Vancouver Island Riparian Restoration Recommendations and Prescriptions – Quinsam, Chemainus, Englishman, Little Qualicum, and Oyster Rivers

By

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INTRODUCTION

As part of an integrated program to rebuild salmon and steelhead stocks on the east side of Vancouver Island the BC Conservation Foundation (BCCF) was awarded a project to identify and prescribe riparian treatments in the Quinsam River, Chemainus River, Englishman River, Little Qualicum River, Oyster River, and Cluxewe Rivers. Vince Poulin, *V.A. Poulin & Associates Ltd.* was retained by the BCCF to undertake the assessments and provide prescriptions and recommendations for their treatment.

The large area of interest necessitated BCCF identify priority areas for assessment and prescription. The areas selected were reaches of river where fish habitat restoration structures were planned or had been constructed. Even with this stratification the amount of area included was still too large to prescribe in entirety. This necessitated approaching the project at two levels of assessment corresponding to Overview and Level 1 and Level 2 riparian assessments. Work on the Quinsam River, Chemainus River and Englishman River was adequate to complete and prescribe treatments. Work on the Oyster River and Little Qualicum River was taken to the level of an Overview. It was not possible to complete work for the Cluxewe River. All of the rivers share common riparian problems and stand types. Treatments within them will not differ greatly, but in order to specify treatments with confidence further fieldwork is necessary in these areas. Accordingly prescriptions are provided for the Quinsam River and Englishman River (Level 1 and Level 2 assessments). After meeting with Ken Epps, Weyerhaeuser to discuss restoration options for the Chemainus it was decided private land management practices limited riparian restoration opportunities, but options were open for partnering with Weyerhaeuser to trial projects leading to conversion of alder dominated stands to conifer. Elsewhere overview mapping was completed and first-approximation recommendations for restoration provided.

Project Rationale

The relationship between recovery of fish habitat and stream side trees is not well understood despite hundreds of hectares of riparian treatments completed in British Columbia by the former "Watershed Restoration Program. During WRP procedures for assessing riparian stands and treating them were established, but since the dismantling of WRP work on speeding recovery of riparian stands has come to a virtual stand still making it critical groups such as BCCF with support from MWLAP and DFO now take the lead. It will not be easy. Riparian restoration is long-term, expensive, and scary. To grow bigger and faster trees you need to remove the ones impeding their progress. This idea does not sit well with biologists and managers who for years protected every tree. Most gardeners understand what needs to be done – thin, pluck, plant and nurture.

Why Treat?

Trees are the cement that glues watersheds together and an essential component of fish habitat. Individual logs and the jams they form give width and depth variability to streams. The habitat provides cover and space to fish. Stable structures control gravel scour ensuring greater survival of fish eggs. Size matters in the world of riparian trees. Young conifers and early pioneering deciduous trees such as alder and birch lack the size and strength of the big giants. Their roots bear no resemblance to the massive structure provided by legacy trees. Old-growth trees commonly exceed 50 m in height and 1.5 m in diameter. When they fall they made a statement. Their large size spans channels or anchors solidly. Their wide lateral roots hold long sections of stream bank together maintaining channel width and retaining flushing flows. These processes were operating on all the rivers assessed prior to development. It doesn't take much imagination to see the difference, but a picture is worth a thousand words (Figure 1).

Figure 1 legacy Douglas fir stumps on the Chemainus River

Extent of Problem

Just how bad is it? Habitat loss from BC coastal streams is serious and unfortunately riprap and artificial construction cannot replace the quantity and quality of stable habitats once provided by intact mature forests and old-growth stands. Made worse is today's riparian stands are now predominantly second growth (Figure 2). Most have been cut at least once and have been reforested either naturally or by timber companies. By comparison to pre-harvest stands the trees in them are mere adolescents. They haven't quite got their legs and won't for many years. They are tall, spindly and without size. Young conifer stands are almost always overstocked, with each tree competing for limited space. Self-thinning and the ultimate rigor of wind, insects and disease allows stands to contain trees of great size, but the time frame is not measured in decades, but hundreds of years. Alder, birch, maple and cottonwood now dominate many of the stands assessed (Figure 3). Deciduous trees and in particular alder have always been part of natural riparian ecosystem, but never before in the abundance seen today. Alder is a highly successful pioneering tree species that grows wildly on disturbed sites. Early forms of timber harvesting enabled alder to gain a foothold throughout the coast in great abundance. Alder suppresses conifer growth and worst case prevents its establishment.

