based on streamflow data from a nearby Lytton Creek Watershed, the mean annual precipitation for the watershed should be 440 millimetres or greater (station #1114741, 37 years

of data). The annual peak flows are generally governed by snowmelt regime with a lesser degree of influence by rainstorms. The peak months of precipitation are November, December and January.

Stakeholders

As part of the assessment the Ministry of Environment Lands and Parks, Ministry of Forests, Department of Fisheries and Oceans, Nicoamen Band, Lytton Lumber Ltd. and JS Jones Timber Ltd. were contacted to identify issues, values and concerns relating to channel stability, water quality, and proposed development within the watershed. Individual consultation and a July 23rd conference call with stakeholders were conducted. The Department of Fisheries and Oceans (DFO) identified the major concern as the important fish habitat in the lower section of mainstem Nicoamen River. This was based on the knowledge that juvenile salmonids (i.e. pre-smolt and smolt stage salmon) are known to seek refuge in tributaries similar to the Nicoamen River when large rivers such as the Thompson are undergoing periods of high and/or turbid flows. The 100 m of Nicoamen River directly upstream of the Thompson River confluence appear to be most suitable for use as "refuge" habitat for juvenile salmonids (refer to photograph 1). Above this 100 m stream section the stream gradient increases (refer to photograph 2) and another 360 m upstream a bedrock confined stream section prevents upstream fish movement. A series of impassable waterfalls exist within this stream section (refer to photograph 3). The apparent absence of fish throughout the remainder of the watershed suggests that fisheries values upstream of the waterfall are very low.

The Nicoamen Band is the only water licensee in the watershed with 2 domestic and 2 irrigation licenses. They do not take domestic water directly out of the creek as they are using a well system. They 2 irrigation license's are in reach 4 for two agricultural fields. The fields did not appear to be irrigated in 1999.

Road Conditions

The majority of the road network (135.923 km or 90.7%) in the Nicoamen River Watershed was assessed as low risk. The length of road considered moderate and high risk is 13.222 (8.8%) and 0.702 km (0.5%) respectively (Table 1). The location of the moderate and high risk roads is in the upper elevations, primarily within the Nicoamen Creek sub-basin and South sub-basin. Table 1 displays the length of moderate and high risk road associated with each tributary.

There were three high risk priority sites identified within the watershed (refer to map) during the July field assessments. Since this time JS Jones Timber Ltd has completed mitigation activities at all of these sites. Priority Site 1 was a landing in the South sub-basin with unstable fill slopes near a creek. Priority Site 2 was also related to unstable fill slopes at a stream crossing upstream from Priority Site 1. Priority Site 3 consisted of an unstable cutslope associated with a historic slide, and an unstable fillslope directly above the Nicoamen River in the Nicoamen Creek sub-basin. Generally, the moderate risk road sections are associated with water management rather than hillslope instability.

Road deactivation including the installation of cross ditches and pullback of unstable fillslopes will facilitate the restoration of these sites.

TABLE 1: Road Sediment Source Survey Summary

Catchment Area	Moderate Risk Road (km)	High Risk Road (km)
East Tributary	Nil	Nil
Lower Mainstem (Residual)	Nil	Nil
South Tributary	6.154	0.452
Upper Mainstem (Nicoamen)	6.414	0.250
West Tributary	0.654	Nil
TOTAL	**13.222**	**0.702**

Although the majority of the roads are low risk, the cumulative effect of the high road densities increases the watershed-wide sedimentation hazard. The closure and revegetation of low-use roads should minimize the generation of sediment, and subsequent delivery into streams.

In addition to these priority sites, there are twelve sites with poorly functioning or improperly installed cross drains (refer to map in Appendix C). These sites should have the culverts removed or backed up with cross ditches or fords. The South and Nicoamen Creek sub-basins have one site each where major stream crossings are inadequately protected from washouts. Both sites require the construction of small fords or swales to properly protect the existing culverts. One crossing of the mainstem in the South Sub-basin consists of a 1400mm x 10m culvert. This culvert is susceptible to debris accumulations and should be armoured with large rip-rap or replaced with a ford.

