Limiting Factors Assessment and Restoration Plan

Buttermilk, Spilde, and Yaquina Headwaters Sixth fields

Tributaries to the Yaquina Basin

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Table of Contents

Introduction

This document provides watershed restoration actions proposed to enhance the coho salmon population within the Buttermilk, Spilde and Yaquina Headwaters Sixth Field basins in Lincoln County, Oregon. The basins are sub-watersheds of the Yaquina River, which enters the Pacific Ocean through an estuary directly south of Newport, Oregon.

The goal of the restoration effort has been to identify the dominant processes and habitat characteristics that currently limit the production of coho salmon smolts in the subbasins, and to develop a prioritized list of actions ("prescriptions") for removing the limitations in ways that normalize landscape and stream channel function.

Restoration and assessment protocols used in developing the plan are described in "Midcoast Limiting Factors Analysis, A Method for Assessing 6th field subbasins for Restoration", available at www.midcoastwatershedscouncil.org/GIS or by contacting the Midcoast Watersheds Council. Please refer to this document for detailed information on assessment, nomenclature, prioritization rationale and methodology.

Resources used in developing the plan

- Dent, Elizabeth F. 2005. Influence of Small Clearcut Openings in Riparian Areas on Summer Stream Temperatures on Coastal Oregon and Western Cascades Streams COPE Report 8(3):2-6
- Bio-Surveys LLC. 2007. Field Survey Buttermilk, Spilde, Yaquina Headwaters.
- Hinkle, Jason. Oregon Department of Forestry. 2007. Landslide Risk Analysis for Buttermilk, Spilde and Yaquina Headwaters Sixth Fields.
- Lewis, Scott, The A.G. Crook Company. Oregon Forest Industries Council 1993 Aquatic Inventory Pilot Project Final Stream Report : Randall Creek, Buttermilk Creek, Buttermilk Creek Tributary, Stony Creek.
- Lincoln Soil and Water Conservation District. 2007. Aquatic Habitat Inventory: Buttermilk Creek, Humphrey Creek, Little Yaquina River.
- Lindberg, Roberta. Oregon Department of Environmental Quality. 2007. Temperature monitoring graphs for Upper Yaquina River Streams..
- Scheerer, Paul et al. 1992. ODFW Aquatic Inventory Project Stream Report: Upper Yaquina River.

Please refer to the appendices to to find the tables, figures, photos referenced in the text of the report:

- Appendix 1 - Drainage systems of the study area
- Appendix 2 - Habitat features and survey status of streams which have coho bearing potential
- Appendix 3 - Spawning gravel estimates
- Appendix 4 - Limiting habitat analysis based on the Nickelson model
- Appendix 5 - ODF slope risk analysis maps
- Appendix 6 - Summer coho distribution charts
- Appendix 7 - Prescription and anchor site location maps
- Appendix 8 - Photos
- Appendix 9 - Yaquina mainstem stream temperature charts

Watershed overview

This analysis combines three separate 6th field HUC subdivisions into a single more natural subdivision that includes all of the mainstem Yaquina and tributaries above the confluence of Bales Cr. The three 6th fields are Buttermilk, Spilde and Yaquina Headwaters[1]. Previous analyses using the limiting factors methodology

[1] Referred to as the "complex of 6th fields" below.

have examined 6th fields individually. In this case the larger geographical area better represents the type of watershed subunit that the methodology is designed to accurately interpret. These three upper basin 6th fields exhibit an extensive interactive relationship that results in the support of what is probably a single deme of OCN coho.

The Buttermilk sixth field subbasin is 12,480 acres in size. It is located in the upper Yaquina Watershed, between Norton and Nashville, Oregon., northeast of Eddyville. The sixth field begins at river mile(RM) 41.1, just above the mouth of Bales Creek and ends at river mile 50.5, just below the mouth of Spilde Creek.

The Spilde Creek sixth field subbasin is 1,841 acres in size. It encompasses Spilde Creek, which enters the Yaquina River at RM 50.5, at the uppermost boundary of the Buttermilk sixth field.

The Yaquina Headwaters is 6,597 acres in size, extending 13.8 miles from the confluence of Spilde Creek to the headwaters of the Yaquina River.

Within the combined study area there are eleven Yaquina River tributaries that provide habitat for coho salmon. From steep headwaters areas in the coastal hills, these streams level out to the low gradient habitat utilized year round by coho salmon.

An additional 15 tributaries are potential sources of cold water to the main stem Yaquina River, but do not provide significant habitat for salmonids, due to their limited habitat capacity and gradient. The majority of the tributary stream miles are primarily managed for timber production. Management styles vary considerably through the various ownerships, with robust, true buffers present on some private and industrial stream sections.

The main stem Yaquina River below the confluence with Spilde Creek is very low gradient (0.2%), relatively straight and is constrained by high terraces. Historical and present land use includes livestock grazing, hay production and rural residence. There are few riffles present in this stream section; units are long uniform depth pools. Above the mouth of Spilde Creek the nature of the mainstem changes dramatically. The gradient increases, sinuosity improves, spawning gravel appears more regularly, and summer- rearing juvenile salmonids can be observed.

The majority of the Yaquina Headwaters sixth field is in timberlands, a minor portion of the land use is rural residential, with little livestock impact. One beaver dam, built on a habitat structure, was observed in the entire Yaquina Headwaters sixth field. The Yaquina Headwaters was surveyed to the end of anadromous fish use at RM 53.8. The Little Yaquina River is the only coho-bearing tributary in the sixth field.

The majority of the Spilde Sixth field is in markedly different condition from the other two subbasins incorporated in this review. Two private landowners and the Oregon Dept. of Forestry manage the basin. There are both livestock and timber resources in the lower basin, timber only in the upper portion. Isolated areas of heavy livestock impact were observed. The vast majority of Spilde Creek has been wisely managed with robust riparian areas, a significant abundance of legacy wood, complemented by contemporary natural wood recruitment. As a consequence, this stream interacts with its floodplain, providing model coho habitat and exhibiting high summer rearing densities of coho parr in July of 2007. A 1999 rapid bio-assessment of Spilde Creek by Bio-Surveys LLC found no coho present.

There were six functioning beaver dams observed in Spilde Creek in July 2007. Four were being actively maintained, two were not. Because of the low gradient, the old dams still functioned well, aggrading substrate and creating extensive pool habitat. There are no aquatic habitat inventory data available for the Spilde sixth field.

The Buttermilk 6th field 2007 Bio-Surveys study included Buttermilk Creek, Randall Creek, Stoney Creek, Bryant Creek, Humphrey Creek, Young Creek, Felton Creek and an unnamed southern tributary designated Trib X. Tributaries not surveyed were either deemed too small for coho salmon, or landowner permission to access was denied. Historical and current (2007) AQI inventories indicate a low level of large wood throughout the sixth field. Actively eroding banks on the portion of mainstem Yaquina included in the 6th field were documented. Livestock access to the mainstem and the lack of a contiguous riparian canopy were noted as issues of concern. These conditions continue to exist in 2007.

A notable change in the 15 years since the inventories were conducted is the reduction in beaver pond habitat throughout. Beaver dams were present in great numbers in 1992. The May of 2007survey observed only 10 active beaver dams within the entire 6th field. In 1993 there were 30 dams in Buttermilk Creek alone.