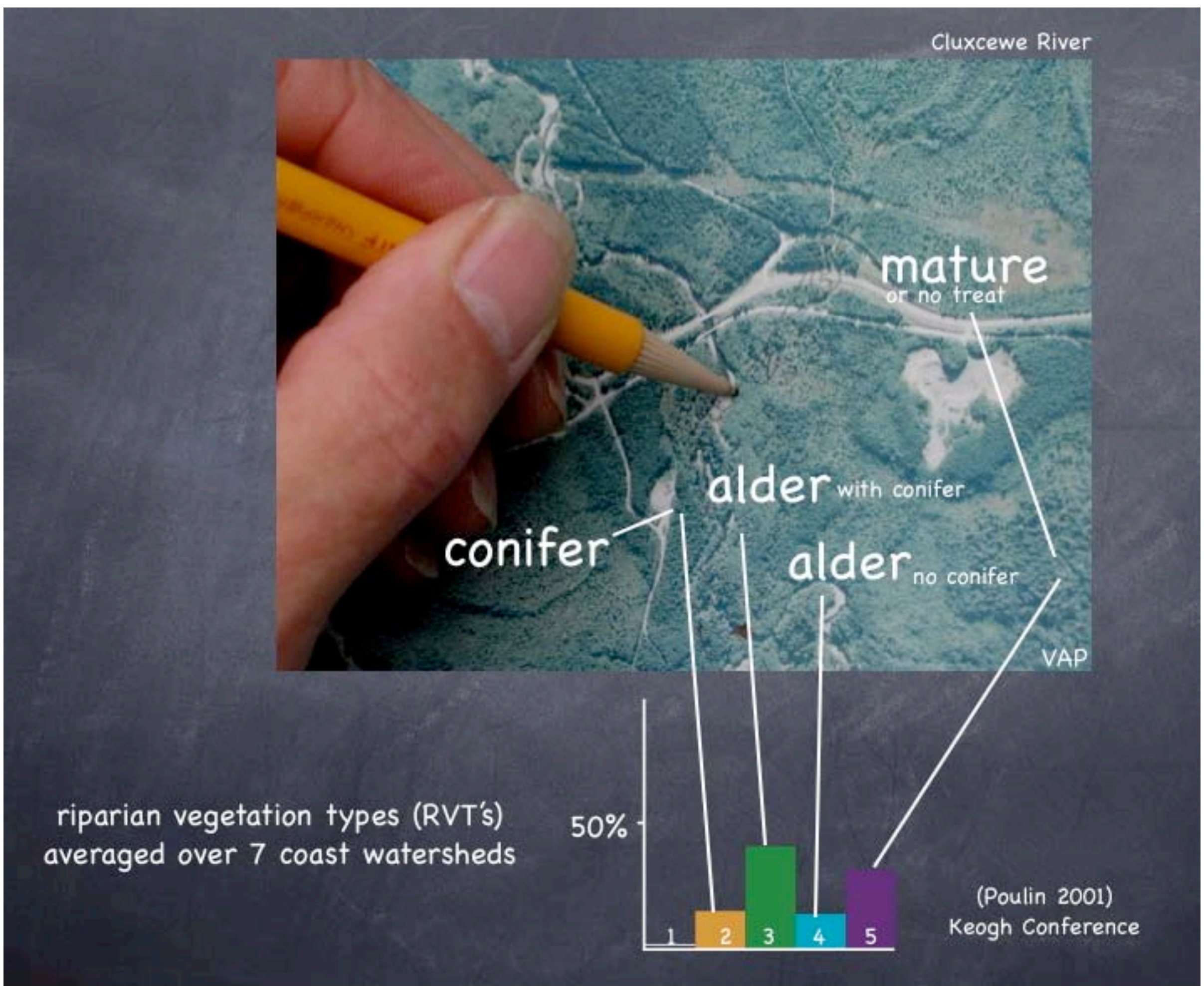


Figure 2 riparian stand composition averaged over seven coastal rivers

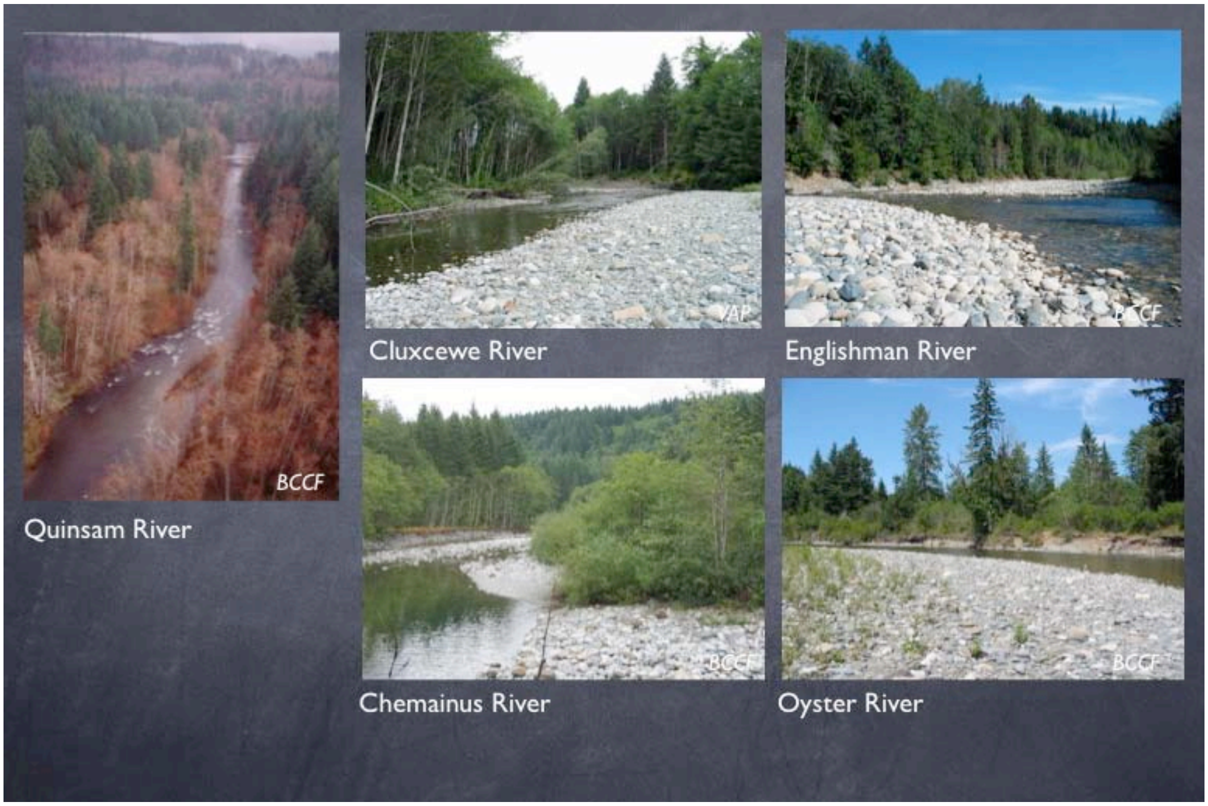


Figure 3 alder stands on the rivers assessed

Vegetation is Mother Nature's defense against erosion. The roots of trees form mats that bind stream banks and floodplains together and ensure water velocities remain high within channels making it possible for a river to flush excess sediment. Not all trees do this well. Short-lived deciduous trees are weak and rip-out when only moderately undercut by erosion. The "weakest" and most problematic of all riparian trees is alder. Alder grows intensely on disturbed sites often achieving densities of 600 - 1200 stems per hectare. Growth is rapid. Once above the height of seedling conifers their tops fill the sky closing off light to the smaller trees. Starved of light seedling conifers grow slowly, many die if not established on good growing sites. Alder are not long-lived. From Campbell River south they begin to die at 40 years, but can live to 60 - 80 years. Alder are effective nitrogen producers; their litter helps build floodplain soils and it contributes organic material to fish food production. However, critical to fish habitat protection and restoration is the damage they do. The sediment added from bank erosion caused by alder toppling increases bed load, gravel scour, deposition and ultimately exacerbates channel widening. The process is seen in nearly every major coast river system and is a serious problem in all of the rivers assessed. Once in rivers the size of those assessed alder debris is not stable. It is usually washed out or jams forming temporary structures that more often than not causes additional erosion and bank loss. These factors are a serious impediment to watershed restoration and so much so they far out weight the ecological benefit it provides. Conifer suppression, alder jams, avulsions and wholesale channel widening are in the opinion of this author the leading impediments to the rebuilding of salmon and steelhead stocks virtually coast wide.

Figure 4 bank erosion caused by alder toppling

APPROACH

V. A. Poulin conducted fieldwork for this project on July 12, July 29, and during the period December 14-16, 2004. BCCF provided logistical support for all except a visit to the Cluxewe River, which was done in concert with another project. It was not possible to walk all of the riparian stands contained in the recommendations, but for the rivers assessed adequate access was available to view enough of the stands to extrapolate recommendations over similar stand types. All of the rivers contained a common riparian stand structures and with the exception of the Cluxewe River fell within dry Coastal Douglas Fir or dry Coastal Western Hemlock biogeoclimatic zones.

Assessment Procedure

The steps undertaken to complete the project followed the procedures recommended in *Riparian Assessment and Prescription Procedures (RAPP) Watershed Restoration Technical Circular No. 6* (Koning, W. editor 1999). An overview was completed using the aerial photography and maps provided by BCCF. The overview consists of an aerial photograph interpretation of stand composition and generates a map showing location of riparian polygons with boundaries established by change in riparian vegetation type (RVT). The maps direct work in the field to verify the preliminary vegetation types and establish the best approach for restoration if required. The field component meets objectives established by Koning for Level 1 and Level 2 riparian assessments. Experience facilitates the field procedure as dysfunctional stands are readily identified and treatments are known.

Classification of Riparian Polygons

This report makes reference to riparian vegetation stand types (RVT's). A five-class system adopted by Poulin and Simmons (1998) and explained in Poulin et al. (2000) provides the basis for discussing riparian stands and their treatments (see also: Guidelines for: riparian restoration in British Columbia, recommended riparian zone silvicultural treatments, MOF, at http://www.for.gov.bc.ca/hfp/pubsriparianSilv.htm). The classification system is based on the four most common stand conditions that require restoration, and a fifth category for stands that do not require treatment:

- **RVT 1** is an area where conifer stocking is low due to competition from brush, insects, frost or disease.
- **RVT 2** is a conifer-dominated site where high stocking densities have significantly reduced conifer diameter and crown development. They are usually pure conifer, but can contain minor deciduous.
- **RVT 3** is a deciduous-dominated site with an understory of conifers. The overstory usually consists of alder, but may have other deciduous species such as cottonwood, big leaf maple or alder. In most situations, the deciduous trees form a pronounced overstory that has the effect of suppressing the growth and survival of conifers.
- **RVT 4** stands are similar in all respects to RVT 3 stands, but contain sparse (<100 stems per hectare) to nil conifers in the understory.
- **RVT 5** stands are functional riparian sites or stands containing characteristics necessary to achieve a desired future condition for the site. They may be (i) mature

forests or old-growth forests that are already in the desired condition, or (ii) young forests—even pole-saplings—that are on their way to the desired future condition.

Stand Structure

Stand structure refers to the composition and arrangement of standing dead and live trees within a stand and the characteristics the stand exhibits with respect to canopy layers, understory vegetation, and even decaying wood on the forest floor. It has significant relevance to riparian restoration options as treatments differ between young stages of a forest and older stands. Stand structure is broadly classified at the overview stage, but is dependent on the quality and scale of aerial photography. Ground surveys are necessary to verify and make changes to both stand labels and RVT's. Stand structure labels that appear on the attached maps include:

- shrub – SH
- pole sapling deciduous – PSd
- pole sapling conifer – PSc
- pole sapling mixed - PSm
- young forest deciduous – YFd
- young forest conifer – YFc
- young forest mixed – YFm
- mature forest conifer – MFc
- mature forest mixed – MFm

Labels containing m/c indicate mixed stock with patches of pure conifer.

Reference Ecosystems

Reference ecosystems for the area prescribed are CWHxm (very dry maritime CWH subzone) site series 08 (09) and CDFmm site series 07 (08) to 06 07 (Green and Klinka 1994).

Field Visitation and Data Collection

All field information compiled on this project was synthesized directly in the field to produce the stand structure determinations and treatment options provided in the report. Stands were assessed visually and treatment options generated based on experience with similar stand conditions. Vegetation plots (as given in Field Form 2) were completed on representative stand types as a reference check for size and density of trees present.

RECOMMENDATIONS FOR RESTORATION

All of the rivers assessed drain portions of the east coast of Vancouver Island from Campbell River south to Chemainus. All fall within heavily industrialized forests with stands in the areas assessed generally first harvested in the 1950's. During this period streams were logged to stream edges unless the timber was isolated by topography or not wanted. Harvesting practices were harsh by today's protective standards. Access to some timber required hauling logs through and across streams. Ground disturbance caused by these early operations can still be seen today in patterns marked by stands of alder. Logging has been ongoing since the first trees were felled. Streamside logging on the Englishman continued through the 1970's and 1980's. Weyerhaeuser Ltd. and Timber West hold private land in many of the areas and are presently actively logging second growth trees.

Restoration Options

Three riparian vegetation types make up the majority of stands in the areas assessed. These include: RVT 2 – overstocked conifer stands, RVT 3 – alder dominated stands containing suppressed conifer understory and RVT 4 – alder dominated stands lacking conifer. Accordingly, treatments aimed at thinning overstocked conifer stands (RVT 2), releasing understory conifers (RVT 3) and establishing conifers in areas where they are lacking due to an alder overstory (RVT 4) are recommended. The later two are the highest priority treatments and best suited for being undertaken by BCCF and community organizations. Photo Mosaics identifying locations of riparian polygons where treatments are recommended are provided in Appendix 1. Specific prescriptions and information relevant to each respective system is discussed. Treatment recommendations for the Quinsam and Englishman River are listed and summarized in Appendix 2.

Private Land

Private land issues complicate what is possible on some sites and make establishing prescriptions for them in the absence of company involvement inappropriate. Ownership necessitates a cooperative interaction with companies such as Weyerhaeuser and Timber West. Expectations for restoration on their private lands must reflect their standard of practice and management expectations. It may be possible to work with each company to achieve a different standard. Current requirements for retention of trees on private land are specified in Part 2 of the Private Land Forest Practices Regulation under the *FOREST LAND*

RESERVE ACT. The regulations require land owners retain a minimum of 40 trees per 200 m on both sides of a stream whose width is greater than 3 m. The trees retained are to be of a minimum size and specified distance from the stream edge. The regulations do not specify a retained tree achieve a maximum age nor retained in perpetuity. Thus, all trees within the specified distance are harvestable provided the minimum number and diameter are retained. The regulation further specifies that trees retained maintain the same range of sizes, for both coniferous and deciduous trees, as in the pre-harvest stand. These standards imply that trees grown through BCCF restoration efforts could ultimately be harvested and at a size that does not allow them to contribute fully toward stock rebuilding creating uncertainty whether public funds should be expended on public land. They most certainly necessitate a different approach than what can be done on Crown Land. Nothing inhibits BCCF from partnering with either company to assist them in conducting trials involving meeting some if not all objectives for restoration. In alder dominated areas where trees are of merchantable size projects resulting in improved conifer establishment will provide significant benefit to fish irrespective of whether the trees are retained beyond maturity.

