CWAP Summaries and Recommendations

This Appendix includes summaries of recommendations and strategies for each completed Coastal Watershed Assessment Procedure (CWAP). Weyerhaeuser's strategies to implement the recommendations are in italics and are from current Forest Development Plans.

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1.0 Little Qualicum CWS (Cameron)

The CWAP was completed in April, 2001. The Little Qualicum watershed is a designated CWS. The Water Purveyor is the Little Qualicum Waterworks District. Other water licensees within the watershed include Canada Department of Fisheries and Oceans (DFO) on Cameron Lake. The Little Qualicum Watershed has a total area of 237km^2. The Cameron Watershed area is 158km^2, or 67% of the Little Qualicum drainage area.

This basin was severely impacted by the logging methods of the 1960s and 70s, but since that time, recovery is taking place. Erosion and sediment movement stemming from the high road density, high density of stream crossings, and old road construction standards remain a management concern, as do the alluvial reaches of the Cameron River where channel bank erosion has not yet stabilized.

The Cameron River basin has a large road network with a legacy of old road construction standards, including old bridges and culverts, as well as numerous tracks and trails. The active roads, especially mainlines, are of particular concern because these roads have the greatest potential to generate sediment.

1.1 Watershed Management

Objective

Ensure the continuing recovery of the Cameron River channel and its tributaries. Of specific concern are erosion of logged channel banks and sediment delivery to the channels. Channel bank erosion could be aggravated by increases in peak flows.

Roads are the main source of sediment to the channels. Strategies manage roads and control erosion in this basin so as to minimize sediment input to the Cameron River channel.

Strategies

CWAP Recommendations	Weyerhaeuser Strategies / Response
<u>Existing Roads</u> A workplan should be prepared to continue addressing stability and erosion concerns on the existing roads as indicated in the 1998 CWAP. Specifically: 1. Where existing roads on steep slopes will be reactivated for harvesting (such as the roads in Sub-basin 1), the stability of the existing roads should be assessed and remedial measures for these roads undertaken as part	*1. Stability of the existing roads will be assessed and remedial measures for these roads undertaken as part of road development for the FDP cutblocks.* *2. Further deactivation of CE10 and C200 is planned for 2001. Yellow Creek Main is being maintained to provide access to cutblocks 1776 and 272117. A portion of YC100 was permanently deactivated in 2000. Cameron Main maintenance upgrades will be undertaken during the term of this FDP. It was assessed in 2000 for works required.* *3. The Mount Arrowsmith road will be assessed in 2001*

CWAP Recommendations	Weyerhaeuser Strategies / Response
of road development for the FDP cutblocks. 2. Continue with deactivation of the CE10 and C200 roads in Sub-basin 2, deactivation of Yellow Creek Road, and maintenance upgrading of Cameron Main between Yellow Creek and Cop Creek. 3. Review drainage measures and erosion control on the Mount Arrowsmith ski road. 4. Assess the road network in Sub-basin 3 (Cop Creek). In particular, the Henry Creek crossing has long steep fills that extend to the channel, and a crib at the bridge approach that is eroding. Carry out remedial work on existing roads in conjunction with the proposed development in the basin. 5. Prioritize and assess the rest of the road network on steep slopes, especially the stream crossings. (Example: midslope roads on the gullied slope above Reach 7.)	*for drainage and erosion control measures. A workplan will be developed to address any issues identified.* *4. The Henry Creek crossing on spur road Cop100 is planned for replacement in 2001 as part of the road upgrade plan to access cutblocks 1777, 1785, 174412, 174414, and 2727. This plan will address problems with the roads in the Cop Creek basin.* *5. A general overview assessment of the entire watershed will be undertaken to identify and prioritize other roads, especially stream crossings, requiring remedial work. This will be done using new orthophotos that are to be created in the summer of 2001.*
<u>Proposed New Roads</u> Terrain stability assessments should be carried out for proposed roads on Stability Class IV or V terrain. Most tributary streams in this basin have a high transport capability. Design and construction of new roads should ensure that there will be a very low hazard of landslides or significant erosion that could enter streams.	*Perform a TSFA, if indicators of instability are found in the field, and on all road locations and cutblocks on Class IV or V terrain.* *Ensure TSFAs and SEFAs make recommendations to ensure that there will be a very low hazard of landslides or significant erosion that could enter streams.*
<u>Erosion Control</u> 1. Grass seeding of soil having a moderate or higher erosion hazard (as determined from the soil erosion mapping) should be done wherever there is a potential for erosion to occur and cause sediment to transport to any stream. In particular: a) Any exposed soil along the mainlines beside Cameron River in cutslopes, fillslopes or ditchlines should be seeded unless otherwise protected with armour or other erosion control. b) Cutslopes, fillslopes and ditchlines in soil materials should be seeded where	*1. These recommendations will be incorporated in road construction plans and deactivation prescriptions within this watershed.* *2. "Other erosion control measures" will be utilized where required.* *3. This recommendation will be implemented for active mainlines in this watershed.* *4. Follow WEYERHAEUSER, WEST ISLAND TIMBERLANDS, ENVIRONMENTAL MANAGEMENT SYSTEM, STANDARD OPERATING PROCEDURES, GENERAL RAINFALL SHUTDOWN GUIDELINES (community watershed section) developed for controlling sediment caused by road construction or*

CWAP Recommendations	Weyerhaeuser Strategies / Response
they connect directly or via a ditchline to any stream. c) All stream culverts should be armoured with rock or other suitable measures at the inlet and outlet; or seeded if grass would adequately protect against erosion. d) All ditchwater culverts should be seeded at the inlet and outlet unless otherwise protected by armour. Ditchlines should be seeded for at least 10m upgrade of the culverts. 2. Other erosion control measures, such as sediment basins, erosion blankets, and ditch checkdams should be implemented as necessary and appropriate. 3. Sections of active mainlines within 30m of stream culverts, and sections close to the Cameron River channel, should be reballasted with rock as necessary to prevent muddy runoff from the road surface entering Cameron River or any stream leading to Cameron River. 4. Rainfall shutdown procedures should be followed to limit sediment production.	*logging activities.*

1.2 Equivalent Cut Area (ECA)

Since December 1997, there has been 59ha of logging in the TFL portion of Cameron River basin, and approximately 3km of new road construction. (This does not include harvesting or road construction on the private land outside the TFL; however no major development was apparent in this area during a helicopter reconnaissance.

Of the area harvested, 24ha was in Basin 1 (Labour Day Lake) and the rest was in the Remainder. Road construction was in the Remainder.

The CE10 and C200 roads, identified as a priority in the 1998 CWAP report, have been assessed for deactivation, and 1km of permanent deactivation has been completed. More deactivation of these two roads is scheduled for 2001 and 2002. Assessments of road stability since the last CWAP have also been done for Yellow Creek Road, and a section of Cameron Main between Yellow Creek and Cop Creek.

Since December 1997, the weighted ECA for the Cameron Basin has declined from 21% to 18%; and ECAs in all sub-basins have declined as well. To December 2000, the ECA in the rain-on-snow zone (300 – 800 m elevation) was 17%. The potential for peak flow effects from these ECA's is low. No potential peak flow effects from ECAs or road density are likely to have occurred since the 1998 CWAP. The present rate of recovery over the total basin is 90 ha/year (unweighted); and 47 ha/year in the rain-on-snow zone.

No natural or logging-related landslides have been reported since the 1998 CWAP, and no new sediment sources were seen during a helicopter reconnaissance. The largest source of sediment at the present time is mobile channel sediment stored in Reach 7 of Cameron River. Sinuosity is developing in the channel and vegetation is becoming established on bars in Reach 7, although recovery in this reach is still fragile. Channel bank erosion is still occurring in places. Stability of old roads on steep slopes, and stream crossings, remains a concern.

This FDP proposes to harvest 578ha in the Cameron River basin. Taking recovery into account, at the end of 2005, this would bring the unweighted ECA for the total Cameron basin to 16%; and the weighted ECA to 19%. The ECA in the rain-on-snow zone would decline from 17% to 15%. All sub-basins except Sub-basin 3 (Cop Creek) would have a weighted ECA of 20% or less. This is well within the limit of 30% recommended for this basin until recovery is well advanced.

It is proposed to harvest 183ha in Cop Creek (Sub-basin 3), and construct 11.2km of road. The unweighted ECA in this sub-basin would increase to 34% by 2005, and the weighted ECA would increase to 37%. Cop Creek enters Cameron River in the canyon downstream of Reach 7 so would not effect this reach. With respect to reaches of the Cameron River downstream of Cop Creek, the increase in ECA in Cop Creek is offset by a net reduction in ECA in the Remainder and Sub-basin 4. Except for a low-gradient reach in the upper valley, Cop Creek itself has an incised, non-alluvial channel. Therefore this increase in ECA in Sub-basin 3 would have minimal effect.

The projected ECAs were determined using the gross area of the proposed cutblocks from the 1:20,000 FDP maps. Actual cut areas are likely to be less. As well, no recovery in the second growth for cutblocks harvested since 1997 was assumed.

Weyerhaeuser also proposes to construct 21 km of new road. The road density would increase from 2.3 to 2.5km/km^2. Some new road sections, and sections of existing road proposed for reactivation, cross steep Class IV and V terrain.

2.0 China CWS

The China watershed drains into the east side of Alberni Inlet, south of the city of Port Alberni. China Creek is the main municipal water supply for the city of Port Alberni, which has a dam and intake structure at 9.34km upstream from the mouth of the stream. The portion of the China watershed upstream from the intake is a designated CWS for the city of Port Alberni. The assessment

encompasses the designated CWS portion of the China watershed and was completed in April, 2001.

2.1 Watershed Management

Objectives

Roads are the main source of sediment to the channels. Promote good road construction methods, good maintenance and timely deactivation.

Strategies

CWAP Recommendations	Weyerhaeuser Strategies / Response
Existing Roads 1. Continue with assessment of existing roads on steep slopes as provided for in the workplan, with particular attention to the stream crossings. Where there is a potential for erosion or fillslope instability, these sections should be scheduled for deactivation. 2. Assess the stability of the spoil area near the lower end of the community watershed before placing any more spoil. 3. Include replacement of the three pipes in Plate 5 in the watershed workplan. 4. Ditch cleaning within the community watershed should be done in early summer during dry weather. The sides of ditches should be sloped to minimize sloughing.	*The spur roads off Duck Main (CC1000), the stability of the spoil site and fills, and the three culverts will be assessed in 2001/2002 and recommendations incorporated into the workplan.* *Any ditch cleaning will be undertaken in late spring / early summer in dry weather.*
Proposed New Roads Terrain stability assessments should be carried out for proposed roads on Stability Class IV or V terrain. Most tributary streams in this basin have a high transport capability. Design and construction of new roads should ensure that there will be a very low hazard of landslides or significant erosion that could enter streams.	*Perform a TSFA, if indicators of instability are found in the field, and on all road locations and cutblocks on Class IV or V terrain.* *Ensure TSFAs and SEFAs make recommendations to ensure that there will be a very low hazard of landslides or significant erosion that could enter streams.*
Erosion Control 1. Grass seeding of soil having a moderate or higher erosion hazard (as determined from the soil erosion mapping) should be done wherever there is a potential for erosion to occur and cause sediment to transport to any	*1. These recommendations will be incorporated in road construction plans and deactivation prescriptions within this watershed.* *2. "Other erosion control measures" will be utilized where*

CWAP Recommendations	Weyerhaeuser Strategies / Response
stream. In particular: a) Any exposed soil along China Main in cutslopes, fillslopes or ditchlines should be seeded unless otherwise protected with armour or other erosion control. b) Cutslopes, fillslopes and ditchlines in soil materials of roads leading on to China Main should be seeded up to the first culvert that discharges onto the forest floor and not to any stream. c) Cutslopes, fillslopes and ditchlines in soil materials should be seeded where they connect directly or via a ditchline to any stream. d) All stream culverts are to be armoured with rock or other suitable measures at the inlet and outlet; or seeded if grass would adequately protect against erosion. e) All ditchwater culverts are to be seeded at the inlet and outlet unless otherwise protected by armour. Ditchlines to be seeded for at least 10 m upgrade of the culverts. 2. Other erosion control measures, such as sediment basins, erosion blankets, and ditch checkdams should be implemented as necessary and appropriate. 3. Sections of China Main within 30 m of stream culverts, and sections close to the China Creek channel, should be reballasted with rock as necessary to prevent muddy runoff from the road surface entering China Creek or any stream leading to China Creek. 4. Roads leading onto China main should be rock-ballasted for the section where the ditchline is connected to China Main, i.e., up to the first culvert that drains onto the forest floor. 5. Rainfall shutdown procedures should be followed to limit sediment production.	*required.* 3. *This recommendation will be implemented for active sections of the China Creek mainline.* 4. *This recommendation will be implemented for active sections of roads joining China Creek mainline.* 5. *Follow WEYERHAEUSER, WEST ISLAND TIMBERLANDS, ENVIRONMENTAL MANAGEMENT SYSTEM, STANDARD OPERATING PROCEDURES, GENERAL RAINFALL SHUTDOWN GUIDELINES (community watershed section) developed for controlling sediment caused by road construction or logging activities.*

Approximately 46ha has been logged since the 1998 CWAP, and 3.6km of road have been built. Permanent deactivation of 3.6km has been done, and semi-permanent deactivation of 11.2km (this work was done on Duck Main, identified as a high priority in the 1998 CWAP). As a consequence, the effective road density has been reduced from 2.0km/km^2 to1.8 km/km^2.