In May of 2007, brook lamprey were observed spawning in all surveyed portions of the Buttermilk sixth field, except Bryant Creek. The other two sixth fields were surveyed in July of 2007. At that time, no lamprey were noted. This is probably a factor of seasonality, rather than habitat suitability.

Current status of coho

Basin wide

The status of Oregon Coast Natural (OCN) coho in the Yaquina basin has been well documented for adult spawners by ODFW's Stratified Random Sampling Program, and for the summer standing crop of juveniles by the Midcoast Watershed Councils Rapid Bio-Assessment Inventory. The adult data provide a sense of basin-wide trends in abundance, while the juvenile data indicate trends within specific 5th and 6th fields. Since 1990 the spawner escapement has ranged from a low of 365 in 1998 to a high of 24,409 in 2002.

The 6th field

Bio-Surveys LLC conducted a summer juvenile abundance survey in 1999 for the Buttermilk, Spilde and Upper Yaquina sixth fields. The survey looked at the production from the lowest spawner abundance on record for the period 1990 to 2005. The Rapid Bio-Assessment survey certainly reflected the abysmal adult return, with low numbers, low densities, and a complete absence of juveniles in areas of suitable summer habitat. A field survey in May of 2007 noted abundant coho juveniles in Young's, Spilde and Trib X, all devoid of coho in 1999.

Core Area

The core describes the full extent of the summer distribution of juvenile coho. The core area for the 6th fields discussed in this report extends from the confluence of Bales Cr upstream to the anadromous barrier on the mainstem at RM 54.2, 22,585m upstream. In addition, the core includes all of the listed tributaries to the end of anadromous potential. Within the scope of this area, however, the mainstem Yaquina from the confluence of Spilde Creek to the confluence of Bales Creek (a 9.4 mile reach) can be classified as completely dysfunctional because of temperature limitations. The 1999 rapid bio-assessment survey noted a complete absence of coho below Randall Creek, and very few coho were noted between Randall and Spilde Creek.

The high level of dysfunction observed in the lower Core area results from complex relationships among upslope management, natural valley / channel morphologies, and water use:

- Extremely low mainstem gradients below the confluence of Spilde Cr predispose these habitats to slow turnover rates.
- Broad active channels accommodate large winter flows which enhance the potential for solar exposure during low summer flows.
- Degraded riparian canopies along the mainstem exacerbate the temperature limitation by providing for prolonged solar exposure.
- The combined impacts of large industrial forestry and the presence of Hamar Lake in the headwaters of the Little Yaquina create a condition of elevated temperatures high in the watershed that becomes cumulatively more severe by interacting with the downstream impacts.

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Limiting seasonal habitat analysis

Data sources

Habitat and spawning gravel inventories were used to estimate the capacity of the watershed to generate and support the development of coho salmon through the four stages of freshwater residence up to smoltification. Historic or current AQHI habitat inventories were available for some stream corridors. However, a lack of habiat survey data required that some habitat areas be estimated based on 1999 RBA snorkel inventory surveys. These fish inventories sample 20 percent of the pools in reaches having coho.

ODFW and the Oregon Forest Industries Council (OFIC) conducted habitat inventories in portions of the Buttermilk and Yaquina Headwaters sixth fields during the summers of 1992 and 1993. These surveys omitted all of the tributaries within the Yaquina Headwaters, and included only three of the nine tributaries of the Buttermilk sixth field. In 2007, Lincoln Soil and Water Conservation District conducted habitat surveys in Buttermilk Creek, Humphreys Creek, and the Little Yaquina River.

Model limitations

The Nickelson model was employed to determine whether spawning gravel or one of the seasonal rearing habitats constitutes the resource that most limits coho smolt production. Information for this analysis came from two principle sources: 1) The Field Assessment phase of the project, which provided estimates of the quantity and quality of spawning gravel; and 2) ODFW habitat inventories, which provided most but not all of the necessary habitat data.

Habitat conditions and distribution are then compared to an overlay of summer juvenile salmonid distribution. These two data layers provide a real world display of interaction between populations and physical habitat variables. These distribution and abundance layers (fish and habitat) are then compared to the Nickelson modeling exercise that looks at hypothetical subbasin relationships utilizing only total seasonal habitat surface areas and their associated seasonal survival rates (the data available for the basin does not allow us to actually estimate the abundance of spring habitat and winter habitats are estimated utilizing a regression equation developed from existing summer habitat inventories) to identify a habitat bottleneck (limiting factor).

It is important to clarify that the modeling exercise is not capable of evaluating all existing density dependant factors and their impacts on seasonal survival rates. Habitat quality, levels of sedimentation, temperature thresholds, intra and inter-specific competition and similar potentially important factors are not included in the Nickelson model. Because of this important weakness, we also apply seasonal survival rates summarized from the Alsea Watershed Study that better reflect the impacts of these other factors.

At this point we incorporate professional judgment into the process of identifying limiting factor issues. We utilize all of the information consolidated in the following assessment to specify both the short term and long term issues of concern in the subbasin that when addressed are expected to restore functional processes and boost subbasin smolt production.

Buttermilk Creek field assessment

Migration barriers

There does not appear to be an adult passage barrier at Buttermilk Lake. There is however, a small bedrock intrusion 1575 meters below the lake that exhibits a minor 3 ft vertical drop. There were no juvenile coho observed above this intrusion during the May 2007 inventory. DOF surveys in the 1980's found anadromous fish use ended ¼ mile below this natural barrier. RBA surveys put the end of coho use at 1,700' below the lake in 1999. Anecdotal data suggests coho spawned above the lake in the past and it appears that the bedrock intrusion noted as having influenced the endpoint of anadromous distribution does not pose a significant barrier to migration except during low flow periods.

Temperature issues In July of 1993 Oregon Forest Industries Council funded an aquatic habitat inventory in portions of the Buttermilk 6th field. Temperature data collected in July of 1993 in Buttermilk Creek ranged from 52 to 62 F. 2005 ODEQ temperature monitoring of Buttermilk Creek failed; no acceptable data was generated.

Aquatic habitats overview

Spawning gravel

Describe the quantity, quality and location of spawning gravel.

A total of 70 square meters of spawning gravel was identified during the Bio-Surveys 2007 field investigation of Buttermilk Creek. Of these one was of poor quality, 68 fair quality (97%), and one ranked as good quality . These rankings are based on professional evaluation of embeddedness, fines and silt. 38 sq m (54%) of the gravels are below the 1 m falls that identifies the top end of the only identified anchor site. Trib A had two sq meters of gravel just above its confluence with Buttermilk Creek. From the 1m falls to the Lake there are an additional 30 sq m (43%) of gravel. Above Buttermilk Lake there are eight sq meters of gravel.

Summer juvenile distribution

Describe the summer distribution of coho juveniles. Include a description of the resources used.

Bio-Surveys LLC conducted rapid bio-assessment snorkel surveys for juvenile salmonids in the summer of 1999. 1998 was the lowest recorded coho spawner return for the Yaquina River. Buttermilk Creek had coho fry present to 1700 lineal feet below Buttermilk Lake. In May of 2007 the Bio-Surveys stream survey noted coho use ending at a 1 m falls, approximately 1,575 m below the lake. ODFW reported coho fry above this falls in summer of 2006 for summer coho distribution in 1999 (Figure 1 Appendix 6). In May of 2007 coho fry were present in the majority of pool habitats available on mainstem Buttermilk.
Very low levels of wood in Buttermilk Creek limit both pool formation and cover for summer juvenile habitat.