Workers Compensation Board Requirements

All of the silvicultural prescriptions requiring the removal of trees by chain saw involve felling. Workers Compensation Board recently required all fallers certified under Occupational Health and Safety Regulation 26.22 (Work Safe BC). Certification of workers is currently underway. Some volunteer workers may hold certification, but it is more likely the majority of work requiring felling will have to be done by professional crews. Non-felling work such as girdling, brushing and grubbing and planting in prepared openings, girdling alder on bars, cutting small diameter cottonwood for use in vegetating woody debris installations and follow-up brushing are all suitable tasks for volunteers.

All work prescribed requires supervision and must meet standards for first aid. Go to http://regulation.healthandsafetycentre.org/s/GuidelinePart3.asp#SectionNumber:Levels for necessary requirements of anticipated risk and size of volunteer work force. All chain saw activities and any work under or through areas containing dead and dying alder should be considered high risk. Snags may be hazard trees. Hazard trees should be provided a flagged no work zone equal to 1.5 times the height of the hazard. Girdling using a hand tool is not hazardous work, but considering the work location treat girdling as a moderate risk. Use of axes and grubbing tools poise moderate to high risk to workers.

Riparian Treatments

The maps in Appendix 1 give the recommended treatment for each riparian polygon in the area identified by BCCF. Consideration has been given for prescribing treatments within the capability of volunteer groups. Some training may be required. Thinning overstocked conifer stands and removing overstory from planting sites will require certified fallers. These tasks may or may not be within the capability of any one group and may necessitate contracting this portion of the work. For Quinsam River and Englishman River treatment labels are prescribed. Treatment labels provided for the remaining rivers are preliminary recommendations and indicate the most likely treatment for the respective stands. Multiple treatments are usually indicated. This is due to variability within the stands. Pure alder stands for example may contain up to 100 sph of conifer. The prescription for such a stand will be planting (PL) with conifer release (CR) of the 100 stems if each were a suitable tree to release. The following explains the letter codes:

CR – conifer release: treatment removes competing overstory or brush by felling, girdling or brushing.

UT – uniform thin: a thinning treatment that spaces conifer generally uniformly throughout a stand. The treatment maximizes the number of large diameter conifers per unit area.

VT – variable thin: allows for wide variability in conifer spacing. Mimics distribution of conifers on moist and wet sites where competition is generally most severe. It is a common characteristic of older riparian forests.

IAct – cottonwood release and thinning: treatment aimed at retaining the dominant cottonwood on low bench and medium bench bars.

PL – planting: planting on best available microsites, implies cluster planting.

RS – river structure: refers to augmenting large woody debris loading in streams when thinning, may be single or multiple trees. Trees are surplus to riparian requirements.

NT – no treatment: generally applied to stands that contain desirable riparian attributes such as MF or in younger stands where riparian silviculture is not needed to achieve a desired future condition. Also used in situations where riparian restoration priority is low due to high flood risk such as PSd stands on low bench floodplains.

NTR – treatment not recommended: areas where benefit/cost was not considered high enough to warrant treatment or site is occupied on private land where trees within the riparian area are subject to future harvesting

Planting Prescription (PL)

Planting establishes conifers in riparian sites where they are lacking or in very low densities. Successful establishment requires light and lots of it requiring heavy overstory removal. Brushing is required to remove competing vegetation at the time of planting and in subsequent years. Planting and brushing can be done by BCCF, but certified fallers must remove overstory trees. The planting approach recommended is to remove overstory trees in small patches to create gaps. Within the gaps trees are planted in groups referred to as "clusters". Clusters are located on sites suitable for conifer establishment. These are generally limited in number and restricted in spatial distribution. They include raised portions of floodplains, hummocks and mounds. They are referred to as "microsites" by virtue of their small size relative to surrounding area. Swordfern is a good indicator plant. When locating "gaps" the openings target areas containing microsites. After the canopy is removed the microsites are brushed and prepared for planting. The number of trees planted per cluster will vary. Eight to ten are specified, but this depends on the size of the suitable microsite. All suitable growing space may be used. Amoeba like microsites allow for odd shape clusters with pleasing variability in tree spacing.

Gaps are located as close to the riverbanks as possible. This is generally not acceptable to DFO and some others, but the fact remains that alder will not secure channel width. The purpose of planting conifers is to provide a long-term source of wood and re-establish rooting networks that can retain stream banks. The further away the trees are planted the further down the road their ability to meet this objective. Not all alder can be removed from a stream edge. Trees with unacceptable lean cannot be felled manually. Stream bank failure is a serious issue and everything should be done to remove trees that may contribute to accelerated bank loss. This applies not only to areas where gaps are created but elsewhere along the rivers. Light created to establish conifers encourages brush. Outside of the cleared clusters salmonberry response is fierce quickly filling all available space. Root mats of salmonberry will provide intermediate bank support.

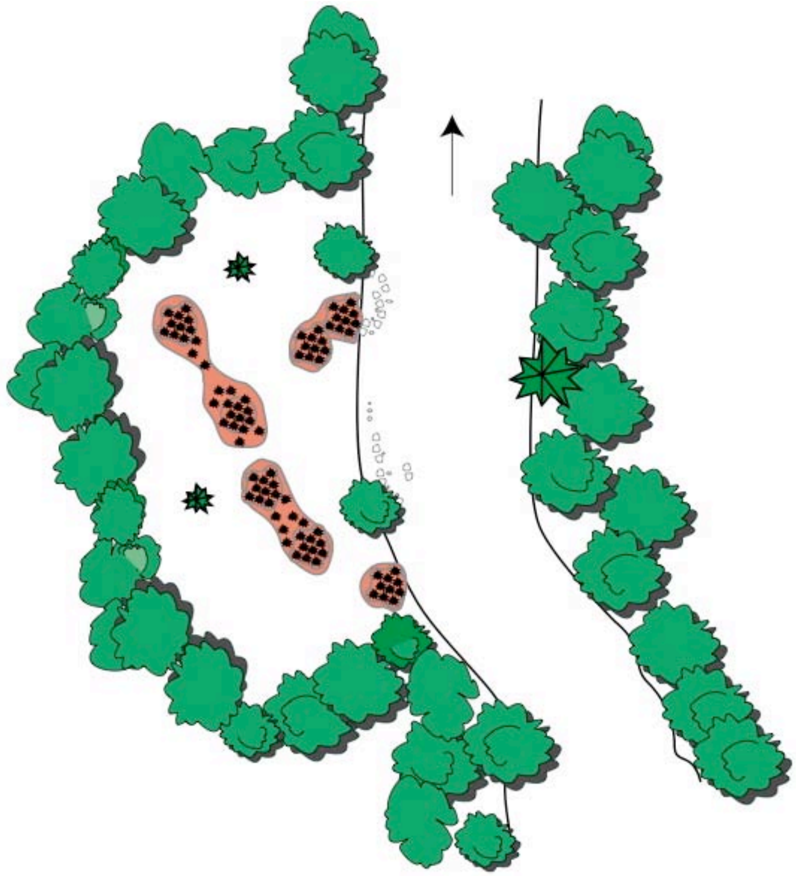


Figure 5 plan view of gap with planted microsites

Specifications:

GAPS

a) Create gaps by felling overstory alder.
b) Gap size may vary. Small gaps yield more "park-like" results, but have reduced available light. A typical opening is 2.0 – 3.0 tree lengths (60 - 90 m) in length by 1 to 1.5 tree lengths in width (30 - 50 m). The resulting gap is 0.2 – 0.4 hectare in size. Fit gaps to the site and be sensitive to public use. Gaps of 0.2 hectare are best suited for areas adjacent to the Quinsam trail. Elsewhere larger gaps will get more trees on the ground per unit of effort.
c) Locate gaps above suitable microsites. These are raised soils, hummocks, mounds or deposits noticeably elevated above floodplain soils lacking colonization by herbaceous plants. Use swordfern as a primary site indicator for a microsites. Do not neglect piles of decayed logs, stumps or debris.
d) Gaps separated by non-treatment areas will retain a high component of alder alleviating

concerns regarding impact of alder removal on riparian tree composition. Width of non-treatment areas can vary. Use sites lacking suitable microsites as leave areas.

e) Plant only "raised microsites". These are the highest soil mounds present and usually signified by the presence of herbaceous plants. A good indicator is sword fern. Sword fern is not present on low bench floodplains and is lacking on low elevation portions of medium benches.

f) Locate gaps in areas containing more than one microsite unless the microsite allows trees planted over a reasonable area.

CLUSTERS

a) Prepare microsites by removing all vegetation from within a 5 m diameter area or larger depending on the size and shape of the raised sites. Fit the size of the cluster to the microsite.

b) Grub the entire microsite of underground roots (brush) using hand tools.

c) Within the cluster provide trees with a 1-1.5 m inter-tree spacing resulting in a cluster of 10 trees or more. Trees on outside of perimeter require additional brushing and grubbing. Clear and grub 1 m beyond these trees.

d) Cut brush within 1 metre of the grubbed perimeter and piled on top of adjacent brush.

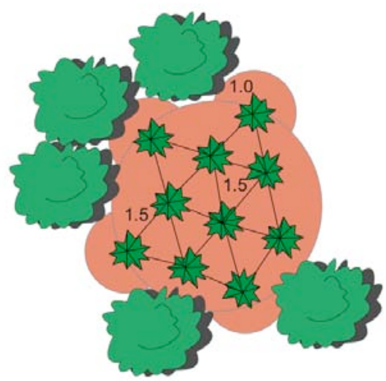
e) Plant 615 or 1015 planting stock (.4 - .6 m tall trees) with preference for the larger trees.

f) Fertilize using any pellet or tea bag type fertilizer that is high in nitrogen and phosphate (2 x 10 grams.

g) Monitor planting sites and brush as required to achieve establishment until above the height of competing brush.

h) Plant any time except July and August.

f) Flag clusters with a visible marker for re-location.