In addition to this road deactivation, Weyerhaeuser implemented a workplan for the watershed to manage sediment production. Items of the workplan that have been completed are as follows:

1. A Standard Operating Procedure has been implemented for wet weather shutdowns to protect water quality in community watersheds.

2. The Mineral Creek culvert has been replaced by a new bridge.

3. Several new culverts have been installed along China Main.

4. China Main was ballasted with rock at the approaches to bridges and stream culverts.

5. Eroding channel bank sections adjacent to China Main have been armoured.

6. A steep section of MC100 (new road) leading up from China Main has been ballasted with clean rock to avoid mud being carried from this road onto China Main.

7. The eroding ditchline on D1400 (now CC900) has been armoured.

8. A reactivation plan has been completed for China Main past King Solomon Road, including new culverts, culvert replacements, and a partial relocation to move the mainline away from the channel. Reactivation has not yet been carried out; it is in the current Forest Development Plan.

9. A reactivation and deactivation plan was done for D1400 (now CC900). Harvesting from this road is now in progress.

The watershed workplan includes assessment and deactivation or reactivation of roads on steep slopes indicated in the 1998 CWAP, including:

- The midslope road in Basin 1 (upper China Creek);

- Spurs off Duck Main (now CC1000). These roads were assessed in 1994 and some deactivation was completed. The roads should be reviewed to determine if there are any remaining stability or significant erosion concerns.

This work is proposed for completion by October 2004.

China Main near the lower watershed boundary has sections of deep fills on steep slopes. Assessment of these fills should be included in a long-term workplan for the watershed. This section includes a large spoil area built out on

a nose. Slopes below the spoil area are steep. No further spoil should be placed here until the stability of the spoil area has been assessed.

The three culverts in Plate 5 *(between D1400 (CC900) and Duck Main (CC1000))* appear minimal for the size of the stream, and susceptible to plugging. Replacement of these pipes should be scheduled in the workplan. It may be necessary to raise the grade here to provide an adequate opening area. The new structure should be properly armoured.

Assessment of the spur roads off Duck Main (CC1000), the stability of the spoil site and fills, and the three culverts will be done in 2001/2002 and recommendations incorporated into the workplan described above.

2.2 Equivalent Cut Area (ECA)

In December 1997 the weighted ECA on Weyerhaeuser's area was 20%. To December 2000, the unweighted ECA over Weyerhaeuser's area is 17% and the weighted ECA is 21%. The ECA on the rain-on-snow zone is 20%. The potential for peak flow effects from these ECAs is low. No potential peak flow effects from ECAs or road density are likely to have occurred since the 1998 CWAP, as change in the ECA has been minimal and the effective road density has decreased. The present rate of recovery is 37ha/year.

Note that this does not take into consideration harvesting that may have occurred on non-Weyerhaeuser private land.

Weyerhaeuser proposes to harvest 298ha over the next five years. Taking recovery into account, at the end of 2005, this would bring the unweighted ECA to 21% and the weighted ECA to 26% in Weyerhaeuser's area. The ECA in the rain-on-snow zone would increase from 20% to 22%. The greatest ECA increase in the rain-on-snow zone is in Basin 3 (Williams Creek), which would increase by 4% to 26%.

Weyerhaeuser also proposes to construct 5.5km of new road. Some new road sections, and sections of existing road proposed for reactivation, cross fairly steep terrain. Without considering any additional road deactivation, the road density would increase from 1.8 to 1.9 km/km^2.

Potential increases in peak flows from these increases in ECA and road density are likely to be minimal.

No natural or logging-related landslides have occurred since the 1998 CWAP.

3.0 McFarland CWS (Bainbridge Lake CWAP)

The CWAP was completed in April, 2001. The Bainbridge Lake basin is a tributary of the China Creek watershed, which drains into the east side of Alberni Inlet. The portion of the basin draining into and including Bainbridge Lake is a designated CWS for the city of Port Alberni. Bainbridge Lake is a supplemental water supply for the city of Port Alberni, which has an intake and pumphouse in the lake. China Creek is the city's main water supply. The city switches to

Bainbridge Lake from China Creek when the China Creek flow is inadequate during the summer, when winter storms cause turbidity spikes in China Creek, or when maintenance is needed at the China Creek dam.

Silty tills in the lower watershed have the potential to generate sediment from ditchline erosion on steep road grades, and from washing of the road surface during active hauling. There are steep road grades on the Egg Hill and Rifle Roads; it was noted that those roads were not active at the time of the assessment. Washing of the road surface is a concern for the Cameron Main Road along McFarland Creek and Bainbridge Lake, and for the section of Bainbridge Main close to the lake.

3.1 Watershed Management

Objectives

Protect channel banks from disturbance, and control erosion into McFarland Creek.

Strategies

CWAP Recommendations	Weyerhaeuser Strategies / Response
Bainbridge Main If the section of Bainbridge Main beside Bainbridge Lake is to become inactive, assess the stability of fillslopes and carry out semi-permanent deactivation as appropriate.	*Will assess the stability of fillslopes on section of Bainbridge Main beside Bainbridge Lake if it is to become inactive.*

CWAP Recommendations	Weyerhaeuser Strategies / Response
Cameron Main 1. Inspect the wood culverts and develop a schedule for replacement. The highest priority appears to be the wood culvert north of Alder Grove Road. 2. When the culverts are replaced, the adjacent fillslopes should be pulled back and the fillslopes, inlets and outlets properly armoured. Settling basins with rock check dams should be constructed at the inlets of the culverts. 3. The road surface for 30 m either side of the stream culverts should be ballasted with clean rock to prevent fine sediment from the haul road washing into the culverts and transporting to the lake. 4. Ditchwater culverts should also be scheduled for improved erosion protection. Fillslopes should be trimmed back at the inlets and outlets, and armour placed at the outlets. Inlets should have adequate settling basins and should be seeded or armoured to control erosion. 5. Ongoing ditch maintenance should be done in early summer, to give time for grass to catch before fall rains. The ditch sides should be sloped to minimize sloughing; and ditchlines and culvert inlets should be seeded immediately.	*1. The wood culverts on this section of Cameron Main are scheduled for replacement in 2001, 2002, and 2003. The wood culvert approximately 100m south of Alder Grove Road was replaced with a bridge in July 2001.* *2. These works will be incorporated into the culvert replacement plans. Settling basins and check dams will not beconstructed if the culvert is being replaced with a bridge.* *3. This recommendation will be implemented during the term of this FDP.* *4. This recommendation will be implemented during the term of this FDP.* *5. Any ditch cleaning done will be undertaken in late spring / early summer in dry weather.*
Other Existing Roads Steep road sections (eg, CAM100) that are not maintained or become inactive should be assessed for deactivation, with particular attention to the stream crossings. Where there is a potential for erosion or fillslope instability, these sections should be scheduled for deactivation.	*Deactivation plans will take this recommendation into account.*

CWAP Recommendations	Weyerhaeuser Strategies / Response
Proposed New Roads Terrain stability assessments should be carried out for proposed roads on Stability Class IV or V terrain. Design and construction of new roads should ensure that there will be a very low hazard of landslides or significant erosion that could enter streams.	*Perform a TSFA, if indicators of instability are found in the field, and on all road locations and cutblocks on Class IV or V terrain.* *Ensure TSFAs and SEFAs make recommendations to ensure that there will be a very low hazard of landslides or significant erosion that could enter streams.*
Erosion Control 1. Grass seeding of soil having a moderate or higher erosion hazard (as determined from the soil erosion mapping) should be done wherever there is a potential for erosion to occur and cause sediment to transport to any stream. In particular: a) Any exposed soil in cutslopes, fillslopes or ditchlines along Cameron Main through the community watershed, and along Bainbridge Main beside the lake, should be seeded unless otherwise protected with armour or other erosion control. b) Cutslopes, fillslopes and ditchlines in soil materials should be seeded where they connect directly or via a ditchline to any stream. c) All stream culverts should be armoured with rock or other suitable measures at the inlet and outlet; or seeded if grass would adequately protect against erosion. d) All ditchwater culverts should be seeded at the inlet and outlet unless otherwise protected by armour. Ditchlines should be seeded for at least 10 m upgrade of the culverts. 2. Other erosion control measures, such as sediment basins, erosion blankets, and ditch checkdams should be implemented as necessary and appropriate. 3. Rainfall shutdown procedures should be followed to limit sediment production.	*1. These recommendations will be incorporated in road construction plans and deactivation prescriptions within this watershed.* *2. "Other erosion control measures" will be utilized where required.* *3. Follow Weyerhaeuser, WEST ISLAND TIMBERLANDS, ENVIRONMENTAL MANAGEMENT SYSTEM, STANDARD OPERATING PROCEDURES, GENERAL RAINFALL SHUTDOWN GUIDELINES (community watershed section) developed for controlling sediment caused by road construction or logging activities.*

There are no culverts along Bainbridge Main that could drain into the west side of Bainbridge Lake. The closest culvert, just below the first spur junction above the lake, drains onto gentle terrain. The potential for sediment to enter the lake from ditch erosion or mud from the road surface is low. There are steep fills above the lake on this road; no cracks or evidence of instability were apparent during a field visit on March 15, 2001. However, if Bainbridge Main becomes inactive, the fillslope stability should be assessed and this section deactivated as appropriate.

Stream culverts crossing this road have the greatest potential to introduce sediment to Bainbridge Lake. As indicated in the 1998 CWAP, the wood culverts are nearing the end of their life and should be inspected to set a schedule for replacement. The wood culvert on upper McFarland Creek (upstream of the lake), north of Alder Grove Road, has a hole in the fill at the inlet end and appears near to collapse *(at time of CWAP author field visit - March 15, 2001)*. This is the highest priority culvert for replacement or remedial work. All culverts on this section of Cameron Main are poorly armoured or not armoured (both ditchwater and stream culverts). This is also true of the wood culvert on Rifle Road (now CAM100) that crosses a tributary on the east side of the basin. Old sloughs in the fillslopes are evident near the inlets and outlets of many of the culverts; this is likely due to the absence of armour and to grading practices that blade material over the shoulder and tend to widen the road over time.

The wood culverts on this section of Cameron Main are scheduled for replacement in 2001 and 2002.

3.2 Equivalent Cut Area (ECA)

Approximately 10 ha has been logged since the 1998 CWAP, and less than one kilometer of new road construction. Weyerhaeuser's data indicates no road deactivation since 1998.