Bio-Surveys average pool complexity score in 1999 was 2.3. This scale is based on the total percent of pool surface area that is associated with some form of structural complexity that is capable of providing cover (Over hanging vegetation, large substrate, wood, undercut bank, etc.) 2 is 1-25% of pool surface area, 3 is 26-50% of pool surface area associated with cover.

Summer cover

Describe the character and distribution of summer cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Summer cover for juvenile salmonids is often expressed in quantitative inventories as the abundance of wood present. The 1993 aquatic habitat inventory described low to modest amounts of large woody debris in the system, contributing little to habitat complexity. The 2007 Lincoln Soil and Water Conservation District (LSWCD) aquatic habitat inventory of Buttermilk Creek noted wood densities of 6 pieces per 100m of stream length. The ODFW habitat benchmark is >20 pieces per 100 meters. Key pieces were in very low abundance, occurring at the rate of 0.4 pieces per 100m. The benchmark for key pieces is >3 per 100m of stream length.

One summer habitat feature widely documented in the 1993 AHI was beaver ponds. Beaver ponds provide stratified summer refugia. Almost all of the beaver ponds documented in 1993 were gone during the 2007 inventory (39 vs. 3).

Buttermilk Creek currently has an abundance of exposed bedrock (~2,200 lineal feet) and a lack of complex pool habitat.

Winter cover

Describe the character and distribution of winter cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

With one exception, Buttermilk Creek is simple. Sinuosity is low, there is little wood present, and as the stream passes through old beaver meadows the channel is deeply entrenched. Below the sinuous site mentioned above, the stream has been torrented, with an abundance of exposed bedrock. The channel is incised, and floodplain interaction is not possible. Old beaver meadows, still possessing a matrix of multiple side channels, are four to six feet above the stream channel, as substrates have been scoured away in the absence of dams. Many of these formerly rich impounded areas are now monocultures of reed canary grass with no potential for delivering riparian wood.

Twelve instream habitat structures were noted in 2007. These were placed by ODFW in 1998 and 2001. According to Oregon Watershed Restoration Inventory database (OWRI) records, nine structures were placed originally. The increase in the number of structures is attributable to some migration of structure logs, not recruitment from elsewhere in the watershed. Of these structures, five are functioning to provide winter habitat for juvenile salmonids.

Bio-surveys' inventory did not observe natural occurring functional winter cover via log jams in Buttermilk Creek. Large conifers were not found in the riparian area, so the recruitment potential is insignificant.

As described in the summer cover section above, Buttermilk Creek is impoverished in terms of large woody debris and the future potential to recruit large wood.

Channel form and floodplain interaction

Describe the channel form and degree of floodplain interaction..

Aerial photos from 1948 show pastureland along Buttermilk Creek. The entire basin is now in industrial timber ownerships. Near its mouth it is bounded by a road on the southwest side for 1,700'. It continues along the northeast side of the creek for another 3,200' before crossing again to the southwest, and moving up the ridge.

There were twelve habitat improvement structures noted in Buttermilk Creek during the May 2007 Bio-Surveys stream evaluation. Five of the twelve structures were highly functional, aggrading the channel and causing floodplain interaction. Of the other seven, 4 were providing limited benefit, and three provide cover, but do not improve floodplain interaction. Nine structures were placed by ODFW in 1998. The discrepancy in numbers is attributable to wood migration. The structures are located between the mouth of Buttermilk Creek and just above the mouth of Trib A.

There is 580’ of exposed bedrock in the above described portion of the stream. From the upstream end of the last habitat structure to the start of the anchor site, there’s an additional 1400’ of exposed bedrock.

There are a series of old beaver meadows in the system. Here, the channel is incised, and floodplain interaction is lacking, due to the absence of former full spanning dams. Many of the old beaver meadows are dominated by reed canary grass, with no recruitment of young trees. The potential for wood recruitment in these areas is limited to materials delivered from slope failures on 1st order tributaries. Protection of riparian vegetation on tributaries contiguous to or nearby these areas is crucial to encourage future floodplain interaction.

Beginning 1,800' below the falls, the creek becomes a highly sinuous anchor area, with an abundance of gravel.

In the area above the falls, there are 3 full spanning beaver dams. In that area there is improved floodplain interaction and good gravel deposition. 200’ of exposed bedrock was observed in this zone.

Channel complexity potential

Assess the potential for the development of meander, braiding, side channel, alcove, backwater channel forms.

Old beaver meadows in Buttermilk Creek still exhibit channel complexity elements, although their connection to the floodplain ended when the beaver dams washed out. Beaver could re-establish channel complexity in these areas, as dams aggrade the channel, and reconnect the creek with its floodplain

There is one minor low terrace in reach one of Buttermilk Creek, which has potential for off channel habitat development. The site could be improved with the addition of large wood.

The channel is currently extremely simplified and lacking the components of meander and braiding. Aggradation is the key to restoring the functional interaction that would result in these complex attributes.

Channel complexity limitations

List and rank the factors currently limiting the development of channel complexity.

1) Reduced beaver abundance. Bio-Surveys documented a total of three beaver ponds below the lake in Buttermilk Creek and its main tributary in 2007. There were 39 dams present there in 1992.

2) Extremely low wood densities. The potential for natural recruitment of wood is low; the system is dominated by a young tree plantation. We observed 2,450' of open canopy along mainstem Buttermilk Creek in May of 2007. This area currently offers no potential for future wood recruitment. Much of the open canopied areas were dominated by reed canary grass, rendering any hope for the long term recruitment of conifers also unlikely.

3) Undersized culverts above Trib A (Photo 1) limit the ability of Buttermilk Creek to realize its channel complexity potential, restricting the movement of large wood, and of the stream itself.

Addressing the limitations

Are these limitations addressable through restoration work? Explain for each limitation listed above.

Addition of full spanning structures would provide a short term solution to the problems compromising channel complexity in Buttermilk Creek. Long term solutions would include:

1) The reestablishment of a robust beaver population (natural recruitment with a no-take policy, or re-introduction)
2) Protection of wood source areas (riparian buffers and buffers on 1st order streams subject to failure and establishment of riparian vegetation in areas currently dominated by reed canary grass
3) Replacement of the two undersized culverts with culverts as wide as the channel, or a bridge.

Anchor Site 1

Location and length

Only one anchor site was identified in Buttermilk Creek. The anchor site begins just above a torrented section of channel 1800 lineal feet below a one meter falls, and extends upstream to the falls. The falls is 1575 feet downstream of Buttermilk Lake

Sinuosity

The creek is highly sinuous in this area, and spawning gravels are abundant. Gravel retention here is aided by low terraces that dissipate hydraulic potential during high winter flow regimes and prevent vertical scour and entrenchment.

Terrace structure

Terraces in the anchor site are ~18' in height, are very uniform in elevation and composed of depositional substrates.

The primary vegetation is young alder, shrubs and reed canary grass.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

This 1800 foot segment of Buttermilk Creek contains all of the attributes necessary to complete the coho life cycle from spawning gravel to winter habitat. The quality of these habitats is compromised by the low wood abundance and sediment deposition, but this zone can function independently to provide year round incubation and rearing. The anchor contains 9% (6 square meters) of all of the fair quality gravel identified in the subbasin.

If these gravels were fully utilized they would be producing approximately 500 summer parr. Inventories conducted in 1999 documented a summer parr estimate of only 1,695 coho for all of Buttermilk Cr and its tributaries. Unfortunately, the 1999 abundance of juvenile salmonids did not test the anchor's carrying capacity because of the lack of adult escapement to the subbasin.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?