TREE SPECIES

a) Recommended tree species for high bench floodplains in the CWHxm (Quinsam) are grand fir, western red cedar and cottonwood with Douglas fir added to this list as an acceptable species in the CDFmm (Chemainus) and transitional areas (Englishman). Sitka spruce is generally not recommended as a commercial species owing to a high weevil risk, but many excellent Ss were found at Quinsam and Chemainus. Some are affected by weevil, but others not. Given this tree species strong performance in providing superior stream bank protection include weevil resistant Ss in the planting regime.

b) At Quinsam plant Bg3 Cw3 Ss3 and Act1. Planting is not required on Englishman River. Chemainus is private land (CDFmm). A good riparian mix is FdBgCw with weevil resistant Ss highly recommended.

c) Protect cedar seedlings and cottonwood whip from deer browse. Use wire cages and not plastic collars.

d) Plant anytime except July and August.

Future Stand Condition:

The plan view given in figure five is drawn roughly to scale with a gap of 60 x 30 m and planted to 7 clusters over 4 available microsites. Stocking is 84 trees when 14 are added as fill. The effective density is 400 sph. Assuming three trees per plot survive to maturity plus four fill trees stocking is taken to an effective density of 125 sph. This density is typical of old growth stands. In the absence of planting this site would revert to brush – principally salmonberry and contain few if any conifers. Planting grand fir, cedar, and spruce on the site establishes climax forest trees with the capability of surviving through the centuries.

Conifer Release (CR)

This treatment opens conifer understory trees to light by removing overstory alder or competing trees. The treatment is done by felling or girdling and highly suited for combining economic recovery of alder where access and tree size allows. The treatment is simply a speeding up of what happens naturally as alder dies. The treatment is done by girdling or falling all trees within 3 - 10 m radius of a target conifer (Figure 6). The goal is to allow 40% full sunlight to reach the target trees. Overstory removal must be high and can amount to 80 - 90% of the alder (Figure 7). Girdling is not a suitable method in locations where trails get heavy public use. Girdling kills trees by cutting off nutrients to the food-producing portion of the tree. Dead trees can become safety hazards making felling the recommended approach for sites where public access is required. A variation to conifer release is sanitation spacing. Sanitation spacing is the removal of trees within the immediate proximity of a target tree and is done to prevent physical injury to the target conifers when wind whips the branches of competing trees. Sitka spruce is especially vulnerable to leader damage from alder and maple branches. Sanitation spacing is used where removing large numbers of alder is not desired or where individual deciduous trees take precedence over releasing a target conifer.

The trees in figure 6 were felled by chain saw. Felled trees were left on the floodplain. In areas where alder stands contain trees of adequate size to harvest partnering with a timber harvesting to remove the trees is recommended. Conifer release treatments have wide application by volunteer groups where girdling is acceptable. Trees are girdled using either a chain saw or hand tool. Hand tools are suitable for all diameters of alder, but larger trees are more easily handled by chain saw. Small diameter alder cut with a chain saw can coppice (sprout) making trees less than say 12 cm dbh better done using a hand girdling tool. The amount of retained nutrients in a tree determines the length of time before released trees can benefit from girdling. Small diameter trees will die in 1 – 2 growing seasons, but larger trees will take 3 – 5 possibly 6 growing seasons for complete defoliation. Incomplete girdles delay the process, but this is not a serious issue when done as part of riparian project. Hand girdling tools are available at local chain saw shops.

Future Stand Condition

The right image in Figure 6 shows the end result of a conifer release treatment. In this case the trees in the image are conifers released naturally when alder died-off. The condition of any future stand is dependant on the composition of the understory trees present at the time of treatment. Conifer release treatments are specified for stands where moderate understory conifer are already in an advanced state of regeneration. Overstory removal leaves these trees in the mix already established through natural regeneration, but better assures the stand will meet the desired future condition by reducing mortality and improving growth of released trees.

Figure 6 conifer release

Specifications:

CONIFER RELEASE

a) Fall, girdle or distress overstory alder to reduce overstory and increase light penetration to understory conifers. Method of removal will be at the discretion of the BCCF or their supervisors. Girdled trees poise risk to stream keepers, anglers and the other people. Do not girdle in areas frequented by the public.

b) Hand girdle alder by cutting two fully concentric rings (tool blade width) around the tree and removing the cambium layer to the depth of sapwood. Separate the two rings by a minimum of 15 cm.

c) Chain saw girdles may be irregular or regular in shape but ensure complete removal of cambium from within a minimum of a 15 cm wide band.

b) Treat all trees within 3.0 m to 10 m radius of target conifer(s) and 1.5 m radius when undertaking sanitation spacing.

c) Target only conifers with 40% or more live crown (%crown to tree height). These are usually well-defined advanced conifer re-generation with heights above competing brush.

d) Sanitation space conifer where retention of deciduous overstory or individual trees is desired.

e) When removing trees by felling, fall away from conifer understory and buck and remove any tree or branches causing press. Upright any conifer tree knocked over.

f) Thin overstocked patches of understory conifer to 600 – 800 sph unless the patch is retained untreated for wildlife or biodiversity reasons.

g) Fall trees at 90 degrees to the floodplain whenever possible. Depending on the number of trees that must be felled leave as many trees as possible fully intact without bucking.

h) Consider slash. Where slash is heavy buck the first pass of trees low to the ground, but ensure that this material is locked on to the floodplain by larger pieces or whole trees. Leave limbs on the top layer to provide perch sites for bird.

i) High stumps are acceptable sources of coarse woody debris and encouraged to better catch flood debris and allow for use by wildlife.

Figure 7 girdled alders 4.5 years after treatment

Thinning (UT/VT)

Thinning is used to increase the diameter growth of trees and improve species composition by retaining trees with the highest ecological site value and removing excess stocking usually by felling (Figure 8). Benefit to fish is in speeding the recovery of large diameter trees in the shortest possible time and ensuring long-term climax trees are favored in the future stands. Young conifers grow rapidly soon after establishment, but growth in diameter slows significantly once the canopies of young trees close and light is cut to lower branches. Conifer continually grow upward fighting for what light is available, but growth in diameter "shuts-down" due to leaving trees tall and thin with small rooting networks. Crowding forces trees to grow tall and to place resources in the upper portion of the tree making it top heavy relative to height. Dense riparian stands become highly vulnerable to blow-down if not thinned early.

Thinning requires felling. It is not fully determined at this time whether the new requirements for certified fallers will apply to spacers, but the suggestion is all spacers cutting trees over 15 cm dbh must be certified fallers. It is fair to assume that all of the conifer stands specified for thinning will likely have to be done by certified crews. This should not discourage BCCF from pursuing thinning as a strategic treatment. The benefits acquired from thinning are very high given well spaced riparian trees on productive sites can achieve radial growth rates of 6 – 12 mm per year (0.5 to 1 inch in diameter) and become exposed to wind at an early age. Exposure to wind strengthens stems and stimulates increases in diameter (Whitcomb 2000).

Figure 8 thinned conifer stand (UT)

Uniform and Variable Density Thinning

Uniform thinning is recommended for polygons 6, 11, and 13 on the Englishman River (Figure 9). Uniform thinning retains the greatest number of stems per unit area on a site and better allows for phased use of trees over time. The entry prescribed is to remove excessive stocking now, but allow for subsequent entry at a later date when trees are of a size for use in reconstruction of fish habitat structures. Polygon 13 contains a sampled stand. Stocking was uniformly Douglas fir at 1300 sph. Mature grand fir, western red cedar and Douglas fir form a thread-like outer boundary of the polygon along the river, but the majority of the polygon is a 1976 Douglas fir plantation. Polygons 6 and 11 are similar dense stands.

Polygons 6 and 11 were not traversed, but appear from the river to be suitable for thinning to 600 – 800 sph. Polygon 13 can be thinned to 500 – 600 with adequate trees retained for future use. It is generally recommended in riparian restoration to retain the largest diameter trees present on a site, but in situations where fish habitat reconstruction efforts are ongoing in the watershed removing some of the largest diameter trees while replacing them with healthy smaller trees is a viable and highly recommended option to reduce restoration costs. Plot 1 in polygon 13 demonstrates this option. The largest trees in the plot are 30 and 35 cm dbh, both have demonstrated good growth since planting and are the dominant trees. Thinning to 500 sph requires the removal of 8 trees in the plot. By utilizing the two largest trees for fish habitat reconstruction two of the 8 trees normally felled would be retained to replace the two largest taken. The concept is similar to pre-commercial thinning.

Figure 9 over-stocked conifer stand Polygon 13 on Englishman River

Specifications:

CONIFER RELEASE

a) Target spacing is 600 to 800 sph. Minimum spacing is 500 sph.
b) Preferred species are Fd, Cw, Bg and Ss.
c) Act is an acceptable species.

d) Uniform spacing is to be generally employed.
e) Where clumps of conifers contain well-spaced trees and established understory, these trees can be left to provide spatial variability.
f) Larger diameter trees may be used in fish habitat restoration. When trees are removed for this purpose ensure trees retained to meet stocking requirements are healthy vigorous trees lacking structural defects. Ensure any removal of largest diameter trees does not include any preferred riparian tree whose numbers are insufficient to meet preferred riparian site tree species composition.
g) Ensure species variability by retaining mixtures of priority species where these are healthy vigorous trees.
h) There are no limitations on treatment timing.