From December 1997 to December 2000, the unweighted ECA has declined from 27% to 24%, and the weighted ECA has declined from 29% to 27% in Weyerhaeuser's area. The ECA on the rain-on-snow zone is 13%. The potential for peak flow effects from these ECAs is low. No potential peak flow effects from ECAs or road density are likely to have occurred since the 1998 CWAP, as the ECA has declined and the road density has not changed. Note that this does not take into consideration harvesting that may have occurred on non-Weyerhaeuser private land.

Weyerhaeuser proposes to harvest 86ha over the next five years. At the end of 2005, this would bring the unweighted ECA to 32% and the weighted ECA to 37% in Weyerhaeuser's area. The ECA in the rain-on-snow zone would increase to 28%, which is still fairly low.

As discussed in the 1998 CWAP, peak flow effects are likely to be of interest only in the tributary channels, as flows out of Bainbridge Lake are artificially controlled at the dam. With the exception of a "semi-alluvial" reach of upper McFarland Creek from about CAM100 to Bainbridge Lake, the tributaries have non-alluvial channels. Most of the largest tributary is on non-Weyerhaeuser private land.

The potential effect of peak flow increases in the tributaries could be an increased potential for erosion at the stream culverts on Cameron Main.

Weyerhaeuser also proposes to construct 4.9km of new road, on the midslope area above the east side of Bainbridge Lake. The upper proposed road crosses fairly steep terrain.

The recommendations and commitments above will address any erosion potential created due to proposed harvesting activities.

4.0 Rogers Creek

The CWAP was completed in December, 1998. Rogers Creek is a tributary of the Somass River, which drains into the head of the Alberni Inlet at Port Alberni. A portion of the Rogers Creek basin upstream was designated as a community watershed. It was delisted in September 2001 as the previous users (Sahara Heights Waterworks District) are now connected to the City of Port Alberni water system.

4.1 Sediment Sources

- Seven slides noted from a section of Cameron Main;
- A washout on a spur off the Rogers Creek Road just below the highway;
- Road sections with steep grades on Yellow Creek Main, where there is a potential for road and ditch erosion.

In the past, the largest sediment sources to the Rogers Creek channel would have been erosion of channel banks caused by riparian logging and small slides from Cameron Main. The slides are revegetated; present surface erosion is minimal. The channel banks have also revegetated and bank erosion is markedly diminished. There is still considerable sediment stored in the aggraded alluvial reaches.

Overall, erosion throughout the basin is minor but there are road sections where erosion is a potential concern.

4.2 Watershed Management

Objectives

Minimize the introduction of sediment to the main channel. Protection of small streams should be looked at on a site-specific basis to determine how best to meet this objective.

Mitigate erosion from active haul roads next to the channel (Cameron Main, Summit Main, and Rogers Creek Road) which are likely to generate the most sediment.

Strategies

CWAP Recommendations	Weyerhaeuser Strategies / Response
Because the intake is in the main channel and there are few sediment sinks along the main channel or in Sub-basin 1A, a primary goal of watershed management is to minimize introduction of sediment to these stream channels. Protection of small streams should be looked at on a site-specific basis to determine how best to meet this objective.	*Utilize the riparian provisions of the FPC Community Watershed Guidebook when developing SPs. These will be used until the area is no longer a CWS, at which point the RMA provisions of this FDP will be used.* *Occasionally, through field reviews and discussions with the MoWLAP Regional Hydrologist, it is determined, on a site specific basis, that a variance on widths of RRZs and RMZs on streams in a CWS can be considered by the Statutory Decision Makers.*
Cuts and fills along the section of Cameron Main between the viewpoint and the junction with Summit Main should be assessed to determine if there is still a hazard of slides and if remedial work is needed.	*Assess this section of road in 2001 / 2002 and complete remedial work by 2003.*
The likelihood of post-harvesting open-slope failures is low and the extent of steep terrain is limited. However, TSFAs should be carried out for any new road sections that cross steep or potentially unstable terrain.	*Complete TSFAs for all road locations that are located on unstable or potentially unstable terrain, or when indicators of instability are found in the field. Incorporate recommendations to maintain stability into Road Layout and Designs.*
Control of sediment is a specific objective on active haul roads close to the main channel (Cameron Main and Summit Main). Ditches and smaller culverts should also be checked to see if additional sediment control measures such as settling basins sediment traps or armouring are needed. If the Rogers Creek Road is reactivated for hauling sediment production off this road where it is close to the creek should also be checked. As well, the short spur off Rogers Creek that has washed out should be checked to see if remedial work is necessary to prevent further fill erosion.	*Assess existing roads (particularly sections with steep grades) for remedial work in order to provide erosion control.* *The Rogers Creek Road was reactivated in early 2000 in order to access cutblock #2751. It was ballasted with rock in order to control erosion.* *Hydroseeding of cut-slopes and fill-slopes of new access roads is generally completed within one year of construction. Hydroseeding of cut-slopes and fill-slopes of roads within a cutblock is generally done within one year of harvesting being completed. This seeding will be done as per the strategy in section 8.3.* *Assess the washout in 2001 to determine if fill pullback is needed.*
The main concern with new roads is management of sediment production and erosion as discussed above, especially timely deactivation of roads with steep grades.	*The strategies described above address this recommendation.*

4.3 Equivalent Cut Area (ECA)

ECA is not a concern in this watershed as the peak flow effects from clearcut logging are low over the total watershed. The ECA at the date of the report

(December 1998) was 22%. It is recovering at a rate of 32ha/year. Therefore, by the end of this FDP, 224ha reduction in ECA will have occurred (since the report date). Since the report, approximately 43 hectares have been harvested within this CWS. Approximately 59ha of harvesting is CP approved and another 269ha (gross cutblock area) is proposed in this FDP. Of this 269ha, approximately 180ha is planned for harvesting (i.e. net harvest area within CWS). This results in a net harvest within the CWS of approximately 282ha since the CWAP report, or an increase in ECA of 58ha.

5.0 Hatton Creek Watershed

The CWAP was completed in April, 2001.

Objectives

Minimize delivery of sediment to the Caycuse River, a high-value stream supporting anadromous fish species.

Minimize impacts to anadromous habitat in the bottom 3.3km of the Hatton Creek channel.

Minimize impacts to resident fish habitat in Hatton Creek, downstream from Hadikin Lake.

Strategies

CWAP Recommendations	Weyerhaeuser Strategies / Response
For terrain in MB-upper where slides could enter Reach R5 or R6 of Hatton Creek, recommend that harvesting for the next 5 years be limited to terrain with an expected landslide frequency of less than one slide per 50 ha logged. Terrain specialists carrying out terrain stability field assessments should be made aware of this criterion. Buffer areas intended to protect stream channels, gullies, and potentially unstable slopes should be treated, or of sufficient width, so that their function is not lost because of windthrow.	*Specialists conducting TSFAs will be made aware of this criterion. A terrain stability mapping calibration exercise will be undertaken to aid in determining landslide risk frequency.* *Buffers intended to protect stream channels, gullies, and potentially unstable slopes will be treated or of sufficient width to remain functional if expected windthrow occurs. Windthrow potential will be a major factor in determining buffer widths and treatments. The objective is to leave a buffer that will not lose its function even if some windthrow occurs.*
Assessment of proposed new roads should specifically address: 1. Fillslope stability of proposed road locations on steep slopes;	
2. Stability of cutslopes of any road sections on steep slopes likely to be in mainly non-rock material; 3. The potential for downslope instability from	

CWAP Recommendations	Weyerhaeuser Strategies / Response
road drainage, including culvert and ditch maintenance considerations for steep grades in non-rock materials; 4. The potential for significant ditch erosion on steep grades in non-rock materials where the ditches connect to streams. Terrain stability field assessments and engineering road designs should include statements confirming whether or not the above concerns can be addressed to meet the sediment control objectives in this watershed.	
Recommend that in MB-upper the rate of cut in the rain-on-snow zone (300 –800 m elevation) not exceed 15 ha/year for the next 5 years. This rate of cut could be cumulative over the 5-year period; that is, a total cut not exceeding 75 ha could be taken during that period. Rate of cut in the TimberWest area should be reduced to allow the ECA to decline over the next 5 years.	*Weyerhaeuser plans to harvest approximately 133ha (gross area) to 2005. Of this, 20ha is proposed in MB-upper and 113ha in MB-lower. This level of harvest would allow the ECA in the rain-on-snow zone in MB-upper to decline to 28% by 2005, and is consistent with the recommended limit on rate-of-cut.*
A plan should be developed to permanently deactivate all roads not needed for long-term forest management, and to seed exposed soil areas on deactivated roads.	*To December 2000, approximately 20km of roads have been permanently deactivated, of which 13km is in Weyerhaeuser's area and 7km is in TimberWest's area. A portion of spur road H200 has been permanently deactivated. More work will be done in 2001. Spur roads H320, H400, and Car10 are planned for permanent deactivation.*
Risk assessments should be done for all long-term roads, and maintenance plans prepared for unstable and eroding sites, with particular attention to gully crossings.	*The CWAP author will be contracted to complete a road maintenance workplan for the Weyerhaeuser portion of the watershed. Specific sites requiring remedial work will be identified and a schedule for completing the works will be developed (a similar plan was developed for the China Creek watershed).*
In TimberWest's area, the H8C road should be a priority for deactivation. In Weyerhaeuser's area, the CAR10 stream crossings, the gully crossing on H300 and H320 roads should be a priority for assessment. Deactivation of the H200 road system should be done consistent with the proposed harvest plans for this area.	*Spur roads H320, H400, and Car10 are planned for permanent deactivation.*
Check that stream culverts on active roads are well armoured; repair and vegetate as necessary to control erosion. In particular, the culvert on Carmanah Main at Plate 1 should be regularly	*Ongoing road maintenance and inspections will uncover any remedial work required.*

CWAP Recommendations	Weyerhaeuser Strategies / Response
inspected to check for plugging.	
Suggest that Weyerhaeuser consider low-level 35mm strip photography of Reaches R5 and R6 to track the channel condition over time.	*Orthophotos are being obtained for the entire TFL in the fall of 2001. If these photos do not provide the detail required to monitor channel condition over time, low-level photos will be acquired in the summer of 2002.*
Grass seeding of soil should be done wherever there is a potential for erosion to occur and cause sediment to transport to any stream. In particular: Any exposed soil along the roads beside Hatton Creek in cutslopes, fillslopes or ditchlines should be seeded unless otherwise protected with armour or other erosion control. Cutslopes, fillslopes and ditchlines in soil materials should be seeded where they connect directly or via a ditchline to any stream. All stream culverts should be armoured with rock or other suitable measures at the inlet and outlet; or seeded if grass would adequately protect against erosion. All ditchwater culverts should be seeded at the inlet and outlet unless otherwise protected by armour. Ditchlines should be seeded for at least 10 m upgrade of theculverts.	*These recommendations will be incorporated in road construction plans, deactivation prescriptions, and the proposed road maintenance workplan within this watershed.*
Other erosion control measures, such as sediment basins, erosion blankets, and ditch checkdams should be implemented as necessary and appropriate.	*"Other erosion control measures" will be utilized where required.*

5.1 Equivalent Cut Area (ECA)

Approximately 390ha has been logged over the total watershed since 1996. Of this, 155ha is in the Weyerhaeuser portion of the watershed and 235ha is in the TimberWest portion.

The weighted and unweighted ECAs over the total watershed have remained essentially constant (33% and 45% in 1996, 33% and 47% in 2000). This is because the total area harvested has been close to the rate of recovery over the same period.

Over Weyerhaeuser's area, unweighted ECA has declined from 39% to 33%, and weighted ECA has declined from 54% to 46%. In MB-upper, the area of

greatest concern in the 1996 CWAP, ECAs declined from 68% to 54% (weighted) and 46% to 37% (unweighted).

Weyerhaeuser plans to harvest approximately 133ha (gross area) to 2005. Of this, 20ha is proposed in MB-upper and 113ha in MB-lower. This level of harvest would allow the ECA in the rain-on-snow zone in MB-upper to decline to 28% by 2005, and is consistent with the recommended limit on rate-of-cut.