The underlying channel and floodplain morphologies exhibit extensive unutilized floodplain surface area because of the lack of significant wood complexity.

Addressing the limitations

List and rank the restoration work at the site that would most effectively increase survival within the site and stabilize the core population at a higher base level.

1) Enhance floodplain interaction by injecting large wood in full spanning structure complexes. The structures will boost the abundance of off channel habitat sites, increase braiding and contribute to the development of side channels.
2) Provide for the recolonization of beaver within the subbasin by transplantation to accelerate aggradation and the restoration of floodplain interaction.

Anchor site rankings

Function

Rank the identified anchor sites in terms of current function (1= best).

Anchor Site 1

Restoration potential

Rank the identified anchor sites in terms of restoration potential.

Anchor Site 1

Secondary Branch 1

Location and length

The only significant secondary branch “Trib A” enters Buttermilk Creek from the right hand side 1630m upstream of the confluence with the Yaquina River. The tributary contained 1,848 ft of utilizable habitat that was inventoried in the 1992 AHI.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

There is one sq meter of spawning gravel near the mouth of Trib A, as described by the 2007 Bio-Surveys LLC field survey.

The AHI reported 11 beaver dams in the trib. In 2007 there were no beaver dams. The only structure present was hardwood debris.

The estimated historical coho parr capacity with the ponds present in 1992 was 1,125. In 1999 Bio-Survey's rapid bioassessment recorded coho present to 1500' from the confluence with Buttermilk Creek, at densities of up to 0.5/m2.

“Trib A” contributes cold water to Buttermilk Creek, mitigating for elevated summer temperatures.

Rearing limitations

Which functions limit the site’s production potential, and what causes these limitations?

The current absence of beaver dams or full spanning structures limit Trib A’s production potential.. An excellent comparison of past and present summer capacity is revealed in the current habitat condition compared to the 1992 levels of beaver abundance. Current summer parr capacity with no beaver dams present is 136 fish.

Addressing the limitations

The riparian area should be protected to reduce solar input (harvest setbacks greater than the minimum current requirement), and reduce ambient air temperatures.
Allowing beaver to re-colonize this tributary would restore full production capacity.

Secondary branch site rankings

Function

Rank the identified branch sites in terms of current function (1= best).

1) Trib A

Restoration potential

Rank the identified branch sites in terms of restoration potential.

1) Trib A

Riparian corridor

Dimensions and location

Describe the lineal dimensions and location of deciduous, coniferous, and open canopy.

The 1993 AHI report on riparian vegetation ranges from "sparse" in the lowest reach, to 95% hardwoods in the headwaters.

In May of 2007, the Bio-Surveys LLC field investigation of Buttermilk Creek observed ~ 0.5 miles of open canopy, another 0.5 miles with 50% closure. In 1993, the OFIC AHI found canopy closure ranging from a low of 54% to a high of 74%. The best rating was in the headwaters of Buttermilk Creek; the majority of the stream had a range of 54% to 63% closure. The ODFW AHI habitat benchmark for desirable canopy closure is >70%.These conditions may well create unfavorable temperature conditions in Buttermilk Creek during low summer flows.

The highest percentage of conifer recorded in the riparian area in 1993 was 27% in AHI reach 2, which extends from a point 184m from the mouth to 1144m upstream, just above Trib A. The remaining surveyed areas-~80% of the stream's length were dominated by hardwoods ranging from 74% to 95% of the canopy present.

Near the mouth of Buttermilk Creek, the slope is failing where the road abuts the stream (Photo 2), and the hillside above is a new clear cut harvest unit on the southwest side of the stream.

Recruitment potential

What is the recruitment potential and time frame for delivery to the channel?

There is no recruitment potential along the ~1/2 mile of reed canary dominated riparian area. The timeframe for delivery of large coniferous wood to the channel is four to five decades out. The young conifer plantation present will not have enough size to positively effect change for at least that long. Senescing alder may provide recruitment sooner, but will provide no stable, long term contribution to channel complexity.

Thermal problems

Describe the relationship between riparian condition and thermal problems in the aquatic system. Include locations and causes.

Reed canary grass dominated riparian areas complemented by long stretches of exposed bedrock provide a formula for elevated summer temperatures during low flow season. This condition was noted intermittently throughout Buttermilk Creek below the gorge leading to Buttermilk Lake.

The only existing continually recorded temperature data for this stream was taken by the OSU College of Forestry for several years in the mid 1990's[2]. Experimental manipulation of riparian canopy to test stream temperature response seemed to be the goal. Repeated requests for the data have been denied. However, the study's lead author provided a copy of a report which contains a graphic showing three data sets on the mainstem of Buttermilk Creek demonstrating stream temperatures exceeding ODEQ standards at each site.

The only temperature data within the normal range is that of Trib A. In May of 2007 Bio-Surveys LLC noted that this tributary had been logged in its lower reaches, with only shrub and forb canopy present.
It is worth noting that the 1993 AHI identified 7 springs, and 3 seeps adjacent to Buttermilk Creek below the lake. The presence of these cold water sources suggests that excellent potential exists for mitigating elevated summer rearing temperatures in Buttermilk Creek.

[2] Dent, Elizabeth F. 2005. Influence of Small Clearcut Openings in Riparian Areas on Summer Stream Temperatures on Coastal Oregon and Western Cascades Streams COPE Report 8(3):2-6

Critical Contributing Areas (CCA)

Description and relation to core site

Identify the CCA's and describe the spatial relationship between each CCA and the Core Area and Anchor Site(s). Identify CCA's that contribute directly to specific Anchor Sites.

There are four CCA's in Buttermilk Creek. Two of these have the potential to contribute significant resources to the coho bearing segment of the mainstem. One is Site K on the slope north of the anchor site (Appendix 7). Failure here would deliver material directly into the anchor. The second site is 1,400' upstream of the anchor. (Site G). The remaining two sites indicated on the landslide risk analysis contribute to Buttermilk Lake or above, and have lower failure risks associated with them.

Ranking

Rank the CCA's in order of importance to the Core/Anchor Site system. This ranking should consider the contribution of substrate, wood, flow, and temperature maintenance to the Anchor Site system.

G,K,S,T (Appendix 7)

Bryant Creek field assessment

Bryant Creek is the first significant tributary entering the Yaquina from the North upstream of Buttermilk Creek. It enters the Yaquina River at RM 43.

Migration barriers

The county road culvert at Bryant Creek. is a juvenile barrier, with a 0.5 m drop at the apron (Photo 3).

Trib A on Bryant Creek has a culvert that will block delivery of large wood, not a significant issue for fish migration.

The first road crossing above the county road is a possible adult barrier; a 0.25 meter perch, spills onto a bedrock slide (Photo 4).

A five foot bedrock falls ends anadromous access 2,400' from the mouth.

Temperature issues

There is no temperature data available for Bryant Creek

Aquatic habitats overview

Spawning gravel

Describe the quantity, quality and location of spawning gravel.

Seven sq m of fair quality gravel was present in May of 2007. Lots of small, transient wood and canopy litter is responsible for the gravel sorting that does occur. The heavy silt loading observed within native gravels was probably the normal condition for this sandstone geology.

Summer juvenile distribution

Describe the summer distribution of coho juveniles. Include a description of the resources used.