Cottonwood Release and Thinning (IAct)

Cottowood is a highly prized riparian tree for its ability to grow on low bench and medium bench floodplains. Bars on the Englishman River bars have colonized with alder, cottonwood, willow and red osier. Cottonwood will ultimately outperform alder on these sites, but the alder will compete with it for many years. To obtain the best riparian mix of tree species on bars cottonwood release and spacing is recommended. Cottonwood, red osier dogwood and willow are used in all bioengineering projects where brush staking, waddling, and palisades are prescribed for bank re-stabilization. Unlike alder, cottonwood thrives in the presence of abundant moisture. Its roots are laterally spreading and will tap into soils and gravels below waterline making them the best candidates for occupying re-colonized bars. Cottonwood has other benefits. It lives longer than alder and can achieve large diameter fast. It is not uncommon for cottonwood to add 20 - 30 mm in radial growth per year on good sites. Cottonwood does not rot quite so quickly as alder and contributes to large woody debris. River systems like Kingcome, Machmell, Sheemahant and Kilbella Rivers rely heavily on native cottonwood as a precursor to conifer stand development.

Recommendations are to undertake cottonwood release by girdling alder in a manner similar to conifer release. Cutting small diameter alder causes it to coppice (sprout) and should be avoided. The remaining cottonwood can be spaced, but this should be done when cottonwood is needed for re-vegetation projects. It is recommended that all future fish habitat restoration projects include a re-vegetation component using cottonwood, red osier dogwood and willow. This material can come from the low and medium bench bars in need of spacing. Chain saws are acceptable for cottonwood removal. Sprouts will retain live rooting.

Specifications:

COTTONWOOD RELEASE (with collection)

a) Target spacing is 300 - 400 sph. Minimum spacing is 200 sph.
b) Preferred species is Act unless Fd, Cw, Bg and Ss present.
c) Uniform or variable spacing acceptable.
d) There are no limitations on treatment timing.

Planting Fish Habitat Structures using Cottonwood and Shrubs

Vegetation is now widely used to prevent soil erosion and stabilize excess gravel on river bars. A wide variety of techniques and methods have been applied with varying success. Re-vegetation of fish habitat structures need not be as rigorous as that needed to stabilize a bank. The primary objective is to achieve vegetative cover within and over the structure to enhance their use by fish and improve site aesthetics by hiding cables and other evidence of being artificially created. The primary plant material used in re-vegetation techniques in BC is a dormant cutting from cottonwood, red osier and willow. Dormant cuttings are not available during the instream work window when fish habitat structures are normally constructed (usually July 15 to September 15). This will necessitate using live material and accepting a high mortality rate for installed cuttings. The key to reducing losses will be to ensure cuttings are handled in a manner that does not allow them to dry out, planted within 48 hours of being collected and keeping them soaked. Mixing cuttings with rooted stock available from nurseries is highly recommended provided the material is of a stock that came from similar habitats as being planted.

Several excellent references are available that describe use of native vegetation for erosion control. Consult them to become familiar with the full range of techniques possible. Dave Polster (2002) explains techniques developed in British Columbia and excellent graphics are contained in a stream bank re-vegetation guide for Alaska (Muhlberg and Moore 1998).

Three techniques are recommended, but become familiar with the full range of possibilities as all methods have merit. The three include palisades, live stakes and brush layering (Figure 10). They may be applied in any variation that gets plants into and around the structures such that there is a good chance of successfully obtaining vegetative cover. The task need not be perfect. Even small successes with initial plantings will enable the site to develop over time as rooting matrices spread and successful cuttings grow. Palisades are large cottonwood posts usually installed in trenches either above the bank or at the toe slope of an eroding cut in the bank, but individual posts can be placed anywhere. Posts extend down into the water table. This is extremely important for survival and rooting. The material used is of large diameter (15 to 20 cm) and long enough to reach below water level. Spacing is tight to allow dense rooting, but this does not have to be the case when used for the purpose intended. Live staking establishes plants over a broader area and makes use of smaller material (20 mm +). A steel bar punches a hole large enough to take a live stake in the ground and the stake inserted. Use them to cover the entire area excavated above and below the structure. Brush layering is a more complex, but effective technique. It involves more specialized work and costs. The bank is re-vegetated in progressive layers beginning from just below the streambed. The bank is excavated then replaced using layers of jute wrapping filled with soil. Cuttings are placed between each layer as shown in Figure 10. This technique can incorporate mixed species of cuttings and included rooted stock. Using all three species in varying amounts creates natural looking plant groups.

Specifications:

LIVE CUTTINGS FOR STREAM BANK REVEGETATION

- Species suitable: cottonwood, red osier dogwood, willow
- Harvest sites: Englishman River bars having similar soil structure as banks being planted
- Size of cuttings: not less than 20 mm in diameter at tip for live stakes and brush layer whips, 15 – 20 cm diameter for palisades
- Length of cuttings: poles for palisades must be long enough to reach below water line, length determined is determined by depth of excavation, cut live stakes at least 40 cm and layering whips to 1 to 1.5 m
- Preparation of cuttings: trim small branches, twigs and leaves from cutting. Re-cut base of all cuttings immediately before using
- Submerged cuttings until used in water and not less than 48 hours prior to use (assumes August – September cuttings)

PALISADES

- usually done in rows adjacent to top of bank, but consider individual posts incorporated within the structures at and leading up the bank
- 50 cm maximum spacing if rowed
- re-cut base of post immediately prior to placement
- ensure posts are submerged below waterline
- keep wet

LIVE CUTTINGS

- distribute over broader area in and around structures
- place between boulders at time of construction or in holes made using an iron bar
- use long cuttings that reach waterline if possible
- when inserting between boulders back fill with soil and use water to wash soils in place around cutting
- when planting directly in soil use an iron bar to create a suitable diameter hole
- expose 15 cm of stake bury remainder
- ensure minimum of two buds above ground
- keep wet

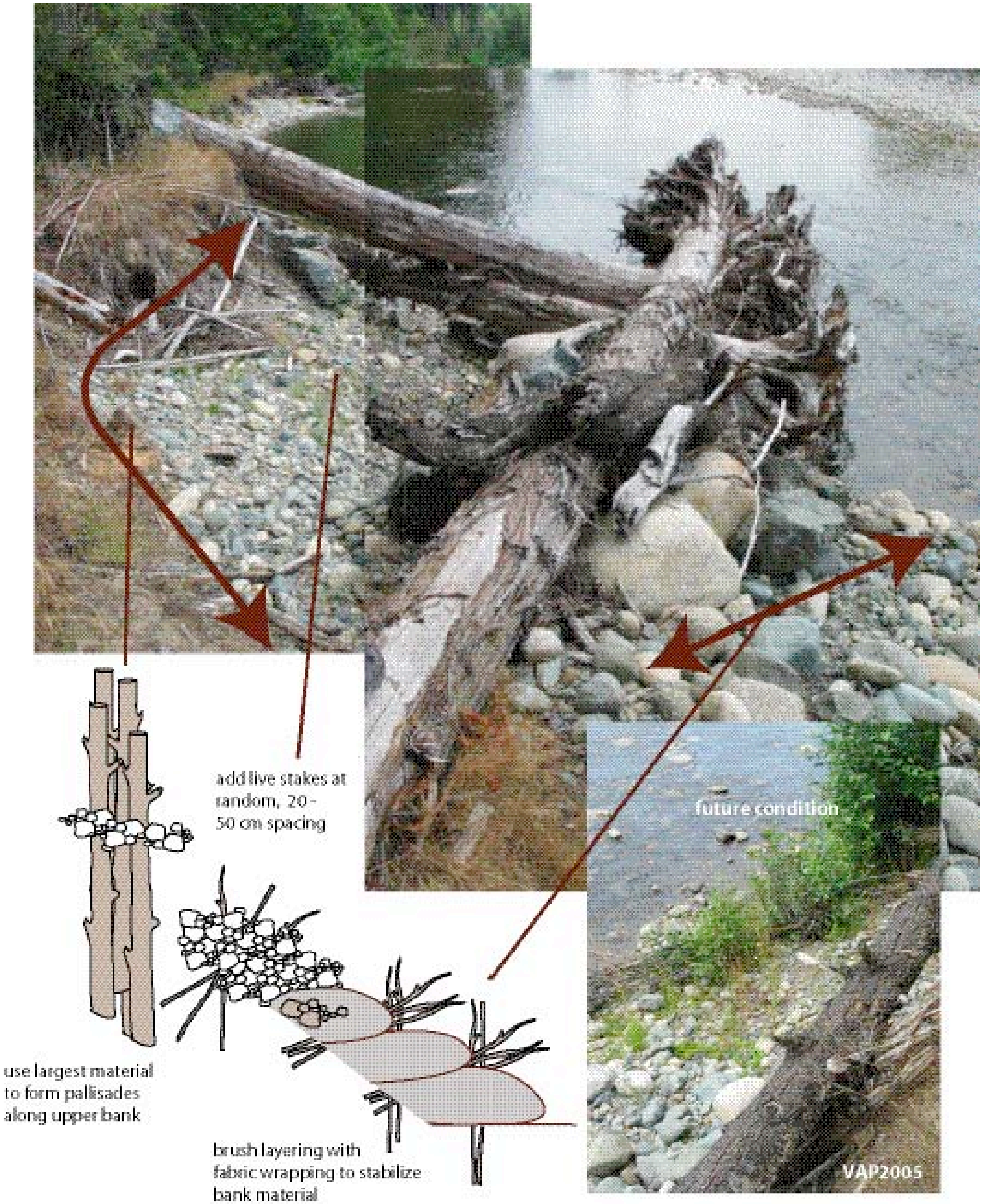


Figure 10 three methods for using native cuttings to re-vegetate fish habitat structures