Over TimberWest's area, unweighted ECA has increased from 26% to 34%, and weighted ECA has increased from 35% to 47%.

To December 2000, approximately 20km of roads have been permanently deactivated, of which 13km is in Weyerhaeuser's area and 7km is in TimberWest's area. As well, 13km are semi-permanently deactivated (3km for Weyerhaeuser and 10 km for TimberWest). Seasonal deactivation (crossditching and backing up culverts) has also been done on the maintained roads. During a field review, field markings were noticed indicating more assessment work has been done (H200 Road, HC8 Road), but the deactivation work has not yet been completed.

In MB-upper, a new crossing was constructed at Tyler Creek on Haddon Main. Previous structures at this site had blown out because of heavy sediment deposition at the crossing location. The new structure consists of a low-level bridge and dyking to contain the channel and prevent further avulsion downstream of the crossing. Some erosion of the gravel dyke has occurred on the inside bend upstream of the bridge.

6.0 Sarita River Watershed

This non-directed CWAP was completed in February, 1997. The Sarita watershed comprises an area of 18,972ha draining into Trevor Channel on the west side of Vancouver Island.

In summary, it is believed that the main impacts on streams from past harvesting have been as follows:

- A reduction of large woody debris because of a lack of large trees to recruit from.

- Increased bank erosion and sediment deposition on sensitive alluvial reaches of the Sarita and South Sarita Rivers, because of the removal of trees along the stream banks, and increased sediment supply to streams.

6.1 Watershed Management

Objectives

Control sediment sources and in particular, control sediment introduction to the recovering fisheries habitat.

Strategies

Sarita River CWAP Recommendations and Strategies for Frederick Creek Basin

CWAP Recommendations	Weyerhaeuser Strategies / Response
Harvesting should be limited to areas with a low potential to introduce sediment to the Frederick Creek channel. Special care should also be taken with road construction, for example: • applying rainfall shutdown criteria for construction through silty material for any locations where sediment from the road could enter the Frederick Creek channel; • using special measures such as armouring of ditches or construction of stilling ponds where needed to control erosion and sediment transport; etc. • seeding or planting exposed soil surfaces as soon as possible following road construction; • ensuring surfaces of active haul roads adjacent to the channel are ballasted with clean materials that do not generate muddy runoff.	*Limit harvesting to areas with a low potential to introduce sediment to the main stream channel.* *Apply WEYERHAEUSER, WEST ISLAND TIMBERLANDS, ENVIRONMENTAL MANAGEMENT SYSTEM, STANDARD OPERATING PROCEDURES, GENERAL RAINFALL SHUTDOWN GUIDELINES for construction through silty material for any locations where sediment from the road could enter the Frederick Creek channel.* *Use special measures such as armouring of ditches or construction of stilling ponds where needed to control erosion and sediment transport.* *Hydroseeding of cut-slopes and fill-slopes of new access roads is generally completed within one year of construction. Hydroseeding of cut-slopes and fill-slopes of roads within a cutblock is generally done within one year of harvesting being completed. This seeding will be done as per the strategy in section 8.3.* *Ensure surfaces of active haul roads adjacent to the channel are ballasted with clean materials that do not generate muddy runoff.*

Sarita River CWAP Recommendations and Strategies for South Sarita Basin

CWAP Recommendations	Weyerhaeuser Action / Response
Harvesting should be limited to areas with a low potential to introduce sediment to the South Sarita or lower Sabrina Creek channels. New road construction should plan to minimize risk to these channels, as described above for Frederick Creek.	*Limit harvesting to areas with a low potential to introduce sediment to the main stream channel.* *Apply WEYERHAEUSER, WEST ISLAND TIMBERLANDS, ENVIRONMENTAL MANAGEMENT SYSTEM, STANDARD OPERATING PROCEDURES, GENERAL RAINFALL SHUTDOWN GUIDELINES for construction through silty material for any locations where sediment from the road could enter the South Sarita or lower Sabrina Creek channels.* *Use special measures such as armouring of ditches or construction of stilling ponds where needed to control erosion and sediment transport.*
	Hydroseeding of cut-slopes and fill-slopes of new access roads is generally completed within one year of construction. Hydroseeding of cut-slopes and fill-slopes of

CWAP Recommendations	**Weyerhaeuser Action / Response**
	roads within a cutblock is generally done within one year of harvesting being completed. This seeding will be done as per the strategy in section 8.3. *Ensure surfaces of active haul roads adjacent to the channel are ballasted with clean materials that do not generate muddy runoff.*

Sarita River CWAP Recommendations and Strategies for Thompson Creek Basin

CWAP Recommendations	Weyerhaeuser Action / Response
The objective here should be to manage the steep, potentially unstable terrain in the upper basin slopes so as not to increase the frequency of natural landslides or channel sediment loads. Normal application of the FPC and guidebooks is appropriate for this basin. That is, TSFAs should be carried out for all proposed harvesting areas in steep or potentially unstable terrain. A long term strategy for the watershed should address the mainline road and bridge across this stream.	*Complete TSFAs for all road locations that are located on unstable or potentially unstable terrain, or when indicators of instability are found in the field. Incorporate recommendations to maintain stability into Road Layout and Designs.* *The bridge crossing this stream on the Bamfield Road was replaced in 2000. This project included some in-stream work to alleviate sediment aggradation at the crossing.*

Sarita River CWAP Recommendations and Strategies for Miller Creek Basin

CWAP Recommendations	Weyerhaeuser Action / Response
As with Thompson Creek, the objective in this basin should be to manage the steep terrain in the upper basin so as not to increase the frequency of natural landslides or channel sediment loads. Normal application of the FPC for management of steep terrain is appropriate. A long-term management strategy for the watershed should address the mainline bridge and road, and should review maintenance options for the campsite on the fan.	*Complete TSFAs for all road locations that are located on unstable or potentially unstable terrain, or when indicators of instability are found in the field. Incorporate recommendations to maintain stability into Road Layout and Designs.*

Sarita River CWAP Recommendations and Strategies for Basin 6 (Unnamed Creek)

CWAP Recommendations	Weyerhaeuser Action / Response
This stream flows into the north side of Sarita Lake. The management objective for this basin should be to stabilize the slides, erosion and sediment transport. Until recovery is well progressed, harvesting should be limited to terrain with no more than a low-moderate potential for instability. The present ECA is very high (60%). It is noted that this basin, with an area of 356 ha, is a smaller area than one would normally manage for rate of cut. That is, it would be included in a larger area such as the Remainder 0. However, because of the history of instability and impacts to the fish habitat on the fan, it is recommend that the rate of cut in this basin be reduced to allow the long-term ECA to decline to below 40%, until the mitigative effects of road deactivation and watershed restoration take hold. At that time, this small basin could probably be included in the Remainder 0 for purposes of managing rate of cut. It is recommend that the length of new road construction in this basin not exceed the length of roads to be permanently deactivated, so there is no net increase to the road density within this basin. Care should be taken with new roads as described in Section 6.1 for Frederick Creek. The cut of 28ha proposed in the 1997-2001 FDP in this basin allows some recovery to take place; the ECA is reduced to 51% by 2001. This is still high, and the next FDP should allow for continued recovery.	*Limit harvesting to areas with a low potential to introduce sediment to the main stream channel.* *Complete deactivation assessments and perform remedial work, to ensure the road density in this basin is not higher at the end of the period covered by this FDP.* *Apply <u>WEYERHAEUSER, WEST ISLAND TIMBERLANDS, ENVIRONMENTAL MANAGEMENT SYSTEM, STANDARD OPERATING PROCEDURES, GENERAL RAINFALL SHUTDOWN GUIDELINES</u> for construction through silty material for any locations where sediment from the road could enter creek channels.* *Use special measures such as armouring of ditches or construction of stilling ponds where needed to control erosion and sediment transport.* *Hydroseeding of cut-slopes and fill-slopes of new access roads is generally completed within one year of construction. Hydroseeding of cut-slopes and fill-slopes of roads within a cutblock is generally done within one year of harvesting being completed. This seeding will be done as per the strategy in section 8.3.* *Ensure surfaces of active haul roads adjacent to the channel are ballasted with clean materials that do not generate muddy runoff.* *The proposed cut referred to is cutblock 9626. It is a Category I cutblock.*

Sarita River CWAP Recommendations and Strategies for Upper Sarita

CWAP Recommendations	Weyerhaeuser Action / Response
The Central Creek sub-basin has experienced a high incidence of logging and road-related landslides. Harvesting in this sub-basin should be limited to areas with a low potential to impact the Central Creek channel. New road construction should plan to minimize risk to the channel as described for Frederick Creek. The extent of new road construction should not exceed the extent of roads deactivated, so that the road density in this sub-basin is not increased. A long-term management strategy should address the bridge site across Central Creek at the mainline, if it is not addressed through the WRP. The upper slopes in the Harrison Creek sub-basin have also experienced a high incidence of logging and road-related instability which have been partly mitigated by lengthy low-gradient reaches providing sediment storage in the upper channel reaches. The WRP will address the unstable road sections.	*Limit harvesting to areas with a low potential to introduce sediment to the main stream channel.* *Apply WEYERHAEUSER, WEST ISLAND TIMBERLANDS, ENVIRONMENTAL MANAGEMENT SYSTEM, STANDARD OPERATING PROCEDURES, GENERAL RAINFALL SHUTDOWN GUIDELINES for construction through silty material for any locations where sediment from the road could enter the Central Creek channel.* *Use special measures such as armouring of ditches or construction of stilling ponds where needed to control erosion and sediment transport.* *Hydroseeding of cut-slopes and fill-slopes of new access roads is generally completed within one year of construction. Hydroseeding of cut-slopes and fill-slopes of roads within a cutblock is generally done within one year of harvesting being completed.* *Ensure surfaces of active haul roads adjacent to the channel are ballasted with clean materials that do not generate muddy runoff.*

6.2 Summary of Conclusions and Recommendations

The WRP will address unstable roads and will revegetate landslides and deactivated roads.

If sediment sources along the Sarita Mainline are not addressed through the WRP, a long term management strategy for the watershed should plan to address them.

Special care is recommended for new road construction in basins where past harvesting or road construction has impacted fish habitat (Basins 1, 3, 6, and 7). For these drainages, it is recommended that harvesting be limited to areas with a low potential to introduce sediment to the main stream channels.

6.3 Rate of Cut

In Basin 6, the past rate of cut has been high; this FDP allows the ECA to decline, which means that the basin will see a slight improvement over the term of this FDP but the ECA will still be high. The next FDP will allow for a continued decline in the ECA in Basin 6.

The CWAP states the watershed is recovering approximately 219ha/year (therefore 1095ha of recovery within the time frame of this FDP). Approximately 880 hectares of harvesting are approved or proposed within this FDP. This level of harvesting, in addition to WRP work, will allow the watershed to continue recovering.

6.4 Access Management Plan

An Access Management Plan for the Sarita Watershed recommended objectives for road deactivation, and subsequently classified all roads in the watershed with respect to future use and level of deactivation; i.e. maintain or semi-permanent/permanent deactivation.

Objectives

Identify and priorize road sections for deactivation.

Review heavily overgrown roads to determine which can be considered permanently deactivated in their present state and which require further work.

Reduce sediment entering the lake and streams from sources such as the bridge sites at Central Creek, Miller Creek and Thompson Creek.

Avoid further impacts to sensitive fish-bearing alluvial reaches by controlling soil erosion. There are deep soils in much of the watershed and potential for large cumulative effects of seemingly small events. Management of sediment sources downstream of Sarita Lake is of particular concern to the anadromous habitat.

Potential sediment sources include:

- landslides from unstable roads and settings;
- erosion, inundation or sloughing of the mainline where it is in close proximity to the lake and stream channel;
- erosion of exposed soils from road cutslopesand fillslopes, ditches and waste sites.

Strategies

Semi-permanently deactivate a total of 63.24km of road.