Sediment Sources and Mass Wasting

Forest roads within the Nicoamen watershed have undoubtedly increased sediment production. However there is little evidence of this having had a significant impact on channel morphology except in reach 1 of the mainstem. In the lower 220m of reaches one and 2 there are roads parallel to both sides of the creek that have non-cohesive and raveling fill slopes. The fill materials were identified as directly entering the creek in several areas and have resulted in some pool infilling.

Throughout the rest of the watershed the steep streams, with powerful flow regimes and continuous sediment transport zones can flush much of the smaller textured sediments (silt through gravel) out of the system (long profile in Appendix A). Sediment aggradation was rarely observed during field assessment. While overall road density within the entire watershed is relatively low (0.866 km/km^2), selected areas have quite high road densities (i.e. the south sub-basin).

Valley walls along the lower mainstem constitute a significant natural sediment source. These valley walls are often sparsely vegetated as a result of semi-arid climatic conditions. They generally contribute sand to gravel textured sediments to the drainage network by way of sheet and rill erosion or dry ravelling.

Nineteen mass wasting events were identified within the watershed. Eleven of these are likely related to past development and are coupled directly to the stream channel. Significant levels of stream channel disturbance were not observed in relation to the majority of these sideslope failures. The majority of material introduced into the drainage network consisted of easily entrained and transported sands, and gravels.

Riparian conditions

The riparian conditions are very good, except in the upper watershed where many tributary creeks were harvested to the stream banks. The lower third (~7 km) of the watershed has an untouched riparian buffer except in two places where some encroachment of development has occurred. The first place is the bottom 260 m of the river where road construction parallels the creek and the second is 2.0 kms upstream of the Thompson River adjacent to the cleared fields where some minor riparian clearing has occurred.

Historically, 95 kilometres (25%) of riparian forest has been harvested within the Nicoamen Watershed. The majority of streamside harvesting adjacent to the main channels in the watershed was completed prior to the 1990's. Deciduous regeneration along a substantial portion of these stream channels is now dense and often in excess of 3 metres in height. This successional riparian vegetation is providing a measure of both bank stability and stream channel shading (refer to photographs 5 and 6). The shading element of this riparian regrowth should help to alleviate possible stream temperature increases. The most apparent effect of historical riparian logging on stream channel morphology has been significant reductions in large woody debris recruitment. This deficiency was observed in the south sub-basin (reach 3) where pre-code logging was conducted without riparian buffers. An increase in sediment transport has likely resulted from this loss of channel structure. However, the Nicoamen drainage is generally quite insensitive to this degree of sediment mobilization and channel stability has not been compromised.

Equivalent Clearcut Area

Several Unweighted Equivalent Clearcut Area (ECA) calculations were conducted to determine the historical (1990), current (1999) and proposed (2003) levels of harvesting (Table 2).

TABLE 2: ECA calculations

Sub-basin	Historical ECA (% in 1990)	Current ECA (% in 1999)	Projected ECA (% in 2003)
East	2.4	2.4	2.3
Residual	2.1	9.6	10.5
South	15.6	34.1	34.9
Nicoamen Creek	35.0	19.4	18.2
West	33.8	28.9	27.2
TOTAL	**19.9**	**20.9**	**20.7**

A historical ECA calculation was conducted to determine what the ECA would have been in 1990. Through GIS analysis, any forest cover openings with dates more recent than 1990 were eliminated and tree heights were reduced by subtracting 25 centimetres for each years growth. The ECA for the total watershed in 1990 was calculated at 19.9%.

The 1999 ECA for the Nicoamen Watershed is 20.9%. Channel sensitivity to increases in peak flows is generally LOW within the watershed, and the current watershed wide ECA is not altering channel morphology significantly.

ECA is projected to undergo a slight decrease (0.2%) by the year 2003. The projected ECA includes 290 hectares of proposed harvesting by JS Jones Timber Ltd. and Lytton Lumber that is identified on the forest development plans (refer to Table 3). The ECA will decrease from its' current level of 20.9% to 20.7% despite of proposed harvesting, due to hydrologic recovery rates (derived from tree growth) exceeding the rate of timber harvest. Plantations generally appeared to be healthy with good stocking densities.