LIVE CUTTINGS

- distribute over broader area in and around structures
- place between boulders at time of construction or in holes made using an iron bar
- use long cuttings that reach waterline if possible
- when inserting between boulders back fill with soil and use water to wash soils in place around cutting
- when planting directly in soil use an iron bar to create a suitable diameter hole
- expose 15 cm of stake bury remainder
- ensure minimum of two buds above ground
- keep wet

BRUSH LAYERING

- mix cuttings to include all species available
- consider adding direct transplants or rooted stock to mix
- plant same day as transplanting, prune roots of transplants before planting
- secure toe of slope with rock
- begin first brush layer at ordinary high summer water level
- lay biodegradable fabric and fill with available bank material add fines if necessary
- fold fabric backward to contain soil
- stake fabric in place to hold in position
- add layer of cuttings with tips angled 20 degrees upward and butts down
- layer height varies with slope angle, try 30 cm to start
- plant 20 to 25 stems per meter
- crisscross layers of cuttings to entangle roots
- ensure tips or shoots extending beyond the edge of the fabric bench is not more than 25% of the total length of cutting
- deposit layer of top soil over cutting
- add next layer following the same procedure until desired height is gained

ESTIMATED COST OF RESTORATION

Costs to complete the riparian works are not possible estimate given the mix of tasks possible by volunteer support, but some guidelines will help in projecting future costs. It is fair to say that restoration is expensive and when done using limited fish habitat restoration funding it should be in steps. In this way volunteers can be trained in the methods required and BCCF can better determine how much work can be accomplished in each of the areas. For planning purposes use an average costs of $2,500 - $2,800 per hectare for felling conifers including removing alder overstory (these costs include some biodiversity treatments including tree topping suggesting the low end price range may be most suitable for HCCF projects). Use $3,000 for brushing and planting for a combined cost of $5500 - $5800 per hectare if work is done without volunteers. These costs do not factor implications of the new requirements for WCB certification. Requirements for certified fallers will increase costs, but by how much is not possible to determine at this time. Fallers in the above prices received spacing wages at $180.00/day plus benefits. Fallers run up to $450.00 per day. Future costs will probably lie between. Brushing and planting is assumed done by volunteer groups making costs associated with this phase limited to cost of plants and supervision of crews, but the values provided are useful "in-kind" costs. Trees run up to $1.00 per plant for larger plants (recommended), but will vary with local nurseries. Another useful costing tool for estimating partial projects is felling production. Trained spacers can fall up to 0.25 to 0.30 hectares per man per day.

EFFECTIVENESS MONITORING

Future site evaluations are necessary to monitor effectiveness of the re-vegetation plan and benefits. Planting sites will require frequent monitoring to determine brushing requirements. For all thinning treatments establish a minimum of three permanent plots per stand type and at least one per polygon. Use the riparian assessment field card contained in Koning (1999) and base each plot on a 5.64 m diameter area. It is useful to hand sketch each plot using grid lines for NS and EW. Within each quadrant identify the location of each retained tree (species) and diameter at breast height. This includes conifer and cottonwood treatments. GPS and sketch map reference locations. Obtain digital images of the reference plots including images of canopy before and after thinning. At planting sites establish one reference plot per gap in the manner described. Document overstory removed and condition of the pre-treatment understory. Map and name each opening. Within each gap to be planted sketch map location of microsites and provide each with a unique number for tallying trees planted. Follow a similar procedure as for permanent plots but treat each microsite as a "plot". Record area planted and tally trees planted. For each tree list species and height. This can be done using prior to planting as stock size is relatively uniform in height. Height, diameter and the number of trees that survive to establishment are the three primary parameters used in monitoring.

REFERENCES CITED

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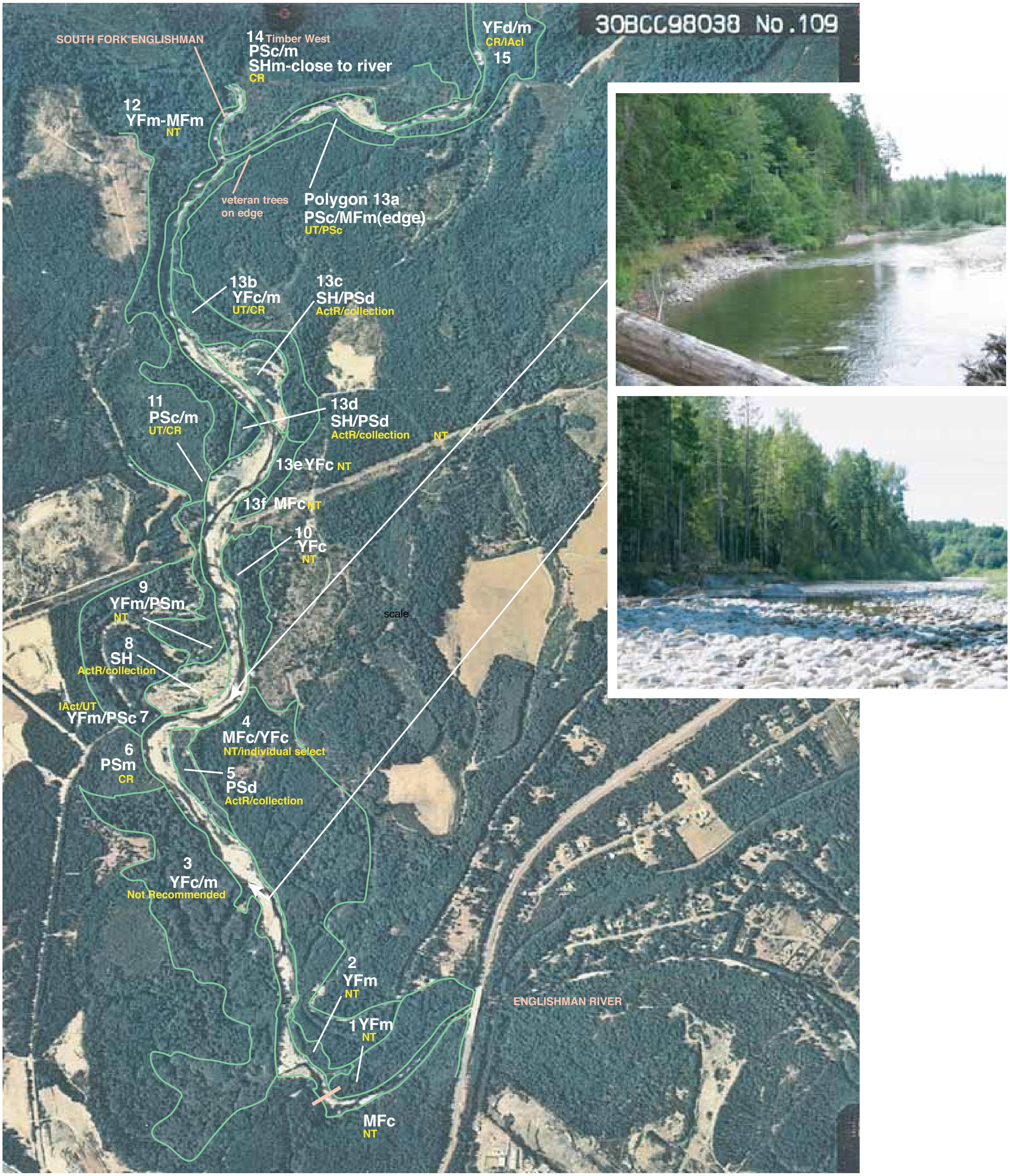
Appendix 1. Aerial photo mosaics showing riparian polygons mapped and assessed on the Quinsam River, Englishman River, Chemainus River, Little Qualicum River and Oyster River. Refer to page 6 and 7 for explanation of treatment codes and stand structure labels

V.A. Poulin/Dec/2004
Area Locator:
Photo: SRS 6062-206
S1 riparian classification
⊕ survey plot
0 100
fix scale (original 10 000)

N

Aerial Photo Mosaic Q1
Quinsam River
Location of Polygons

Poulin



V.A. Poulin/Dec/2004
Area Locator: 92M010
Photos: 30BCC98038 109
S1 riparian classification
scale 1:15 000

N

Aerial Photo Mosaic E1
Englishman River
Location of Polygons

Poulin

V.A. Poulin/Dec/2004
Area Locator:
Photos: 30BCC98055 168
S1 riparian classification
scale: 1: 15000

N

Aerial Photo Mosaic C1
Chemainus River
Location of Polygons

Poulin

V.A. Poulin/Dec/2004
Area Locator:
Photos: 30BCC98034 119
S1 riparian classification
scale: 1: 15000

N

Aerial Photo Mosaic C2
Chemainus River
Location of Polygons

Poulin

V.A. Poulin/Dec/2004
Area Locator:
Photos: 30BCC98034 117
S1 riparian classification
scale: 1: 15000

N

Aerial Photo Mosaic C3
Chemainus River
Location of Polygons

V.A. Poulin/Dec/2004
Area Locator:
Photos: 30BCC98037 124
30BCC98037 058
S1 riparian classification
scale: 1: 15000

N

Aerial Photo Mosaic LC1
Little Qualicum River
Location of Polygons

Poulin

V.A. Poulin/Dec/2004
Area Locator:
Photo: MB94012-297 upper
MB94012-299 lower
S1 riparian classification
scale: 1: 40000