Permanently deactivate 275.34km of road (some may be done naturally because of vegetation growth).

As of December 31, 2000, approximately 25.3km of road have been permanently deactivated and approximately 22km of road have been semi-permanently deactivated in this watershed. Further permanent deactivation is planned in 2001 under the WRP.

Continue deactivation, under the WRP, of identified high-risk roads (ongoing for the past 3 years).

Carry out a risk assessment of the remaining Sarita watershed by the end of 2003 to determine which roads are naturally recovered and which require further work.

Include sections of Sarita Mainline that encroach on Sarita River, Sarita Lake and South Sarita River for remedial work in the WRP. Temporary armouring has been carried out where Sarita Main encroaches on the South Sarita River. A channel assessment is being carried out under WRP to determine what long-term measures may be needed.

7.0 Klanawa River Watershed

The CWAP was completed in May, 1999. The Klanawa watershed drains into the Pacific Ocean on the west side of Vancouver Island, south of Barclay Sound. Weyerhaeuser manages 99% of the watershed area under TFL 44. At the mouth of the watershed, 317ha are in Pacific Rim National Park (Phase III). A WRP has been underway in the West Fork basin. Work to date under the WRP has mainly involved road deactivation. This project has now been expanded to include the entire Klanawa watershed.

7.1 Summary of Key Findings

Terrain conditions (extensive glaciofluvial deposits, gravelly till, gravelly colluvium), and a high rainfall environment make this watershed highly susceptible to natural and logging related landslides, and to erosion of exposed soils.

Moderate to severe channel impacts have resulted from logging of the riparian forest on erodible stream reaches on the valley flats.

The largest chronic sediment sources are eroding glaciofluvial escarpments on the West Fork and the Klanawa mainstem. Other major chronic sediment sources are eroding channel banks and bars on alluvial stream reaches, and an active natural slide area in the North Fork.

Natural landslides, slides from roads and slides from logged slopes and gullies are smaller sediment sources, but have had significant impacts on the upper reaches of the main streams and on smaller streams.

7.2 Watershed Management

Objectives

Take a low risk approach to terrain stability for cutblocks and for construction of new roads (with respect to landslides both from roads, and from drainage off the roads), wherever there is a potential to impact a fish-bearing stream channel.

Good control of erosion and sediment production from roads.

Follow strategies resulting from CWAP recommendations in order to limit the impacts of harvesting and road construction on the watershed.

Strategies

CWAP Recommendations	Weyerhaeuser Strategies / Response
In consideration of existing impacts to the stream channels, a low-risk approach should be taken with respect to further impacts on fish habitat and channel stability. Harvesting and road construction should be limited to terrain with a low hazard of slides that could enter a fish-bearing stream. Of particular sensitivity are small fish-bearing streams and the upper fish-bearing reaches of the main streams. Elsewhere in the watershed, harvesting and road construction should be limited to terrain with no more than a moderate potential for instability. Assessments of risk with respect to new roads should take into consideration both failures at the road prism (cutslopes, fillslopes), and failures below the road which could result from road drainage.	*Complete TSFAs for all road locations and cutblocks that are located on unstable or potentially unstable terrain, or when indicators of instability are found in the field. Incorporate recommendations to maintain stability into Road Layout and Designs and SPs.* *TSFA recommendations for conducting operations (road construction and/or harvesting) must be developed to meet CWAP recommendations or roads and/or cutblocks will not proceed.*
Specialists carrying out TSFAs should be made aware of both the history of landslide occurrence in this watershed and the rainfall environment, and the recommendations for watershed management in the Klanawa Watershed Assessment Report (May 28, 1999) and minutes.	*Make all persons conducting TSFAs aware of the CWAP recommendations and the Round Table minutes.*
Future logging of valley flats (defined as: areas adjacent to an alluvial channel with erodible banks where logging may cause the bank to become unstable), both in the remaining unlogged areas and in the second growth, should ensure that erodible channel banks are protected by good buffers (defined as: adequate forest structure remains after logging to protect the channel bank). Windthrow hazard must be taken into account in the establishment of buffer dimensions. It is recommended to limit cutblocks on valley flats to noncontiguous small patches or high retention cutblocks to minimize the potential for channel instability to develop after logging.	*The silviculture system for cutblocks on the valley flats will be a retention system with a high level of retention.* *Effective and stable RMAs will protect erodible channel banks.*
Because soils in this watershed are highly erodible, road construction and maintenance should provide good erosion protection,	*Hydroseeding of cut-slopes and fill-slopes of new access roads is generally completed within one year of construction. Hydroseeding of cut-slopes and fill-slopes of*

CWAP Recommendations	Weyerhaeuser Strategies / Response
particularly around the small fish-bearing streams: Exposed mineral soils should be seeded as soon as practicable after construction. Roads with steep grades which could impact on fish bearing habitat should have adequate erosion protection to prevent ditchlines from eroding, and should be at least seasonally deactivated when not in active use. Road sections (on roads built before 1995) with steep grades are indicated on a map attached to the report. Remedial work is recommended where erosion is occurring at the D1500 and Darling Main crossings of Moon Creek. Existing deactivation should be reviewed at the K100 crossing of the upper East Fork to see if further work is needed. Branch 265 where it follows the Herman Creek channel should be assessed for stability and erosion to see if remedial work is needed to prevent further slides into Herman Creek. Upper Klanawa Main from the UK bridge on the East Fork down to approximately UK1100 should be assessed for potential stability or erosion concerns above the East Fork channel. Assessment and deactivation of old roads on steep slopes should continue, with priority given to roads where slides or erosion could connect to high-value fish habitat. Roads built before 1995 on steep slopes are indicated on a map attached to the report.	*roads within a cutblock is generally done within one year of harvesting being completed.* *Assess roads identified as having erosion control concerns in 2000, and develop a plan (in conjunction with the WRP) to schedule required remedial work.*

CWAP Recommendations	Weyerhaeuser Strategies / Response
The existing road density in Basin 1 (Moon Creek) is high. New road construction in this basin is of concern because much of this basin has relatively steep terrain and highly erodible soils. Moon Creek is a relatively small fish-bearing stream and sediment from the roads can have significant effects on the channel. Deactivation of the older roads should be a priority in this basin, and new roads not required for long-term access should be permanently deactivated after logging as soon as they are no longer needed. Weyerhaeuser should work with FRBC with respect to planning and funding of deactivation.	*Cutblock #7622 is within the Moon Creek basin. The cutblock and associated roads are on gentle lower slopes. A TSFA was required under OPR 17. The cutblock and roads comply with the recommendations of the TSFA and the recommendation above regarding limiting harvesting near fish-bearing streams.* *Consider the condition of Moon Creek and the risk associated with the roads in the basin when prioritizing deactivation work within the Klanawa watershed.*
Based on potential for sediment delivery to high value fisheries habitat, the following roads are recommended in as a priority for assessment for potential deactivation. Basin 1 – Moon Creek: D1450 road system upslope of Darling Main / D600 Road / Stream crossings on the D1500 Road. Basin 3 – West Fork: D250 Road / SS300 and SS310 Roads (these roads are upstream of fish habitat, but slides from this slope have historically been very large and would deliver a significant sediment load to the fish-bearing reaches). Any work outstanding on Branch 334 Roads. Steep roads in the lower Gorge Creek sub-basin (3B). Basin 4 – East Fork: UK820 (steep portion) / UK821 / UK824 / UK910 / UK920.	*Use this information when scheduling deactivation and remedial work.* *There are other roads on steep terrain, some with existing slides that will also be assessed in a long term management program. They are more distant from anadromous fish, but some could affect resident habitat.*

7.3 Potential HLP Hydrological Impacts

With the declaration of the HLP and the allowance for cutblocks greater than 40ha and/or green-up height being reduced to 1.3m., the CWAP author was asked to review the proposed level of harvest in the Klanawa watershed to assess the potential hydrological effects. This review determined it is important that terrain stability and sediment be aggressively managed and made the following recommendations:

CWAP Author Recommendation	Weyerhaeuser Strategies / Response
The 1999 CWAP recommended that harvesting be limited to cutblocks with a low hazard of a slide to occur that could enter a stream. For further clarity, I suggest that low hazard be defined as terrain with a probable landslide occurrence of no more than 1 slide per 100 ha logged.	*A terrain stability mapping calibration exercise will be undertaken to aid in determining landslide risk frequency.*
Terrain stability field assessments for proposed roads must consider potential instability from fillslopes, cutslopes and road drainage. TSFA's and engineering designs should contain a statement confirming that the hazard of instability that would reach a stream is low for all three factors.	*Specialists conducting TSFAs will be made aware of these criteria*
A work plan should be developed to assess the remaining high priority roads identified in the 1999 CWAP and to implement any recommended deactivation or remedial work.	*A work plan will be developed in 2001/2002 and implemented as recommended.*
Grass seeding of soil should be done wherever there is a potential for erosion to occur and cause sediment to transport to any stream. In particular: • Along all road sections adjacent to creek channels, where sediment eroding from or washing off the road could enter a stream, any exposed soil in cutslopes, fillslopes or ditchlines should be seeded unless otherwiseprotected with armour or other erosion control. • Cutslopes and ditchlines in soil materials should be seeded where they connect directly or via a ditchline to any stream. Fillslopes in soil materials should be seeded for at least 30 m on either side of all stream crossings. • All stream culverts should be armoured with rock or other suitable measures at the inlet and outlet; or seeded if grass would adequately protect against erosion. All ditchwater culverts in soil fills should be seeded at the inlet and outletunless otherwise protected by armour. Ditchlines should be seeded for atleast 10 m upgrade of the culverts. Other erosion control measures, such as sediment basins, erosion blankets,and ditch checkdams should be implemented as necessary and appropriate.	*These recommendations will be incorporated in road construction plans, deactivation prescriptions, and the workplan within this watershed.*

7.4 Interim Update (July 2001)

Klanawa River Coastal Watershed Assessment Procedure (CWAP)

An interim update of the CWAP was completed in July 2001 to assess the potential hydrological effects of the 2001-2005 Alberni East FDP. This was undertaken to address one potential implication of the Enhanced Forestry Zone designation of the Klanawa watershed under the Vancouver Island Higher Level Plan.

An update to the Klanawa CWAP was completed for this amendment. This update consisted of the following:

- Updating equivalent cut areas (ECA's) by sub-basin and elevation band for the proposed Forest Development Plan cutblocks and roads included in this amendment. The proposed cutblocks (including gross and estimated harvest area) and roads in this amendment are reflected accurately in the CWAP update.

- Updating (from GIS information) road deactivation and road construction information.

- Providing the results of a historical landslide survey completed by Denny Maynard and Associates and augmented by my additional information to upgrade the sediment source information in the 1999 CWAP.

- Reviewing the 1999 report recommendations in the context of the proposed harvest levels.

- Reviewing key channel reaches by comparing 1994 airphotos with 2001 orthophotos.

Results

At the end of 2005 with this Forest Development Plan, the ECA over the total watershed would be 27%. This is considered to be in the low-moderate range for peak flow effects, although it is noted that peak flow effects from ECA are unlikely to be evident in a drainage area of this size.

Since the impacted channels in this watershed are aggraded rather than degraded, the primary management concern continues to be to not increase the sediment load in stream channels. With the current heavy sediment loading, potential peak flow increases from increasing ECA's and road densities are unlikely to produce degraded channel conditions or to have a discernible impact on channel conditions. The main concern with the extent of proposed road construction is sediment originating from new roads and the potential for instability from road drainage. The specific management focus should be:

- Management of terrain stability;

- Continued mitigation of unstable or eroding roads;

- Management of sediment from new roads by good construction methods, application of the grass seeding strategy, and mitigative measures as needed to contain sediment;

- Adequate stream buffering on alluvial reaches so as not to increase the potential for channel instability.

Recommendations

Terrain stability and sediment sources continue to be critical concerns in this watershed and need to be aggressively managed.