Channel Assessment

Field assessments established several conditions relevent to stream channel morphology. They are the following:

- Stream channels generally exhibit undisturbed to slightly disturbed characteristics.
- Hydrologic regimes and the physical composition of the drainage network combine to generate powerful peak flows.
- Stream channel morphology is generally insensitive to increases in peak flows, and fine textured sedimentation.
- Depositional zones where fine textured sediments can settle out of suspension are very limited. This fact may have implications for fisheries interests within the fish bearing reaches of the lower mainstem.
- The lower 100m of the mainstem (reach 1) undergoes annual rejuvenation. This is initiated by an increase in the gradient of reach 1 after the Thompson drops. Thus resulting in the Nicoamen River downcutting into the Thompson's sediment deposit.

TABLE 3: Proposed harvesting identified on the Forest Development Plans

CP	Blk	Block Area	Proposed ECA of Block (ha)	Sub-basin	Below H60	Aspect	Licensee	Silviculture System
O	-	67.7	27.08	Residual	Even	WNW	Lytton Lumber	partial 60% ba
20	N	43.34	43.34	Upper	No	E-W	JS Jones	Clearcut (cc)
22	N	28.53	28.53	South	No	NE-SE	JS Jones	Cc
N	92	45.29	45.29	South	No	NW	JS Jones	Cc
	26N	25.68	25.68	South	No	East	JS Jones	Cc
28	N	17.34	17.34	South	Yes	East	JS Jones	cc
47	N	32.02	32.02	South	Yes	NW	JS Jones	cc
54	N	22.36	22.36	South	Yes	West	JS Jones	cc
55	N	21.57	21.57	South-Res	Yes	North	JS Jones	cc
57	N	18.04	18.04	West	Yes	SE	JS Jones	cc
58	N	8.93	8.93	West	Yes	NE	JS Jones	cc
	Total	**330.8**	**290.18**	**Hectares**				

Reaches 2, and 3 within the South sub-basin are lacking adequate amounts of functioning large woody debris where pre-code logging did not provide for riparian buffers. Regulations in the 1970's and 1980's (when a majority of the harvesting occurred) may have required the loggers to remove woody debris from stream channels. This practice often resulted in stream channels with much less woody debris presence than seen in non-manipulated systems. Fisheries values are generally low within this sub-basin where creeks are lacking large woody debris. As a result the loss of channel diversity has had less significance from a fisheries standpoint. Logged riparian buffers generally have deciduous regeneration greater than 3m in height. Coniferous (and possibly deciduous) vegetation will not likely provide sufficient large woody debris recruits for 80-180 years, however existing successional riparian vegetation will provide shade and potentially alleviate concerns of increased stream temperatures.

Streambank erosion was observed within areas of both undisturbed and harvested riparian vegetation. This condition attests to powerful flow characteristics within the Nicoamen drainage. Streambanks in reach 5 of the mainstem, upstream of the high value fish habitat, were identified as not disturbed during field assessment after the spring freshet. They are generally cobble dominated banks with a gravel component and heavily covered in moss (refer to photograph 4). In the lower 330m stream section of reaches 1 and 2 of the mainstem the banks are dominated by non-cohesive cobble, boulder, gravels and sands that are susceptible to erosion. Contributing to their erodability is the lack of riparian vegetation that is influenced by climatic conditions and highway and railway development. Despite the stream bank conditions in reach 1 and 2 the

creek is generally able to maintain natural diversity of habitat (cascades with deep pools). However this diversity was identified as decreasing downstream of the three bridges in the lower 200m stream section.

Throughout the remainder of the watershed the observed bank erosion was most often minor and both riparian root structure and generally coarse cobble and boulder banks serve to render most bank erosion insignificant in terms of channel destabilization (disturbance).