N

Aerial Photo Mosaic O1
Oyster River
Location of Polygons

Poulin

Appendix 2. Recommended treatment summary for Quinsam and Englishman Rivers

Recommended Treatment Summary

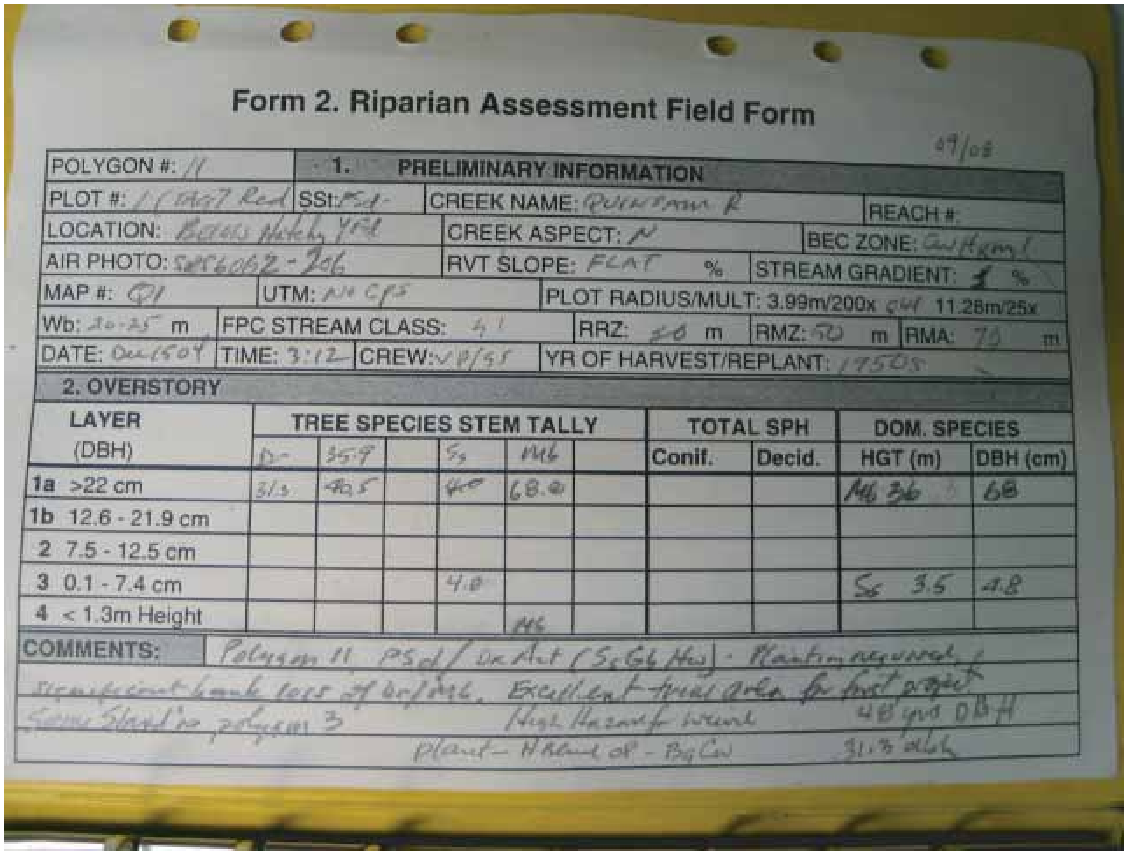
Quinsam River

Polygon	RVT	RVT Label	Treatable Area (Ha)	RVT 1	RVT 2	RVT 3	RVT 4	RVT 5	Total	Treatment
1	2	PSc	0.75		0.8				0.8	No Treatment
2	2	YFd	0.80		0.8		1.0		0.8	PL/CR
3	3	YFd	1.75			1.8			1.8	PL/CR
4	4	PSm/d	1.00				1.0		1.0	No Treatment
5	4	YFm	1.00				1.0		1.0	No Treatment
6	3	YFm	2.75			2.8			2.8	Not Recommended
7	3	YFm	2.00			2.0			2.0	CR/IAct
8	3	YFm	1.25			1.3			1.3	Not Recommended
9	5	MFc	0.50					0.5	0.5	Not Recommended
10	3	YFm	4.00					4.0	4.0	No Treatment
11	4	YFd	1.63				1.6		1.6	PL/CR
Total			17.4	0.0	1.6	7.8	4.6	4.5	17.4	
Percent			Percent	0	9	44	27	26	106	

Englishman River

Polygon	RVT	RVT Label	Treatable Area (Ha)	RVT 1	RVT 2	RVT 3	RVT 4	RVT 5	Total	Treatment
1	5	YFm	2.3					2.3	2.3	No Treatment
2	5	YFm	1.1					1.1	1.1	No Treatment
3	2	YFc/PSc	4.5		4.5				4.5	Not Recommended
4	5	MFc/YFc	1.1					1.1	1.1	No Treatment/single tree
5	4	PSd	1.9				1.9		1.9	Act Release/Act Collection
6	3	PSm	1.1			1.1			1.1	CR (girdleDrMb)
7	2	YFm/PSc	1.5			1.5			1.5	IAct/UTconifer
8	1	SH	1.5	1.5					1.5	Act Release/Act Collection
9	5	YFm	1.9					1.9	1.9	No Treatment
10	5	YFc	1.9					1.9	1.9	No Treatment/single tree
11	2	PSc/m	0.8		0.8				0.8	Uniform Thin/Conifer Releas
12	5	YFm/MFc	4.5					4.5	4.5	No Treatment/single tree
13a	2	PSc(MFc)	3.2		3.2				3.2	UT(NoTreat MFc/m edge)
13b	3	YFc/m	3.8		3.8				3.8	UT/CR
13c	4	SH-PSd	1.5				1.5		1.5	Act Release/Act Collection
13d	4	PSd	0.8				0.8		0.8	Act Release/Act Collection
13e	2	YFc	0.3		0.3				0.3	No Treatment (too narrow)
13f	5	MFc	0.4					0.4	0.4	No Treatment
14	1(3)	SH-PSm	1.2	1.2					1.2	CR (girdleDrMb)
15	3	YFd/m	2.6			2.6			2.6	CR/Iact
Total			37.7	2.7	12.5	5.3	4.1	13.1	37.7	
Percent			Percent	7	33	14	11	35	100	

Appendix 3. Field forms



Form 2. Riparian Assessment Field Form

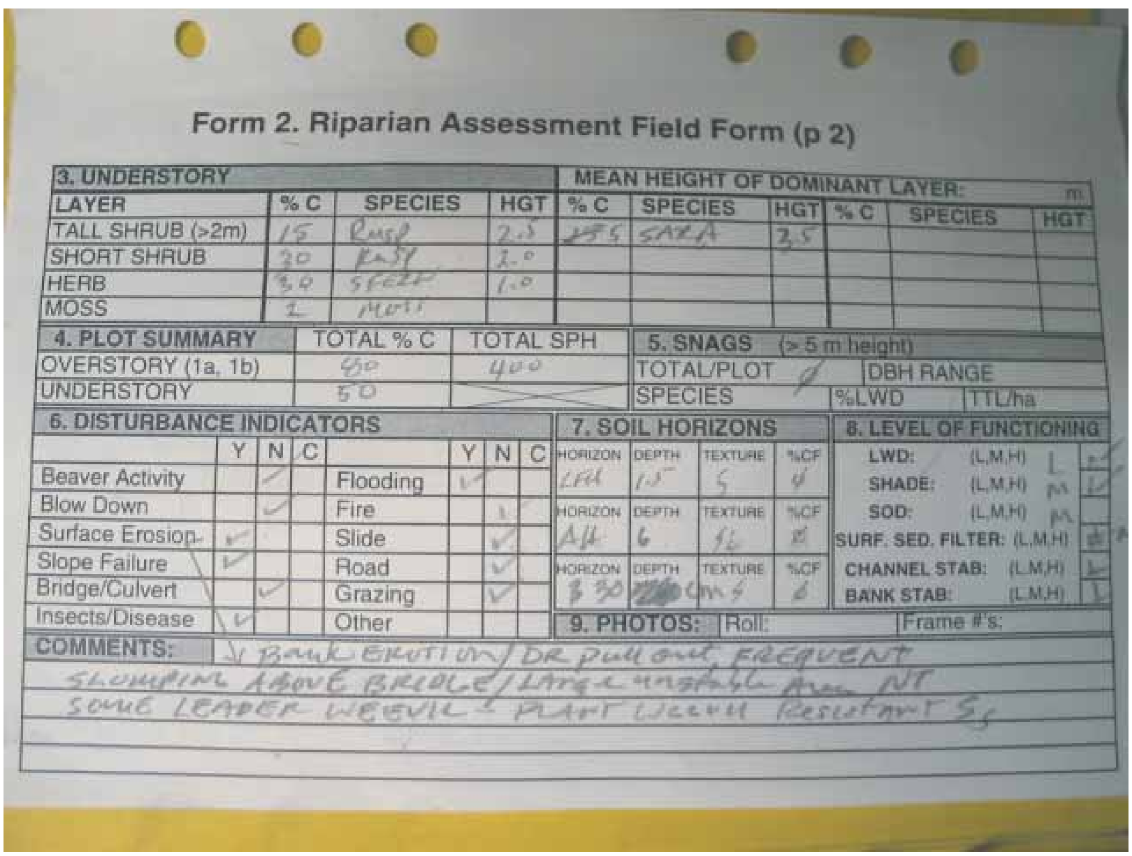
49/08

POLYGON #: 11	1. PRELIMINARY INFORMATION		
PLOT #: 1 (TAG7 Red)	SSt: PSd-	CREEK NAME: QUINSAM R	REACH #:
LOCATION: Bosses Hatchery YRd		CREEK ASPECT: N	BEC ZONE: CWHxm1
AIR PHOTO: SRS6052-206		RVT SLOPE: FLAT %	STREAM GRADIENT: 1 %
MAP #: Q1	UTM: No GPS	PLOT RADIUS/MULT: 3.99m/200x ~~or~~ 11.28m/25x	
Wb: 20-25 m	FPC STREAM CLASS: S1	RRZ: 50 m / RMZ: 50 m	RMA: 70 m
DATE: Oct 15 04	TIME: 3:12	CREW: VB/SS	YR OF HARVEST/REPLANT: 1950s