In 1999 Bio-Surveys recorded juvenile coho present up to the 4' bedrock falls 2,400' from the mouth of Bryant Creek (Figure 2). 1999 was a year of very low abundance for coastal coho due to historically low adult returns in 1998. There was no indication of upstream juvenile migration within the system, suggesting a temperature gradient did not exist, however on further inspection in 2007, it was observed that the culvert at the mouth was preventing any upstream temperature dependant migrations from the mainstem Yaquina..

Bryant Creek is well shaded and cold, offering potential refugia from elevated summertime temperatures in the mainstem Yaquina River. A 0.5 m drop at the county road culvert excludes juvenile coho from migrating into the system.

Summer cover

Describe the character and distribution of summer cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Summer cover is limited in Bryant Creek. There are low levels of wood, so pool complexity and depth are also limited. In 1999 Bio-Surveys' rapid bio-assessment noted that pools were shallow, and the average pool complexity was 1.8, on a scale of 1-5. This scale is based on the total percent of pool surface area that is associated with some form of structural complexity that is capable of providing cover (Over hanging vegetation, large substrate, wood, undercut bank, etc.) 2 is 1-25% of pool surface area, 3 is 26-50% of pool surface area associated with cover.

There are no aquatic habitat inventory data for this creek.

Winter cover

Describe the character and distribution of winter cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Two low terraces on the Fields' property, low in the stream corridor, provide winter refuge from peak flows. There is some structure associated with these terraces. Elsewhere in Bryant Creek there is a general lack of large wood.

Channel form and floodplain interaction

Describe the channel form and degree of floodplain interaction.

Bryant Creek, like its neighbors in the Buttermilk sixth field, lacks structure. There was no significant evidence that Bryant Creek possessed the same beaver legacy that was so commonly observed in most other Yaquina complex streams. In 2007, Bryant Creek had no dams, no large wood, and lots of exposed bedrock.

The two low terraces had a minimal structural component associated with them, so that the creek interacts with the floodplain only at peak flows. There is some indication that historic stream channel modifications may have altered the course of the channel in the 1st 400 ft. Restoring historic sinuosity here could improve floodplain interaction.

There is a gradient shift in Bryant Creek from ~2-~4% at the confluence of Trib A.

Channel complexity potential

Assess the potential for the development of meander, braiding, side channel, alcove, backwater channel forms.

The greatest potential for enhancing or developing channel complexity in Bryant Creek exist at the two low terrace sites on Fields' property.

Channel complexity limitations

List and rank the factors currently limiting the development of channel complexity.

1) Channel complexity in Bryant Creek is limited by lack of structure.

2) 10% exposed bedrock substrate in anadromous use area
3) Lack of sinuosity

Addressing the limitations

Are these limitations addressable through restoration work? Explain for each limitation listed above.

1) Channel complexity could be increased in the lower portion of Bryant Creek by adding structure near the terraces
2) Addition of full spanning structures would aggrade bed material
3) Sinuosity could be vastly improved by an aggressive channel reconstruction that utilizes the full width of the available low terraces

Anchor Site 1

Location and length

There were no anchor sites identified in Bryant Creek.

Secondary Branch 1

Location and length

Trib A is located 1,000' from the mouth of Bryant Creek, and is about 1,000' in length.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

At present, Trib A is a cold water contributor for summer juveniles rearing in Bryant Creek.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?

A small culvert at its confluence with Bryant Creek prevents the delivery of canopy litter .

Addressing the limitations

Replacing the culvert with a ford would best facilitate the movement of litter into Bryant Creek.

Secondary branch site rankings

Function

Rank the identified branch sites in terms of current function (1= best).

Trib A

Restoration potential

Rank the identified branch sites in terms of restoration potential.

Trib A

Riparian corridor

Dimensions and location

Describe the lineal dimensions and location of deciduous, coniferous, and open canopy.
The first 0.25 miles of Bryant Creek is in old pasture. The west side of the creek has some riparian canopy of mixed conifer/hardwood/shrubs. Above this pasture the canopy is closed conifer and alder.

Recruitment potential

What is the recruitment potential and time frame for delivery to the channel?
The riparian area on Starker land was flagged for logging in 2007. Steep slopes next to the stream in this area would facilitate the delivery of wood to the creek if the existing robust buffer were allowed to mature.

Thermal problems

Describe the relationship between riparian condition and thermal problems in the aquatic system. Include locations and causes.

At present there are no indicators that thermal problems exist in Bryant Creek. However, the known temperature limitations in the adjacent mainstem Yaquina, suggest that maintaining the delivery of high quality cold flow from Bryant Creek to the mainstem is a high priority for addressing basin scale limitations for summer rearing salmonids.

Critical Contributing Areas (CCA)

Description and relation to core site

Identify the CCA's and describe the spatial relationship between each CCA and the Core Area and Anchor Site(s). Identify CCA's that contribute directly to specific Anchor Sites.

The headwaters of Bryant Creek have been classified as landslide prone slopes. The entire catchment of Trib A, Bryant's only tributary, is also prone to slope failure. Neither of these sites delivers upslope resources to a highly functional Anchor site. However, Bryant Cr is one of the most likely candidates for delivering upslope resources to the mainstem Yaquina and was ranked very high (fourth likely site to fail within the complex of three 6th fields) in the Landslide Risk Analysis (Appendix 7, Sites D and E).

Ranking

Rank the CCA's in order of importance to the Core/Anchor Site system. This ranking should consider the contribution of substrate, wood, flow, and temperature maintenance to the Anchor Site system.

D, E (Appendix 7)

Stony Creek field assessment

Stony Creek enters the mainstem Yaquina River at RM 43.35 from the North, 0.35 mile upstream of Bryant Creek.

Migration barriers

The fish ladder below the county road crossing creates a juvenile barrier, with a 0.25 m step. This condition could be substantially improved with minor adjustments in baffle height and frequency* (Photo 5). Baffles in the culvert also need adjustment.

At the second road crossing the culvert (1,800' to mouth) is probably a juvenile barrier with water flowing underneath.

An eight foot vertical bedrock falls 3,500 feet from the mouth ends anadromous use. Local residents suggest that this site was not a barrier when beaver impoundments in the basin succeeded in aggrading the active channel to a passable elevation (Photo 6).

Temperature issues

There are no indications of temperature issues in Stony Creek. The 2005 ODEQ thermister placed at the mouth of Stony Creek recorded stream temperatures of ~7-16C from July to October (Figure 1 Appendix 9).

Aquatic habitats overview

Spawning gravel

Describe the quantity, quality and location of spawning gravel.

There are 20 sq m of fair and 37 sq m of good quality spawning gravel in Stony Creek. Thirty eight sq m (77%) is in the mainstem, the remaining 19 sq m (33%) is found in Trib A.

Summer juvenile distribution

Describe the summer distribution of coho juveniles. Include a description of the resources used.

Bio-Surveys 1999 rapid bio-assessment of Stony Creek found modest densities (peak of 0.6 fish/sq m) of juvenile coho present to the falls (Figure 3)

Summer cover

Describe the character and distribution of summer cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Summer cover for juvenile salmonids is often expressed in quantitative inventories as the abundance of wood. Stony Creek has a good supply of transient small woody debris. Key pieces are in short supply. In 1999 the Bio-Surveys rapid bio-assessment rated pool complexity at 1.6 on a scale of 1-5. This scale is based on the total percent of pool surface area that is associated with some form of structural complexity that is capable of providing cover (Over hanging vegetation, large substrate, wood, undercut bank, etc.) 2 is 1-25% of pool surface area, 3 is 26-50% of pool surface area associated with cover.