CWAP Recommendation	Weyerhaeuser Strategies / Response
Terrain specialists carrying out terrain stability field assessments in this watershed should be provided with the Maynard report, "Klanawa Historical Landslide Inventory", and the revised terrain stability mapping that will be prepared with that project.	*A copy of this report and the revised terrain stability mapping derived from it will be provided to all specialists carrying out terrain stability field assessments in the Klanawa watershed.*
As recommended in my July 24, 2001 interim update, harvesting should be limited to cutblocks with a low hazard of a slide to occur that could enter a stream. For further clarity, to be consistent with the goals of this assessment, I previously recommended (July 24, 2001) that low hazard be defined as terrain with a probable landslide occurrence of no more than 1 slide per 100 ha logged.	*Specialists carrying out terrain stability field assessments in the Klanawa watershed will be aware of this recommendation and the mapping referred to above will aid in determining the probable landslide occurrence.*
Terrain stability field assessments for proposed roads must consider potential instability from fillslopes, cutslopes and road drainage; and should contain a statement confirming that the hazard of events that would reach a stream is low for all three factors.	*Specialists carrying out terrain stability field assessments in the Klanawa watershed will be aware of this recommendation.*
Where cutblocks are immediately adjacent to Class IV and V terrain, terrain stability field assessments should evaluate this adjacent terrain as well as the cutblock, and consider the possible effects on the adjacent terrain from windthrow disturbance.	*Specialists carrying out terrain stability field assessments in the Klanawa watershed will be asked to consider the possible effects from windthrow disturbance on immediately adjacent Class IV and V terrain.*
While potential peak flow increases from high ECA's are unlikely to have significant effects on the channels at the watershed level or for the large basins, a precautionary approach continues to be warranted in Basin 3 (West Fork). Continued channel instability is still evident in Reach W1.	*At the end of 2005, the ECA in the rain-on-snow zone would be 24% and over the total basin is also 24%. This is in the low-moderate range for peak flow effects and is within limits recommended in the July 24, 2001 update. ECA's in the sub-basins (upper West Fork, Gorge Creek and Bottaro Creek) will be in the low to moderate range (=<30%). Effects on the channels from these ECA's would be low.*

CWAP Recommendation	Weyerhaeuser Strategies /Response
Until channel recovery in the West Fork is further advanced, I recommend that for planning beyond 2005, ECA's in Basin 3 continue to be limited to 30%, and ECA in the rain-on-snow zone (300 – 800 m) be limited to 25%. The ECA recovery in Basin 3 is currently 63 ha per year, with 35 ha per year in the rain on snow zone. (Recovery was determined from the average tree growth in the existing 2nd growth from 2002 to 2007). Setting net harvest levels in Basin 3 cumulated over a 5-year period to within the ECA recovery would maintain the ECA within the recommended limits.	

8.0 Sproat Lake CWS

The CWAP was completed in August, 2000. The Sproat Lake watershed is a designated Community Watershed. The water licence is held by the Hupacasath First Nation. Other water licensees within the watershed include Pacifica Papers for the paper mill in Port Alberni and several individuals for domestic water. The Sproat Lake CWS has a total area of 35,428 ha. Ninety-five percent of the CWS is managed by Weyerhaeuser within TFL 44.

The specific concern in the Sproat Lake watershed is sediment generation that could affect water quality for the community water supply; and which could also affect fish habitat.

8.1 Changes to the watershed and work carried out since 1997 CWAP

There have been no new landslides in the watershed since the 1997 CWAP.

The following work has been carried out since the 1997 CWAP:

- Permanent deactivation of 10 km of roads, and semi-permanent deactivation of 55 km of roads.
- Seeding of landslide tracks and deactivated roads.
- Maintenance upgrading of the Antler Creek roads (540 road system).
- Armouring of two wood culverts on Great Central Main, as recommended in the CWAP roundtable meeting.
- Construction of a groundwater pond and channel in the upper Taylor, at the site of an old flooded gravel pit (FRBC project).
- Construction of a sidechannel in the lower Taylor (FRBC project).

A debris jam at the inlet end of the highway culvert at Bookhout Creek is gone. The jam, which obstructed about two-thirds of the inlet area, was noted in a field reconnaissance for the July 1997 CWAP.

8.2 Equivalent Cut Area

The total area logged over the watershed has increased from 13,871 ha to 14,590 ha since December 1995, an increase of 719 ha. This is less than the total cut area proposed in the 1997 Forest Development Plan (Table 3 in the July 1997 CWAP report).

Except for Gracie Creek and Snow Creek, ECA's in all basins have declined. ECA's for Gracie Creek and Snow Creek have increased slightly (by 2%). ECA's for all basins are low. Much of the second growth has reached 9 m in height and thus attained the maximum level of recovery achievable under the ECA model in the April 1999 CWAP guidebook. The rate of ECA recovery (projecting from the 1997 IR data for 2000 to 2005) is 100 ha per year. This means that, if no **further** harvesting is carried out, the ECA will decline by an average of 100 ha per year from 2000 to 2005.

8.3 Recommendations for Watershed Management

Recovery in this watershed is well advanced. The objective should be to protect the alluvial streams (Taylor and Gracie Creek) against further impacts and to allow continued recovery. As well, the habitat enhancement work in the Taylor should be protected from logging related impacts.

Recommendation	Weyerhaeuser Action / Response
Trim back and armour the eroding section of Taylor Main (approximately 3.4 km west of the gluelam bridge over the lower Taylor). This will probably to be done during the fisheries window, and should be scheduled at the earliest opportunity.	*Rock groins were installed in the Taylor River in September 2000 in an attempt to deflect water flow away from Taylor Main. The effectiveness of this project will be monitored and if required, further work such as armouring and/or further in-stream work will be undertaken.*
Remove the eroding culvert in the upper Antler Creek basin on a spur off the 540F road.	*The culvert will be removed in 2001 if the proposed road deactivation is approved.*
Pull back the fill shoulder at the tension cracks on the upper Taylor main about 100 m past the last bridge.	*The fill will be pulled back in 2001.*

Recommendation	Weyerhaeuser Action / Response
Include permanent deactivation of the 540 road system in a long term plan for risk management of the road system.	*This road system accesses a large area. Spur roads not required for long-term access will be deactivated to an appropriate level. Roads required for long-term access will be maintained and inspected regularly. The inspections will include an annual inspection by a P. Eng. or P. Geo.. The active road system will be temporarily deactivated when not required for harvesting operations.*
In the absence of other effects, there is no evidence linking high ECA's with increased channel erosion in coastal watersheds. However, given the sensitivity of alluvial reaches of Gracie Creek, and as it is not yet fully recovered, it would be prudent to continue taking a precautionary approach in this basin with rates of cut. The rate of cut should be set so that the unweighted ECA does not exceed 30%.	*The unweighted ECA for the Gracie Creek basin (2390 ha) will be managed to remain below 30%. It is currently at 15% and is recovering at a rate of 6 ha/yr. This plan proposes 135.2 ha of harvesting (conservatively using gross area of all cutblocks (including Category I blocks): 2505, 2511, 2532, 2542, 2556, 2560, 2562, and 2563) in this basin which, accounting for recovery, will result in an unweighted ECA of 19.4 % at the end of the five year period covered by this FDP.*
In Gracie Creek and Taylor River basins, a low risk approach should be taken for harvesting and road construction that could impact the Gracie Creek channel, the lower reaches of Sutton Creek, the new habitat channels on the Taylor River, or the alluvial reaches of the Taylor River. It is recommended that "low risk" be defined as a 10% or less chance of a slide occurring that could enter the stream. Terrain specialists carrying out terrain stability field assessments should be made aware of this criterion.	*Professionals carrying out TSFA's will be made aware of this recommendation for these basins. Cutblocks and/or roads that can not meet this criteria will not be harvested and/or constructed.*
Continue to assess and deactivate as necessary roads that are potentially unstable. Proposed priorities for assessment are shown on the Roads map in Appendix II. Except for the sections of Taylor Main close to the channel, maintained roads on steep slopes are identified as Priority 3 for assessment, because it is expected that any critical problem areas would be addressed during maintenance.	*This information is used to prioritize road deactivation assessments and work.*

Recommendation	Weyerhaeuser Action / Response
Thin fringes left along stream channels have proved to be susceptible to windthrow and do not provide an adequate buffer. Plans for harvesting in the second growth should include providing good buffers along alluvial reaches of Gracie Creek, Sutton Creek and the Taylor River. Buffers left to protect streams should be treated, or of sufficient width, so that their function is not lost because of windthrow.	*Appropriate RMA's will be preserved along Gracie Creek, Sutton Creek, and Taylor River channels, especially along sections with erodible banks. Windthrow potential will be a major factor in determining RMA widths and treatments. The objective is to leave an RMA that will not lose its function even if some windthrow occurs.*
Normal good practices for road construction, riparian management, and management of terrain stability as defined in the Forest Practices Code and guidebooks are appropriate for the rest of the watershed. Terrain stability field assessments should be carried out for any new roads or cutblocks on potentially unstable terrain.	*TSFA's will be carried out as required by the FPC. Recommendations of TSFA's will be incorporated into Road Layout and Designs and Silviculture Prescriptions.*

9.0 Macktush Creek

The CWAP update was completed in August, 2000. The Macktush Creek watershed comprises an area of 2798 ha draining into the west side of the Alberni Canal. The original CWAP was done by M. Miles & Associates Ltd. in July 1996.

Sediment sources from roads and hillslopes have visibly improved since the 1996 Miles assessment. Although early indications of revegetation on channel bars and banks are promising, it is premature to suggest that the channel is recovering. Except for major events such as an extreme storm or large landslide, significant channel change is rarely detectable within intervals of less than 10 years.

The Miles report determined that Reach 4 (the alluvial reach extending upstream from the debris jam at the top of the canyon) has been severely impacted by logging. This is the "key reach" in this watershed for evaluating impacts and potential recovery. Vegetation (willows, salmonberry) appears to be spreading on the gravel bars, and increasing in size and density along the channel banks. However, active bank erosion is still occurring and it is premature to suggest that this reach is recovering.

The morphology of the lower part of this reach is also influenced by a debris jam that forms at the downstream end of the reach, at the top of the canyon. This choke point is known to have a cyclic history of building then releasing a debris jam. While this is probably a natural cycle, the rate of sediment and debris

accumulation has been greatly increased by the effects of logging. As of the field review (July 8, 2000), the debris jam has developed a large sediment wedge that has created a gradient step 2 – 3 m high at the debris jam. In its present state the debris jam is a barrier to fish passage. Because the debris jam effectively prevents downstream transport of sediment, the lower alluvial reach is depleted of gravel-sized sediment. DFO habitat specialists suggest that habitat downstream from the debris jam could be improved by removing the jam and releasing the sediment. It is understood that the debris jam will reform, and would need to be removed again in future. It may be advantageous to continue to remove debris jams that form until the rates of sediment and debris accumulation have decreased to natural levels.

The jam would have to be removed by blasting. Once the debris jam is removed, release of sediment and stream downcutting across the wedge will happen rapidly. This work should be done during dry weather when the stream is at seasonal low flows. Removal of the jam should only be done with approval from, and in consultation with, habitat specialists from DFO and MOELP.

MoELP has applied to DFO to remove the debris jam in the summer of 2000. In September 2000, the main log within the debris jam was partially removed utilizing explosives. This resulted in a portion of the debris jam being removed and it appears that some sediment has been released from the wedge that had built up above the debris jam.

9.1 Logging, Road Construction and Deactivation since 1996

Logging since 1996 has been limited to less than 4 ha at the lower end of the watershed. There has been no new road construction since 1996. The upper part of Macktush Main has been permanently deactivated, and semi-permanent deactivation has been carried out on the 114F Road (off Ridge Main), roads in the Upper Kanyon area, and the M150 Road. Over half of the roads in the watershed are now either permanently or semi-permanently deactivated.