2. OVERSTORY

LAYER (DBH)	Dr	359		Ss	Mb		Conif.	Decid.	HGT (m)	DBH (cm)
	TREE SPECIES STEM TALLY						TOTAL SPH		DOM. SPECIES	
1a >22 cm	3/3	40.5		40	68.0				Mb 36	68
1b 12.6 - 21.9 cm										
2 7.5 - 12.5 cm										
3 0.1 - 7.4 cm				4.8					Ss 3.5	4.8
4 < 1.3m Height					Mb					

COMMENTS: Polygon 11 PSd / DrAct (SsGbHw) - Maintain regional, significant bank loss of Dr/Mb. Excellent trial area for test project. Same stand as polygon 3. High Hazard for weevil. 48 yrs DBH. Plant - HRend of - BgCw. 31.5 [illegible]



Form 2. Riparian Assessment Field Form (p 2)

3. UNDERSTORY — MEAN HEIGHT OF DOMINANT LAYER: m

LAYER	% C	SPECIES	HGT	% C	SPECIES	HGT	% C	SPECIES	HGT
TALL SHRUB (>2m)	15	RUSP	2.5	25	SARA	3.5			
SHORT SHRUB	30	RUSP	2.0						
HERB	30	SFEZP	1.0						
MOSS	2	MOSS							

4. PLOT SUMMARY	TOTAL % C	TOTAL SPH
OVERSTORY (1a, 1b)	50	400
UNDERSTORY	50	

5. SNAGS (> 5 m height)

TOTAL/PLOT	Ø	DBH RANGE	
SPECIES		%LWD	TTL/ha

6. DISTURBANCE INDICATORS

	Y	N	C		Y	N	C
Beaver Activity		✓		Flooding	✓		
Blow Down		✓		Fire		✓	
Surface Erosion	✓			Slide		✓	
Slope Failure	✓			Road		✓	
Bridge/Culvert		✓		Grazing		✓	
Insects/Disease	✓			Other			

7. SOIL HORIZONS

HORIZON	DEPTH	TEXTURE	%CF
LFH	1.5	S	4
AH	6	SL	Ø
B	30	[illegible] cm S	6

8. LEVEL OF FUNCTIONING

LWD: (L,M,H)	L	[illegible]
SHADE: (L,M,H)	M	[illegible]
SOD: (L,M,H)	M	
SURF. SED. FILTER: (L,M,H)	[illegible]	
CHANNEL STAB: (L,M,H)	[illegible]	
BANK STAB: (L,M,H)	L	

9. PHOTOS: Roll: Frame #'s:

COMMENTS: ↓ BANK EROSION / DR pull out FREQUENT SLUMPING ABOVE BRIDGE / LARGE UNSTABLE AREA NT SOME LEADER WEEVIL - PLANT WEEVIL RESISTANT Ss

Quinsam Polygon 11, Plot 1

Form 2. Riparian Assessment Field Form

TRANSIMPF

POLYGON #: 13	1. PRELIMINARY INFORMATION		
PLOT #: 1	SSt: PSC	CREEK NAME: ENGLISHMAN	REACH #:
LOCATION: 1M S plot of Mac		CREEK ASPECT: E	BEC ZONE: CWHxm1
AIR PHOTO: 9204 30BCC780388-109		RVT SLOPE: FLAT %	STREAM GRADIENT: 1.5 %
MAP #: EL	UTM:	PLOT RADIUS/MULT: 3.99m/200x 564 11.28m/25x	
Wb: 7 30 m	FPC STREAM CLASS: S1	RRZ: 70 m	RMZ: 20 m RMA: 50 m
DATE: DEC 13 04	TIME: 1029	CREW: UP	YR OF HARVEST/REPLANT: 1976

2. OVERSTORY

LAYER (DBH)	TREE SPECIES STEM TALLY						TOTAL SPH		DOM. SPECIES	
	Fd	Fd		Cw		Dr	Conif.	Decid.	HGT (m)	DBH (cm)
1a >22 cm 22.1 22.6	24.6	15.0	30.4 16.3			22.1	500	100	28-30 Fd	35 cm
1b 12.6 - 21.9 cm 12.8 13.3	23.9 13.4	11.8 16.9	15.4 14.3				800			
2 7.5 - 12.5 cm										
3 0.1 - 7.4 cm				3.2	Less 10% LC		100			
4 < 1.3m Height										

COMMENTS: 25 yrs @ BH 35cm + 3 = 28

2004
28 3-4 mm Current
1976 6.5-9 mm Post Rodent

Form 2. Riparian Assessment Field Form (p 2)

3. UNDERSTORY

MEAN HEIGHT OF DOMINANT LAYER: m

LAYER	% C	SPECIES	HGT	% C	SPECIES	HGT	% C	SPECIES	HGT
TALL SHRUB (>2m)		DEAD							
SHORT SHRUB		Ø							
HERB	1	SPERAL	.25	1	Oregon Grape	2			
MOSS	10%	moss							

4. PLOT SUMMARY

	TOTAL % C	TOTAL SPH
OVERSTORY (1a, 1b)	80	1500
UNDERSTORY	2	

5. SNAGS (> 5 m height)

TOTAL/PLOT 1	DBH RANGE 13	
SPECIES Birch	%LWD Ø	TTL/ha 100

6. DISTURBANCE INDICATORS

	Y	N	C		Y	N	C
Beaver Activity		✓		Flooding	✓		
Blow Down		✓		Fire		✓	
Surface Erosion		✓		Slide		✓	
Slope Failure		✓		Road		✓	
Bridge/Culvert		✓		Grazing		✓	
Insects/Disease	✓			Other		✓	

7. SOIL HORIZONS

HORIZON	DEPTH	TEXTURE	%CF
LFH	5	/	Ø
Ah	18	Silt-loam	0
B	750	SAND	0

8. LEVEL OF FUNCTIONING

LWD:	(L,M,H)	L
SHADE:	(L,M,H)	M
SOD:	(L,M,H)	L
SURF. SED. FILTER:	(L,M,H)	L-M
CHANNEL STAB:	(L,M,H)	M
BANK STAB:	(L,M,H)	M

9. PHOTOS: Roll: Frame #'s:

COMMENTS: DISEASE - TWO BG W/ horizontal tracks GIRDLED BY INSECTS
FLOODING OVERLAND FLOW @ POLYGON. Silty-loam nice EARTH SMELL OVER
DEEP SAND
Rich - dark throughout every SAND

Form 2. Riparian Assessment Field Form

POLYGON #: 22	**1. PRELIMINARY INFORMATION**		
PLOT #: 1	SSt: PSd	CREEK NAME: Chemainus River	REACH #:
LOCATION: Upper Chemainus	CREEK ASPECT: South	BEC ZONE: CWHxm1	
AIR PHOTO: 30BCC98034 117	RVT SLOPE: 2 %	STREAM GRADIENT: 2 %	
MAP #: C3	UTM: NO GPS PRIVATE	PLOT RADIUS/MULT: 3.99m/200x (5.64) 11.28m/25x	
Wb: 18 m	FPC STREAM CLASS: S2	RRZ: NA m	RMZ: NA m RMA: NA m
DATE: 12/16/04	TIME: Dec 6	CREW: VP/JC	YR OF HARVEST/REPLANT: 1960's

2. OVERSTORY

LAYER (DBH)	TREE SPECIES STEM TALLY						TOTAL SPH Conif.	TOTAL SPH Decid.	DOM. SPECIES HGT (m)	DOM. SPECIES DBH (cm)
	Dr	Dr	Dr	Dr		Fd				
1a >22 cm	25.0	15.0	23.7	25.2				300	DR 26	25.8
1b 12.6 - 21.9 cm	16.2 18.2	20.4	17.8	17.6	14.1 12.8	20.6		1400	DR 24	18.0
2 7.5 - 12.5 cm	10.0								3.5 m	
3 0.1 - 7.4 cm						3.4	100		Fd	3.4
4 < 1.3m Height										

COMMENTS: PSd / Dr (Hw Fd) ← minor <100 SPH understory, 2 Cw stumps

11.28 PLOT @ 150 SPH stumps – 75-150 sph of Cw old-growth to 1-2.5m dbh

Form 2. Riparian Assessment Field Form (p 2)

3. UNDERSTORY — MEAN HEIGHT OF DOMINANT LAYER: m

LAYER	% C	SPECIES	HGT	% C	SPECIES	HGT	% C	SPECIES	HGT
TALL SHRUB (>2m)	5	Rusp	2.2	3	Vaca	1.5			
SHORT SHRUB	30	Rusp	1.8						
HERB	7	Green	.8	2					
MOSS	20	MOSS							

4. PLOT SUMMARY	TOTAL % C	TOTAL SPH
OVERSTORY (1a, 1b)	80	1700
UNDERSTORY	50	

5. SNAGS (> 5 m height)

TOTAL/PLOT 1 | DBH RANGE 15cm
SPECIES DR | %LWD ø | TTL/ha

6. DISTURBANCE INDICATORS

	Y	N	C		Y	N	C
Beaver Activity		/		Flooding	/		
Blow Down		/		Fire		/	
Surface Erosion		/		Slide		/	
Slope Failure		/		Road		/	
Bridge/Culvert		/		Grazing		/	
Insects/Disease		/		Other		/	

7. SOIL HORIZONS

HORIZON	DEPTH	TEXTURE	%CF
LFH	1		ø
AH	1	SS	ø
B	10	SS	ø

8. LEVEL OF FUNCTIONING

LWD:	(L,M,H)	L
SHADE:	(L,M,H)	M-H
SOD:	(L,M,H)	L-M
SURF. SED. FILTER:	(L,M,H)	L
CHANNEL STAB:	(L,M,H)	L
BANK STAB:	(L,M,H)	L

9. PHOTOS: Roll: Frame #'s:

COMMENTS: Silty/SAND NO COARSE fragment

PLANT - Cw stumps

~~Breast Height Age~~ 25

Chemainus Polygon 22, Plot 1