Potential to Impact the High Value Fish Habitat

There is a LOW likelihood that proposed development plans will adversely affect the physical structure of fish habitat in reaches 1, 2, and 3 of mainstem Nicoamen River. However, the construction of roads and stream crossings in higher elevations has the potential to increase sediment production and consequently increase turbidity levels within these reaches. Mainstem reaches 1, 2, and 3 of the Nicoamen River are considered important to anadromous salmonids by the Department of Fisheries and Oceans (Adrian Wall, pers. Com., 1999). A primary concern is that juvenile salmonids utilizing these lower reaches are not deprived of critical refuge habitat. An essential component of this "refuge" habitat is low levels of turbidity where these fish are able to access clear water, feed and *clean* their gills during Thompson River high flow and high turbidity periods. While fine textured sediments are not currently having significant impacts on channel stability within the watershed, they may have significance from a fisheries perspective. Non-cohesive, ravelling road fill slopes in reaches 1, and 2 (of mainstem Nicoamen River) are sediment sources that directly enter the channel and may be effecting habitat within this area.

FDP Location of Proposed Harvesting

Proposed blocks are located both above and below the H^{60} line between 920 to 1800 metres in elevation. Proposed cutblock aspects vary widely (refer to Table 3). Proposed development is also divided amongst all sub-basins with the exception of the East sub-basin. All sub-basins except the South and Residual sub-basin are projected to undergo a marginal decrease in ECA as a result of the distribution of proposed cutblocks. The South sub-basin tributary is expected to increase in ECA from 34.1% to 34.9% by 2003. An additional 9 kilometres of road will be constructed, with 14 new road-stream crossings within the watershed. All road-stream crossings are proposed on first order or ephemeral creeks.

Forest Development Plan (FDP) Concerns

The proposed FDP possesses a low likelihood of initiating significant channel change, however development plans are likely to generate some degree of fine textured sediment production. While this is not a concern from a fluvial geomorphic standpoint, this may have implications for salmonids utilizing reaches 1, 2, and 3 within the Nicoamen River mainstem. Road construction techniques and regulations within the B.C. Forest Practices Code will minimize sediment generation and reduce the potential impact to the fisheries resource.

Conclusions and Recommendations

There is a low likelihood that the proposed development in JS Jones' and Lytton Lumber's 1999-2003 Forest Development Plans will impact the river or the high value fish habitat in reach 1 providing drainage structures, sediment sources and riparian buffers are managed prudently.

Recommendations for prudent management include the following:

1. Monitor the mitigation activities completed at the 3 high priority road sites
2. Review the 12 sites with drainage structure concerns. Mitigation activities at these sites should be completed prior to or concurrent any the proposed upslope harvesting.
3. Riparian buffers in blocks 54N, 55N, and 57N must have a minimum 10m slope distance reserve zone width and a 30 m management zone width as described on page 50 in the Forest Practices Code, Riparian Management Area Guidebook (Best Management Practices for management zones adjacent to S4 streams – interior). These blocks are located on higher order creeks (greater than second order) and within the lower third of the watershed where the existence of the relatively untouched conifer/deciduous riparian buffer assists the creek in maintaining low disturbance levels downstream. The maintenance of these buffers is considered critical to maintain the integrity of the watershed if harvesting is proposed upstream.
4. The proposed logging in the remainder of the watershed conducted in accordance with Riparian Management Area Guidebook should not have any significant effect on channel morphology. At the same time, any harvesting will have less risk of impact to the creek if any future large woody debris recruits are left standing within 5 m of the creeks.

The low likelihood of impacts to the river or the high value fish habitat is based on: 1) the relative lack of concerns identified with past forest road construction, 2) an intact riparian buffer in the lower third of the watershed, 3) the spatial distribution of existing and proposed harvesting throughout the watershed, 4) a decrease in the overall watershed's ECA, and 4) low channel disturbance levels associated with past forestry development.

Please call if you have any concerns.