The May 2007 Bio-Surveys stream inventory identified one natural debris jam of significance on the main stem of Stony Creek, located below the 2nd culvert.

Winter cover

Describe the character and distribution of winter cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Below the one full spanning jam present in May 2007, deep channel entrenchment precludes any potential for winter habitat. At the jam, the channel aggrades 0.8m, connecting the creek with the adjacent terrace. The current evidence of a beaver legacy also indicates a much higher historical potential for the provision of winter habitat.

In 1993, the OFIC aquatic habitat inventory found the number of wood pieces per 100 m ranged from 0.4 to 2.4. The ODFW benchmark for desirable quantities of wood is >20 pieces/100 m.

Channel form and floodplain interaction

Describe the channel form and degree of floodplain interaction.

The channel is deeply incised below the Trib A confluence. Vertical banks range up to 7' in height, and the channel is scoured to bedrock in many stretches. There is one full spanning jam in this reach, which aggrades the channel, providing floodplain connectivity.

Above the aggraded section, bedrock dominates the streambed again. Here however, the deep channel incision is less the result of natural morphology than the absence of beaver that at one time impounded most of the lineal stream distance from Trib A to the end of anadromous distribution at the falls.

Channel complexity potential

Assess the potential for the development of meander, braiding, side channel, alcove, backwater channel forms.

The potential for development of complex channel features is illustrated in the 1993 OFIC aquatic habitat inventory on Stony Creek. There were 22 beaver dams noted between the mouth of the creek and the falls. The channel was described as braided in two locations. Reach one of the survey, the first 243 m, had a 30% bedrock component, and no beaver dams. The rest of the surveyed area, to the falls, had little exposed bedrock and 22 dams, a strong contrast to conditions in 2007, when no beaver dams were found in the stream, and exposed bedrock was abundant. 615' of bedrock were observed in the 2500' main-stem portion used by anadromous fish, 25% of the lineal distance.

Channel complexity limitations

List and rank the factors currently limiting the development of channel complexity.

1) Deeply entrenched active channels through isolated floodplains; 505'exposed bedrock
2) Limited riparian potential for the recruitment of large stable woody components
3) Low density of full spanning debris jam complexes to encourage floodplain connectivity
4) Low abundance of beaver activity that historically prevented the development of deep entrenchment

Addressing the limitations

Are these limitations addressable through restoration work? Explain for each limitation listed above.

1) Full spanning jams or beaver dams could aggrade bed materials, and improve floodplain interaction
2) Leave current high quality buffers in place long term
3) Full spanning jams; beaver dams
4) Re-introduce beaver and allow them to remain undisturbed

Anchor Site 1

Location and length

The only anchor site on Stony Creek is found on Trib A. Trib A enters Stony Creek from the right,1,650' from its mouth, just above the 2nd culvert.

Sinuosity

The anchor site exhibited markedly improved sinuosity over that observed in Stony Creek.

Terrace structure

The active floodplain is not extensive (averaging 75 ft) but terraces of < 12" are present, indicating the potential for enhanced interaction during winter flow regimes. The channel has the potential to migrate with the addition of even low levels of wood complexity.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

There are 12 sq m of fair, and 7 sq m of good quality spawning gravel in the anchor site. In 1999 the Bio-Surveys LLC rapid bio-assessment found no coho in Trib A. The anchor is small with a current production capacity of 300 smolts.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?
This is a small tributary with small summer pool surface areas. This is the primary limitation to production.

Addressing the limitations

List and rank the restoration work at the site that would most effectively increase survival within the site and stabilize the core population at a higher base level.

1) Increases in pool surface areas provided by either full spanning wood complexity or beaver dam impoundments are the key to boosting salmonid production here. Wood treatment is less feasible and less cost effective than the reintroduction of beaver.

Anchor site rankings

Function

Rank the identified anchor sites in terms of current function (1= best).

1) Anchor site 1

Restoration potential

Rank the identified anchor sites in terms of restoration potential.

1) Anchor site 1

Secondary Branch 1

Location and length

Trib A enters Stony Creek 1650' from its mouth, just above the 2nd culvert, entering from the right. It is 2,060' from it's confluence with Stony Creek to the split at the headwaters.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

The only anchor site in Stony Creek is located in Trib A. It provides year round rearing for the complete freshwater coho life cycle. 34% of the spawning gravel in Stony Creek is found in Trib A. Its summer rearing potential is for over 700 parr. Winter capacity is approximately 300 smolts.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?

This is a small tributary with small summer pool surface areas. This is the primary limitation to production.

Addressing the limitations

1) Increases in pool surface areas provided by either full spanning wood complexity or beaver dam impoundments are the key to boosting salmonid production here. Wood treatment is less feasible and less cost effective than the reintroduction of beaver.

Secondary branch site rankings

Function

Rank the identified branch sites in terms of current function (1= best).

1) Trib A

Restoration potential

Rank the identified branch sites in terms of restoration potential.

1) Trib A

Riparian corridor

Dimensions and location

Describe the lineal dimensions and location of deciduous, coniferous, and open canopy.

The 1993 AHI describes the riparian area as over 80% hardwood dominated above reach 1. Canopy closure at regular transects ranged from the mid 50% range to the high 89% range, in about equal quantity. Reach 1 extends 243m from the mouth, and is conifer dominated.

In 2007, the Bio-Surveys LLC survey noted a sparse buffering of old alders backed by young fir plantation in lower Stony Creek. This quickly transitions to young plantation which continues to just above Trib A where the east side of the stream has a 100'+ alder buffer, the west side has an equally impressive buffer of mixed species. This condition continued throughout the anadromous use area to the falls, and beyond. Trib A has a canopy of mixed species.

Canopy conditions in the upper reaches of the sub basin are high quality and providing extensive protection from solar exposure. The value of this condition to the temperature limited portions of the mainstem can not be overstated.

Recruitment potential

What is the recruitment potential and time frame for delivery to the channel?

If left unharvested the existing riparian in Trib A and on the mainstem above Trib A will provide a mix of hardwood and conifer material to Stony Creek on an ongoing basis. There is a functional jam composed of alder just below the well buffered mainstem area. The jam is aggrading the channel, and trapping transient material. Maintenance of the existing buffer will contribute long term to a net increase in channel complexity

Thermal problems

Describe the relationship between riparian condition and thermal problems in the aquatic system. Include locations and causes.

The current riparian condition on Stony Creek precludes thermal problems. Maintenance of the existing riparian area will prevent thermal problems from arising.

Critical Contributing Areas (CCA)

Description and relation to core site

Identify the CCA's and describe the spatial relationship between each CCA and the Core Area and Anchor Site(s). Identify CCA's that contribute directly to specific Anchor Sites.

Slide prone slopes are present in the headwaters of Trib A, the headwaters of Stony Creek, and on one first order tributary below the Stony Cr headwaters. On the mainstem, the CCA is 4,300' upstream of the barrier falls ending anadromous fish migration. On the tributary, the CCA is 3,000' upstream of the anchor site. Both of these last two sites have the potential of contributing upslope resources to identified anchor sites.

Ranking

Rank the CCA's in order of importance to the Core/Anchor Site system. This ranking should consider the contribution of substrate, wood, flow, and temperature maintenance to the Anchor Site system.