Road deactivation has been complicated by requirements to keep access available to mining claims. It would have been desirable to completely debuild sections of the M400/430/440 road systems. However, the miner required (and was entitled to) access to his claims on both sides of the valley. Pullback of road fills was therefore limited to what could be done that would leave 4x4 access. Consequently there are residual fills remaining on some roads shown to be permanently deactivated.

9.2 Equivalent Cut Area

Because very little harvesting has been carried out since 1996, and because much of the second growth has been in a rapid growth stage, the unweighted ECA has declined to 26%. The rate of ECA recovery (projecting from the 1997 IR data for 2000 to 2005) is 44 ha per year. This means that, if no further harvesting is carried out, the ECA will decline by an average of 44 ha per year from 2000 to 2005.

9.3 Recommendations for Watershed Management

There is interest in salvaging the windthrow patch in the upper watershed, and resuming limited harvesting. This could be done without causing impacts to the stream, provided that a low-risk management approach is taken.

Recommendation	Weyerhaeuser Action / Response
The washed-out culvert at Km 5.2 on Macktush Main should be removed, or properly reconstructed and armoured.	*This culvert will be reconstructed and armoured in 2001.*
There is a large crib on the M150 road directly upslope of the washed-out culvert at Km 5.2 on Macktush Main. The M150 Road is under Road Permit. The crib should be inspected regularly to check its condition.	*This crib will be inspected on a regular basis.*
At Km 4.3 on Macktush Main there is a pipe culvert at a small seasonal stream; the pipe is about two-thirds plugged with sediment. The culvert should be cleaned out or removed.	*This culvert will be cleaned or replaced in 2001.*
The rest of Macktush Main that is not deactivated should be inspected periodically and culverts cleaned as necessary.	*Ongoing road maintenance and inspections will uncover any remedial work required.*
There are sections of steep fills along Kanyon Main in the upper part of the watershed. Fill stability on these sections should be assessed during maintenance inspections.	*Ongoing road maintenance and inspections will uncover any remedial work required.*

Recommendation	Weyerhaeuser Action / Response
In the absence of other effects, there is no evidence linking high ECA's with increased channel erosion in coastal watersheds. However, given the severity of past impacts to the alluvial channel in Reach 4 and its continued sensitivity, it would be prudent to take a precautionary approach with rates of cut. It is recommended that the rate of cut stay below the rate of recovery so that the ECA will continue to decline. That is, the area harvested should be no more than about 40 ha per year, or 25 ha per year in the rain-on-snow zone (300 – 800 m elevation).	*There are six blocks in this plan within the Macktush watershed: 1606 (I), 1609 (I), 1640 (I), approximately 4ha of 161212 (I), approximately one-half of 162118 (PRO), and 162313 (PRO). The SP's for Blocks 1606 and 1609 have been previously rejected by the MOF. In rejecting the SP's the MOF identified that the blocks would be considered for approval in later years of subsequent plans once the watershed was showing improvement from the WRP works underway. The portion of cutblock 162118 within the Macktush watershed and cutblock 162313 are downstream of Reach 4. At the WAP meeting of October 31, 2000, it was agreed that the area of most concern is the rain-on-snow zone (300m-800m elevation) above the location of the debris jam. It was stated that a rate-of-harvest within this zone that was no more than one-half the rate of recovery should allow the watershed to continue recovering, provided the other CWAP recommendations are adhered to. Cutblock 1609 falls within this area of concern. The harvest area of this cutblock is approximately 24ha. This part of the watershed is recovering at a rate of 24ha/yr. Further discussion is provided in Section 7.7.1. Overall, this plan proposes 116 ha (23.2 ha/yr) of weighted ECA harvesting (conservatively using gross area of all cutblocks (including Category I blocks)) within this watershed. This is less than the recommended harvest limit of 25 ha/yr.*
For harvesting and road construction that could impact the Macktush Creek channel, it is recommended that "low risk" be defined as a 10% or less chance of a slide occurring that could enter the stream. Terrain specialists carrying out terrain stability field assessments should be made aware of this criterion.	*Professionals carrying out TSFA's will be made aware of this recommendation. An analysis of the Macktush watershed, as described in the letter dated January 22, 2001 from G. Horel, P. Eng. (copy included in Appendix 7.7.1), will be undertaken for the Macktush watershed. This analysis will calibrate the risk of open-slope failures following harvesting within the different terrain stability class polygons within the Macktush watershed. This analysis will provide the information to determine the 10% risk criteria. Cutblocks and/or roads that can not meet this 10% criteria will not be harvested and/or constructed.*
Buffer areas intended to protect stream channels, gullies, and potentially unstable slopes should be treated, or of sufficient width, so that their function is not lost because of windthrow.	*Windthrow potential will be a major factor in determining RMA and other buffer widths and treatments. The objective is to leave an RMA that will not lose its function even if some windthrow occurs.*

Recommendation	Weyerhaeuser Action / Response
Assessment of proposed new roads should specifically address: • Fillslope stability of proposed road locations on steep slopes; • Stability of cutslopes of any road sections on steep slopes likely to be in mainly non-rock material; • The potential for downslope instability from road drainage, including culvert and ditch maintenance considerations for steep grades in non-rock materials; • The potential for significant ditch erosion on steep grades in non-rock materials where the ditches connect to streams. Terrain stability field assessments and engineering road designs should include statements confirming whether or not the above concerns can be addressed to meet the risk objectives in this watershed.	*Professionals carrying out TSFA's will be made aware of this recommendation.*
Check that stream culverts on active roads are well armoured; repair and vegetate as necessary to control erosion.	*Ongoing road maintenance and inspections will uncover any remedial work required.*
Seed exposed soil immediately after new road construction, or after maintenance activities such as ditch cleaning.	*Exposed soil will be seeded within the first growing season.*

10.0 Cous Creek

This CWAP update was completed in August, 2000. The Cous Creek watershed comprises an area of 7427 ha draining into the west side of the Alberni Canal. Of the watershed area, 1682 ha (23%) lies below 300 m elevation; 4818 ha (65%) is between 300 m and 800 m elevation; and 928 ha (12%) is above 800 m elevation. The Cous Creek watershed has been extensively harvested over the past 40 years. A total of 72% of the watershed area is logged; over half of this (44% of the watershed) was logged more than 20 years ago. Canada Department of Fisheries and Oceans (DFO) has expressed concerns regarding the possible impacts of the harvesting history on anadromous fish habitat

10.1 Logging, Road Construction and Deactivation since 1996

There has been less than 20 ha of logging since 1996, and no new road construction. All of the roads in sub-basins 3B and 3C, and about a third of the roads in the remainder (3-0) of basin 3 have been permanently or semi-permanently deactivated.

10.2 Equivalent Cut Area (ECA)

Because harvesting since 1996 has been minimal, and because much of the second growth has been in a rapid growth stage, the unweighted ECA for the total watershed has declined to 20%. Basin 1 has the highest unweighted ECA at 28%. The rate of ECA recovery (projecting from the 1997 IR data for 2000 to 2005) for the total watershed is 78 ha per year. This means that, if no further harvesting is carried out, the ECA will decline by an average of 78 ha per year from 2000 to 2005. The rate of recovery projected for 2000 – 2005 is considerably less than the rate of recovery projected for 1995 – 1999. This is because much of the second growth has reached 9 m in height and thus attained the maximum level of recovery achievable under the ECA model in the April 1999 CWAP guidebook.

10.3 Recommendations for Watershed Management

The “key reach” in this watershed is R5, the alluvial channel in Basin 3. This reach experienced increased bank erosion, sediment aggradation, channel widening and loss of functioning large wood debris, mainly from road construction and logging 20 – 40 years ago.

The riparian forest along this reach is tnow 30 – 40 year old second growth. Bands of alder along the channel banks, and patches of alder, willow and salmonberry on bars show that the channel width is decreasing. There are several escarpments that are continuing to erode (Plate 3), but vegetation on the face of the escarpments suggests that the rate of erosion may be decreasing. There is still considerable sediment stored in the channel and on bars, and functioning large wood is scarce. Under natural conditions, large wood debris would usually be expected along the sides of the channel and on bars in this reach. The current level of impact is estimated to be moderate, and recovering.

Downstream from Reach R5, Cous Creek has a predominantly bedrock-controlled non-alluvial channel. Channel banks are generally non-erodible and wood debris does not function in channel morphology. Sediment or debris introduced to these reaches tends to transport through the system fairly quickly. These reaches appear to be in a near-natural condition.

Recovery in this watershed is well advanced. The objective should be to protect the streams against further impacts and to allow continued recovery, especially in the sensitive alluvial reach (R5).

Recommendation	Weyerhaeuser Action / Response

Recommendation	Weyerhaeuser Action / Response
In the absence of other effects, there is no evidence linking high ECA's with increased channel erosion in coastal watersheds. However, given the sensitivity of reach R5, and as it is not yet fully recovered, it would be prudent to take a precautionary approach in Basin 3 with rates of cut. In this basin, it is recommended that the rate of cut not exceed the rate of recovery. That is, the area harvested should be no more than 40 ha per year, or 25 ha per year in the rain-on-snow zone (300 – 800 m elevation).	*Basin 3 will be managed such that the ECA at the end of this FDP is no higher than it was when the CWAP was completed. That is, no more than 200 ha of weighted ECA will be harvested during the five year period covered by this FDP. This FDP proposes 50 ha of weighted ECA harvesting in Basin 3 (conservatively using gross area of cutblock 1616 – the only cutblock within Basin 3).*
Terrain stability field assessments should be carried out for any new roads or cutblocks on potentially unstable terrain.	*This is a requirement of the FPC.*
In Basin 3, a low risk approach should be taken for harvesting and road construction. It is recommended that "low risk" be defined as a 10% or less chance of a slide occurring that could enter the stream. Terrain specialists carrying out terrain stability field assessments should be made aware of this criterion. Seed exposed soil immediately after new road construction, or after maintenance activities such as ditch cleaning.	*Professionals carrying out TSFA's will be made aware of this recommendation for this basin. Cutblocks and/or roads that can not meet this criteria will not be harvested and/or constructed. Seeding of exposed soil following road construction is a requirement of the FPC. Seeding will also be done following large road maintenance activities (such as extensive ditch cleaning, major culvert and bridge replacements, and cutslope/fillslope stabilization work).*
Thin fringes left along stream channels have proved to be susceptible to windthrow and do not provide an adequate buffer. Plans for harvesting in the second growth should include providing good buffers along the alluvial channel in Reach R5, and on other stream reaches in tributaries with erodible banks. Buffers left to protect streams should be treated, or of sufficient width, so that their function is not lost because of windthrow.	*Appropriate RMA's will be preserved along the stream channel in Reach R5. Windthrow potential will be a major factor in determining RMA widths and treatments. The objective is to leave an RMA that will not lose its function even if some windthrow occurs.*
Normal good practices for road construction, riparian management, and management of terrain stability as defined in the Forest Practices Code and guidebooks are appropriate for the rest of the watershed.	*TSFA's will be carried out as required by the FPC. Recommendations of TSFA's will be incorporated into Road Layout and Designs and Silviculture Prescriptions.*

11.0 Nahmint River

The Watershed Assessment for the Nahmint was completed in February 1998. The assessment indicates that there is a low probability for negative cumulative effects on the aquatic resources of the watershed, although some site specific problems do exist.