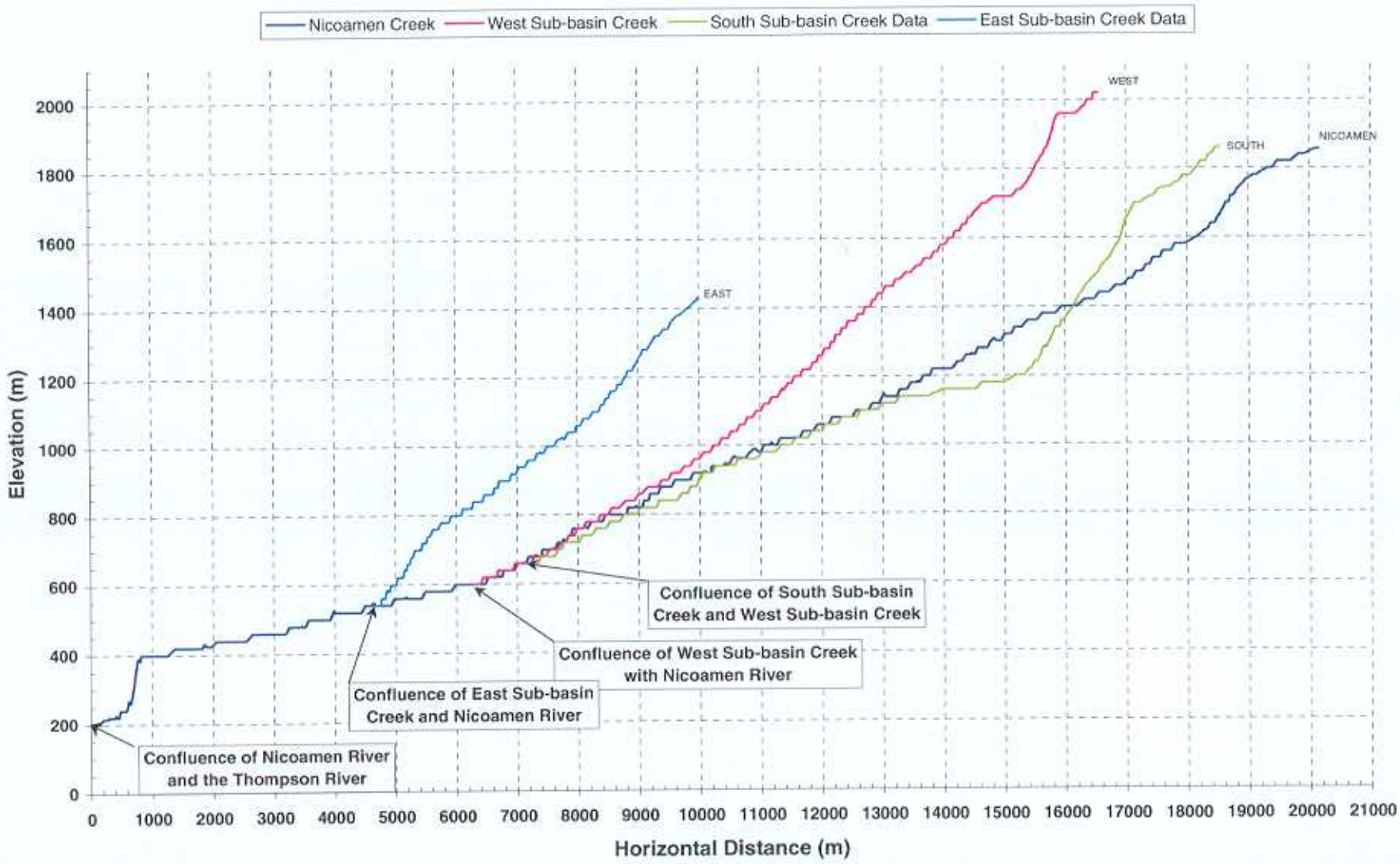
Yours truly,
INTEGRATED Woods Services Ltd.

per Stephen Henderson, RPF
Forester and Hydrologist

APPENDIX A

Long Profile of Nicoamen River and Major Tributaries

Nicoamen River and Tributaries Long Profile Chart



APPENDIX B

Photographs

Photograph 1: Reach 1 of the Nicoamen River backed up by the Thompson River during the July 1999 Flood.

Photograph 2: Reach 3 of the Nicoamen River, cascades and deep pools with stable banks.

Photograph 3: Nicoamen River waterfall in Reach 4

Photograph 4: Stable banks in Reach 5 of the Nicoamen River.

Photograph 5: Revegetating riparian buffers in the South Sub-basin, reach 3.

Photograph 6: Harvesting in the Nicoamen River watershed completed in the late 1980's.