M, N, O, (Appendix 7)

Randall Creek field assessment

Randall Creek enters the Yaquina River from the north at RM 45.3.

Migration barriers

The first private road crossing located approximately 1,300 ft from Randall's confluence with the mainstem Yaquina is an undersized culvert (5.5' CMP in a 12' channel). A small beaver dam at the culvert's upstream end terminates potential for upstream temperature- dependant juvenile migration (Photo 7 Appendix 8).

Temperature issues

A temperature probe placed by Lincoln Soil and Water Conservation District in 2005 recorded temperatures from 6/15 to 9/7/2005. During that time, temperatures did not exceed the ODEQ standard for salmonids (17.8 deg C), ranging from ~10-17C. The probe was located just upstream of the Edwards property on Starker Forests land, about 1,000' from the mouth of Randall Creek (Figure 2 Appendix 9).

Aquatic habitats overview

The 2007 Randall Creek survey began on Starker ownership, access was denied for the first 1,000 ft of Edwards ownership. The Edwards portion of the stream is managed as pasture, with heavy livestock use. No riparian canopy is present on the majority of that stream segment.

Spawning gravel

Describe the quantity, quality and location of spawning gravel.

Below Bones Creek there are 17 sq m of spawning gravel; above Bones 78 sq m. for a total of 95 sq m. Of that 95, 13 sq m (14%) is poor quality, 63 sq m (66%) is fair, and 20 sq m, or 20% is good quality. Bones itself has 2 sq m, one poor, one fair.

Summer juvenile distribution

Describe the summer distribution of coho juveniles. Include a description of the resources used.

The 1999 Bio-Surveys rapid bio-assessment found juvenile coho to ~7,050' from the confluence with the Yaquina River. Summer densities that averaged 0.91 fish/sq m were observed despite the exceptionally low adult returns of 1998 (Figure 4).

Summer cover

Describe the character and distribution of summer cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

There is an insufficient quantity of wood in Randall Creek, as quantified in the 1993 AHI. At that time, on a scale of 1-5, the wood complexity score was just above 1. The situation was unchanged in May of 2007. Habitat structures were placed by ODFW on Starker Forest lands, in 1997. The 2007 Bio-Surveys stream survey noted four boulder gabions and ten log structures as present and functioning. All contribute to summer cover, especially the structure enhanced by beaver to create a large pond and beaver meadow, just upstream of a culvert crossing. The structures are located from just above the 1st left hand tributary to just above the confluence with Buckhorn Creek.

Pool complexity scores computed by Bio-Surveys LLC in 1999 averaged 2.25 on a scale of 1-5. This scale is based on the total percent of pool surface area that is associated with some form of structural complexity that is capable of providing cover (over hanging vegetation, large substrate, wood, undercut bank, etc). A ranking of 2 represents 1-25% of pool surface area associated with cover, and 3 represents 26-50%.

Winter cover

Describe the character and distribution of winter cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

The habitat structures in Randall Creek are not present in sufficient quantity to fully exploit the winter rearing potential that the stream's geomorphology allows.

In May 2007 the Bio-Surveys LLC stream survey noted three beaver dams present in the system; two were insignificant, providing no potential for winter habitat. The dam built on the ODFW habitat structure offers significant winter cover just above the Starker culvert and appears stable through winter flows. The location of this large dam pool low in the system suggests that its potential is large for over wintering juvenile salmonids incubated higher in the subbasin.

Channel form and floodplain interaction

Describe the channel form and degree of floodplain interaction.

Randall Creek has limited floodplain interaction due to very low levels of in channel roughness. Existing structures, located between Trib A and Buckhorn Creek have aggraded substrate materials. Some wood recruitment occurring from robust and diverse riparian areas. Floodplain interaction was maximized only at the beaver dam built on a habitat structure.

Two anchor sites, both above Bones Creek, exhibit the potential for wintertime floodplain interaction.

Channel complexity potential

Assess the potential for the development of meander, braiding, side channel, alcove, backwater channel forms.

The 1993 aquatic habitat inventory documented 21 beaver dams in Randall Creek. Correspondingly, there are a number of old beaver flats located throughout Randall Creek. Should they be re-populated by beaver, these abandoned terraces would develop complex channel attributes.
Randall Creek has good potential for development of diverse habitats. It has a broad active channel present in several locations:

- Low in the system, just above the first tributary on Starker property, there is a one meter high terrace
- The anchor sites, two identified below
- The historical beaver flats above Buckhorn Creek.

Channel complexity limitations

List and rank the factors currently limiting the development of channel complexity.

1) Lack of beavers.
2) A deficiency of instream wood
3) 1,100' of exposed bedrock in the stream channel.

Addressing the limitations

Are these limitations addressable through restoration work? Explain for each limitation listed above.

1) Allow beaver re-colonization or re-introduce beavers to utilize former meadow areas
2) Retain riparian buffers on the mainstem and on first order streams capable of delivering large wood
3) Place full spanning habitat structures in suitable areas to aggrade bed materials and create diverse off channel habitat types.

Anchor Site 1

Location and length

Anchor site 1 is 300' long. It is located ~325' above the confluence with Bones Creek.

Sinuosity

Sinuosity is low because of the limited lineal duration of this anchor site. Some potential exists for encouraging meander.

Terrace structure

Terraces are low (<12”) and composed of depositional fines and sediment. Terraces are highly erodible and would facilitate channel meander.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

There was 5 sq.m of spawning gravel classified as fair within the anchor. The key morphological issue here is that the section exhibits the potential for increasing off channel habitats that would function well for the provision of winter habitat.

In 1999 Bio-Surveys rapid bio-assessment observed the densities of juvenile coho salmon in excess of 1 fish /m2 in this area.

Rearing limitations

Which functions limit the site’s production potential, and what causes these limitations?

A deficiency of full spanning structures limits floodplain interaction in the anchor site.

Addressing the limitations

List and rank the restoration work at the site that would most effectively increase survival within the site and stabilize the core population at a higher base level.

1) Boost instream wood complexity by creating full spanning structure to increase high flow floodplain interaction.

Anchor Site 2

Location and length

Anchor site 2 is ~1,625" long. It is located ~350' above Anchor Site 1, and ends just below Buckhorn Creek. The creek narrows up briefly between the two anchor sites.

Sinuosity

Current levels of sinuosity are moderate with low terraces and moderate width floodplains (75 ft) offering the additional potential for creating meander.

Terrace structure

Similar to Anchor Site 1, terraces are frequently <12" and composed of erodible fines and riverine sediments. They are currently well stocked with alder and capable of providing higher levels of interaction.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

The majority of the spawning gravel found in Randall Creek is located in the two anchor sites. 66% of the total gravels (63 sqm) observed in the system are present in Anchor Site 2. 73% of the gravel in anchor site two was classified as good (the highest quality ranking). This location has the greatest summer and winter rearing potential in Randall Creek because of the larger pool surface areas (summer) below the confluence of Buckhorn and winter because of the lower gradients and higher potential for floodplain interaction.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?

A deficiency of full spanning structures limits floodplain interaction in the anchor site.

Addressing the limitations

List and rank the restoration work at the site that would most effectively increase survival within the site and stabilize the core population at a higher base level.

1) Inject additional large wood in full spanning jam complexes

Anchor site rankings

Function

Rank the identified anchor sites in terms of current function (1= best).

Site # 1-above Bones Creek
Site # 2-below Buckhorn Creek

Restoration potential

Rank the identified anchor sites in terms of restoration potential.