11.1 Recommendations for Watershed Management

Recommendation	Weyerhaeuser Action / Response
There are no ECA or rate-of-cut constraints for the overall watershed. However, restrictions should be considered for some sub-basins to address the potential for harvest related flow increases. These are:	
• For sub-basins 2 and 7, harvesting for the next 5 year period should be limited to a level that does not increase their present ECA level. This corresponds to approximately 70 ha. for sub-basin 2 and 60 ha. for sub-basin 7. Harvesting opportunities beyond this 5 year period can be determined by reviewing the sub-basin conditions and ECA recovery near the end of this period. Concurrent with any harvesting in these sub-basins, road deactivation to address slope hydrology should be completed.	• *There is harvesting planned for Sub-basin 2 (Empress Lake) in this FDP. Cutblock #161212 is proposed with a gross area of 59ha and a harvest area of 36 ha. Both areas are less than the recommended maximum. In Sub-basin 7 (Gracie Lake), this plan illustrates 60 ha of gross cutblock area (two-thirds of #2512, #2517, #2561, and #2564). Actual harvest area will be less than the recommended maximum. The harvesting opportunities beyond this FDP will be subject to another CWAP as the FPC calls for a CWAP every 3 years. Road deactivation carried out in these sub-basins is illustrated on the 1:20,000 map set.*
For sub-basin 4, harvesting in the next 10 year period should be very limited, and should be considered if no new roads are required. Harvesting should be limited to a maximum of approximately 10 ha. for the next 10 years to allow for a small reduction in ECA from its present high level. Concurrent with any harvesting in this sub-basin, road deactivation to address slope hydrology should be completed.	• *Harvest in this sub-basin (Anderson Creek) is proposed within the next 5 years (cutblock 1528). The total area proposed in the FDP is greater than 10 ha, recognizing that approximately 10 ha of harvest area is available. The Effective Clearcut Area will be 10 ha or less to be consistent with this CWAP recommendation. No new roads are proposed and the majority of roads in the sub-basin have been deactivated.*
Because of the peak flow and erosion concerns with roads in sub-basins 2, 4 and 7, it would be worthwhile to develop and implement a road deactivation and rehabilitation plan concurrently with forest development. At a minimum, this road deactivation should include extensive cross-ditching to assist with the restoration of slope hydrology.	*Roads under road permit are required to be maintained or deactivated. The current deactivation status and planned deactivation is shown on the 1:20,000 map set.*

Recommendation	Weyerhaeuser Action / Response
Increasing amounts of logging in the Nahmint River watershed will be located in areas of challenging landslide and avalanche prone terrain. At this time, the Nahmint River does not have significant concerns related to forestry related landsliding. To ensure that problems do not result, it is recommended that field terrain assessments be used for blocks proposed on areas of terrain stability class IV and V, and on any other areas proposed for development where there are indicators of instability on the ground.	*All cutblocks shown in the FDP in areas of unstable (Class V) or potentially unstable (Class IV) terrain are required by the FPC to have Terrain Stability Field Assessments (TSFA) completed prior to submitting a cutting permit. As well, any areas that have field indicators of instability as identified in the Assessing Terrain Stability Guidebook require a TSFA.*
In Sub-basin 5, Blocks #1508 and #1512 should be reviewed and amended to ensure that slope stability is maintained.	*Block #1512 was dropped from the plan in favor of an enlarged Block #1509. A TSFA was required for block #1508. Harvesting plans were consistent with the TSFA for the block. Cutblock #1511 and two-thirds of #1525 are in this sub-basin. Cutblock #1511 has had a TSFA completed and the block is consistent with it and the THPR.*
Harvesting above Gracie Lake should be limited to an ECA of less than 15% to maintain snow hydrology characteristics.	*Block #2512 is shown with a gross area of 34 ha. To comply with the CWAP the actual weighted ECA of the block will not exceed **30 ha**, which is 15% of the 200ha watershed above Gracie Lake.*

12.0 Wolf Creek

The assessment of the Wolf Creek drainage completed on September 25th 1998 indicates that potential negative effects of harvesting on Wolf Creek will be related to three factors:

1) Extent of harvesting

2) Riparian and stream protection

3) Landslides from steep terrain in the Weyerhaeuser portion of the upper watershed.

The extent of harvesting is probably the least important of these three factors.

The CWAP identified that the current ECA was estimated at 20%; this included all TimberWest harvesting to that time and Weyerhaeuser's planned 98/99 blocks. It identifies that the watershed could sustain a level of harvesting that resulted in ECA being increased to 35-40 percent with low risk for hydrological impacts or stream channel disturbance, provided that adequate riparian and hillslope protection is ensured.

If TimberWest was to log the 450 ha that are estimated to be available in their portion of the Wolf Creek watershed over the next ten years, the ECA for the watershed would rise to about 32 percent. If TimberWest were to harvest at this rate, harvesting by Weyerhaeuser would likely be limited to approximately <150 ha over 10 years. 600 ha of logging by the two landowners over 10 years would result in an ECA of about 38 percent.

The CWAP goes on to point out that the potential harvest available to Weyerhaeuser clearly depends on the extent of harvesting conducted by TimberWest. If TimberWest cuts all their available wood over the next 10 years, some logging potential remains for Weyerhaeuser. There is a low risk for stream flow changes and channel disturbance associated with this, but there are risks associated with such a high rate-of-cut. Those risks are related to the extent of site disturbance over a short period of time, and to the extent of machine and truck use on roads. The risks can be ameliorated somewhat by good riparian protection, by good site-level control of erosion, and by minimizing work and hauling during wet conditions. An overall gentler approach, though, would be to distribute 800 ha of harvesting over 20 years (~450 ha for TW and ~350 ha for Weyerhaeuser), allowing both land owners significant cut. At this rate, the ECA value will remain below 35%, the potential hydrological risks are low, and the rate-of-cut is reduced to a moderate level.

It currently appears that a high rate of harvest is planned for TimberWest's private lands. A high rate of harvest will impact on Weyerhaeuser's opportunities to harvest timber within the Tree Farm Licence portion of Wolf Creek over the next ten years or so.

12.1 Recommendations for Watershed Management

The CWAP recommends the following principal factors to minimize disturbance:

Recommendation	Weyerhaeuser Action / Response
Good riparian management, including the maintenance of forested zones on all streams. At a minimum the riparian treatments recommended by the old Coastal Fish Forestry Guidelines should be used.	*FPC requirements and current DFO interpretation of the Fisheries Act usually prescribe riparian treatments in excess of the CFFG.*
Haul roads to be constructed such that road drainage is not concentrated along long ditch lines. Use cross drains or culverts to get water out of the ditches and on to the forest floor, where sediments will settle out.	*The requirements of the Forest Road Regulation (FRR) prescribe getting the water out of the ditch lines.*
Minimize the extent of exposed mineral soil by seeding road cut slopes where appropriate.	*This is a requirement of the FPC.*
Use the services of a hydrologist to design road drainage at critical points, to minimize the entry of turbid water into the creek.	*A hydrologist or Professional Engineer is retained if a stream crossing requires a bridge, a major culvert, or if the crossing requires construction of sills or pads higher than 1.5 meters (as per FRR section 10).*
Minimize machine use and hauling during wet weather, or when the roads are muddy.	*The hoechucking and backspar guidelines for the Sproat Lake Operation give guidance to machine operators to address soil management issues. Roads are built and maintained so they can be used during wet conditions. Muddy areas are patched as part of the ongoing maintenance program. Ditches are designed so the ditch water is discharged to the forest floor or that there is a sump where sediments can settle out before a ditch meets a stream.*

12.2 Logging, Road Construction and Deactivation since CWAP completed

Weyerhaeuser has harvested approximately 67 hectares in the Wolf Creek drainage since the CWAP was completed (Blocks #4524, #4601 and #4602). There is 23.0 ha of approved Category A cutblocks yet to be harvested within this watershed (blocks #4605 and #4606). This FDP proposes no new cutblocks within this drainage. This total area is less than the upper limit of 150 ha in the next ten years that are suggested in the CWAP, if TimberWest harvests all of their timber in Wolf Creek.

13.0 Henderson Lake

The Henderson Lake watershed (14,218 ha) drains into Uchucklesit Inlet. Weyerhaeuser manages 99% of the watershed under TFL 44. 126 ha at the mouth of the watershed on Uchucklesit Inlet are Uchucklesaht First Nation reserve land. The Uchucklesaht operate a fish hatchery at the head of Henderson Lake near the outlet of Clemens Creek.

The Henderson watershed is an area of very high rainfall with intense rainstorms. Thin soils and moderate to steep, bedrock dominated, slopes over much of the watershed, provide for low infiltration and high runoff rates. The occurrence of logging-related landslides in this watershed is low. There are very few post-harvesting slope or gully failures. Most logging-related failures are from old roads. There are many natural slides, especially in the Clemens basin, which provide on-going supplies of sediment to the stream channels.

13.1 Recommendations for Watershed Management

Recommendation	Weyerhaeuser Action / Response
WRP projects should not assume that remediation of logging-related sediment sources will control sediment input into streams.	*None.*
No further logging take place on the Clemens valley floor.	*No cutblocks are proposed on the Clemens valley floor.*
Design of drainage structures must take into account the high rates of run-off, flashy stream behavior and high transport potential in the watershed. Good erosion protection around culverts and in ditches where they discharge directly into anadromous channels should be provided. This is very significant where ditches drain into small anadromous channels.	*All culverts and permanent bridges are designed to handle 100-year flood events. Temporary bridges are designed to handle 50-year flood events. Erosion protection and sediment control measures are incorporated in drainage design and construction.*
The section of Clemens Main close to the stream channel should be assessed to determine if remedial work is necessary to prevent the fill from raveling or sloughing into the channel; and to control sediment from the road and ditch from washing into the channel.	*This section of Clemens Main will be assessed in 2001.*
Specialists doing TSFAs should be made aware of the small anadromous channels.	*All professionals completing TSFAs are given 1:5000 scale maps with stream classifications indicated.*

14.0 Coeur d'Alene Creek

The Coeur d'Alene watershed drains into Effingham Inlet. The total watershed area is 2059 ha; 97% is managed by Weyerhaeuser under TFL 44. The balance of the watershed area, at the stream outlet and estuary, is Uchucklesaht First Nation reserve land.

Most of the channel is incised in the valley floor and has a low potential for bank erosion. Much of the channel is bedrock controlled. Natural and logging-related landslides have had little influence on channel morphology. The channel character is dominated by the flashy hydrologic response of the watershed and high-velocity peak flows. There is a low potential for post-harvesting failures. The majority of logging-related failures have been from roads.

14.1 Recommendations for Watershed Management

Recommendation	Weyerhaeuser Action / Response
Manage the watershed as a single unit with respect to rate of cut, ECA and road density.	*Watershed will be managed as a single unit with respect to ECA and road density. Future CWAP updates will analyze the watershed as a single unit.*
Riparian buffers should be preserved along the Coeur d'Alene and Dyslexic Creek channels. In particular, avoid logging erodible channel banks and escarpments above the channel.	*Appropriate RMA's will be preserved along Coeur d'Alene and Dyslexic Creek channels, especially along sections with erodible banks. Windthrow potential will be a major factor in determining RMA widths and treatments. The objective is to leave an RMA that will not lose its function even if some windthrow occurs.*
The condition of roads, and the effectiveness of any existing deactivation, should be assessed to determine if further work is needed.	*Ongoing road maintenance and inspections will uncover any remedial work required. The effectiveness of road deactivation will be a component of future CWAP updates.*
TSFA's should be done on all proposed road locations on steep (>60%) or potentially unstable terrain.	*TSFA's are undertaken for all roads and cutblocks that intersect a potentially unstable or unstable terrain polygon; or if field indicators of instability are found.*

Recommendation	Weyerhaeuser Action / Response
Provided that stability and erosion on the road systems are properly managed, and riparian buffers are preserved along erodible banks, road densities and ECAs in the moderate range (up to 2.0 km/km^2 and up to 40% respectively) would cause minimal impacts on channel morphology.	*The CWAP assessment concluded that the weighted ECA would be at 25% by the end of 2001 and road density would be 1.9 km/km^2 (based on 1997-2001 FDP). These numbers were based on constructing 3.3 km of road, not taking into account any road deactivation, and harvesting 88 ha (with an ECA of 120ha). Since the CWAP was completed, approximately 65 ha of harvesting has occurred (with an ECA of approximately 90 ha); therefore the current ECA is at approximately 23.5%. This FDP proposes 172 ha of weighted ECA harvesting in this watershed (conservatively using gross area of cutblocks 051409, 0525, 053209, 0535, 0536, 0537, and 054111), which, not accounting for recovery, would bring the ECA to 31.9% at the end of the five year period covered by this FDP.*