Site # 2-below Buckhorn Creek
Site # 1-above Bones Creek

Secondary Branch 1

Location and length

Bones Creek enters Randall Creek 2,425 ft from its mouth. It contains 0.37mile of surveyed habitat (AHI).

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

There is 0.8 m of spawning gravel, and a summer rearing capacity of 160 parr. The tributary is most important for its significant cold water contribution to the mainstem of Randall Creek.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?

Poor pool formation in the lowest reach limits coho production potential.

At 300 m from its mouth, the creek narrows to a V canyon with no significant potential for rearing coho, due to its small size and steep gradient. Bones Creek is primarily important for cutthroat trout, and cold water contribution to the mainstem.

Addressing the limitations

No effort is recommended for Bones Creek because of its limited capacity for rearing coho. Protection of upslope riparian canopies is the most important long term prescription for Bones.

Secondary Branch 2

Location and length

Buckhorn Creek enters Randall Creek 6,000 feet from its mouth. Its primary headwater split is 2,400' from its mouth and the available AHI data extended to this end point.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing

Low densities of coho salmon were observed to 500' in Buckhorn Creek in 1999. AHI data from Buckhorn suggest that the habitat is riffle / rapid dominated and not providing significant pool rearing capacity.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?

There were 5 pieces of wood/100 m of stream length in 1993. The ODFW benchmark is 20pcs/100m. Low wood densities continue to be a factor in Buckhorn Creek. In addition, limited pool rearing surface area creates a natural limitation to significant production.

Addressing the limitations

Secondary branch site rankings

Function

Rank the identified branch sites in terms of current function (1= best).

Secondary Branch 2-Buckhorn Creek
Secondary Branch 1-Bones Creek

Restoration potential

Rank the identified branch sites in terms of restoration potential.

Secondary Branch 2-Buckhorn Creek

Riparian corridor

Dimensions and location

Describe the lineal dimensions and location of deciduous, coniferous, and open canopy.

In 1993, the AHI described the species composition of Randall Creek riparian as 59% conifer and 41% hardwoods. In May of 2007, the Bio-Surveys LLC stream inventory noted a similar mix of species. However, alder conversion appears to have changed the composition of some areas to young plantation right down to the stream.

Randall Creek was well shaded and was exhibiting an advanced stage of recovery in 2007.

Recruitment potential

What is the recruitment potential and time frame for delivery to the channel?

Recruitment potential for LWD is limited in the short term by the absence of large conifers. Some large maples, and older alder will add ephemeral structure in the short term.

Thermal problems

Describe the relationship between riparian condition and thermal problems in the aquatic system. Include locations and causes.

The ODEQ placed a thermister 1,000 ft above the mouth of Randal Cr because access was denied on Edwards. Temperatures never exceeded the DEQ upper limit for salmonids of 17.8 deg C.

Critical Contributing Areas (CCA)

Description and relation to core site

Identify the CCA's and describe the spatial relationship between each CCA and the Core Area and Anchor Site(s). Identify CCA's that contribute directly to specific Anchor Sites.

Trib A enters Randall Creek at 4,170 feet from its mouth, on the right hand side. It enters directly into Anchor Site 2. Trib A delivers cold water to the mainstem. Trib B enters Randall Creek on the Right, 400' above Trib A. It enters directly into Anchor Site 2. Trib B is also a source of cool water to the mainstem. The entire upper Buckhorn Creek drainage is prone to slope failure.

The subbasin is ranked #12 of 21 high risk slope failure sites in the Buttermilk 6th field. Almost any slope failure in Buckhorn would result in delivering upslope resources directly to an identified anchor site.

Ranking

Rank the CCA's in order of importance to the Core/Anchor Site system. This ranking should consider the contribution of substrate, wood, flow, and temperature maintenance to the Anchor Site system.

1) Trib B

2) Trib A

Felton Creek field assessment

Migration barriers

Riprap below the railroad culvert creates a one foot juvenile barrier 600’ from the confluence with the Yaquina River.
A 3.5' bedrock falls ends juvenile upstream migration approximately 1,500 ft from the confluence with the mainstem Yaquina. The 3rd culvert, a 3' corrugated metal pipe in a 6' channel, located ~5,000’ from the mouth, and just below the headwaters split, blocks delivery of wood.

Temperature issues

ODEQ monitoring in 2005 was not successful in Felton Creek. No temperature data are available.

Aquatic habitats overview

Spawning gravel

Describe the quantity, quality and location of spawning gravel.

There was 14 sq m of spawning gravel observed in Felton Creek in 2007. All gravel was observed above the bedrock falls located low in the system. Two sq m of gravel was good quality, the balance was half poor, half fair quality.

Summer juvenile distribution

Describe the summer distribution of coho juveniles. Include a description of the resources used.

1999 rapid bioassessment found juvenile coho to 4,000’ from the mouth of Felton Creek (Figure 5). The lower 2,000’ was not surveyable because of turbulence caused by livestock. In 2007, livestock were present in the lower portion of Felton Creek.

Summer cover

Describe the character and distribution of summer cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Summer cover in Felton Creek is limited by a low volume of wood. In 1999, the Bio-Surveys LLC rapid bio-assessment rated pool complexity at an average of 2.3 on a scale of 1-5. This scale is based on the total percent of pool surface area that is associated with some form of structural complexity that is capable of providing cover (over-hanging vegetation, large substrate, wood, undercut bank, etc.) A ranking of “2” indicates 1-25% of pool surface area, while “3” represents 26-50%.

Winter cover

Describe the character and distribution of winter cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Winter cover in Felton Creek is sub-optimal. Large wood complexity is limited throughout the system and the current absence of beaver impoundments reduces the abundance of low velocity off channel winter habitat.

Channel form and floodplain interaction

Describe the channel form and degree of floodplain interaction..

The lower portion of Felton Creek runs through a pasture. Although the creek is not deeply entrenched here, floodplain interaction is limited by a lack of structure.

Above the bedrock falls, Felton Creek is constrained by hillslope. It then opens into a broad valley, which ends at the beginning of a 290' stretch of bedrock below a confined, torrented gorge area, where the channel is simple.

Channel complexity potential

Assess the potential for the development of meander, braiding, side channel, alcove, backwater channel forms.

There are areas of broad active channel and available adjacent floodplain in Felton Creek that could easily develop higher levels of channel complexity.

Channel complexity limitations

List and rank the factors currently limiting the development of channel complexity.

1) Deficiency of full spanning wood complexes or beaver dams.

Addressing the limitations

Are these limitations addressable through restoration work? Explain for each limitation listed above.

1) Re-introduction of beaver would best address the limitations. The land owner recalled numerous ponds as recently as the late 1970's, early 1980's. There are no aquatic inventory data available for this stream.

Anchor Site 1

No anchor sites were identified in Felton Creek

Secondary Branch 1

No secondary branches were noted on Felton Creek

Riparian corridor

Dimensions and location

Describe the lineal dimensions and location of deciduous, coniferous, and open canopy.

The lower 1,500' of Felton Creek is in pasture. Below the county road, the stream has some cover from willow and other shrubs. Above the county culvert the riparian area is dominated by reed canary grass up to the bedrock falls. Above the falls a mixed species riparian area exceeds forest practices requirements, and includes some old growth conifer.

Scotch broom is present in the riparian area.

Recruitment potential

What is the recruitment potential and time frame for delivery to the channel?

There are riparian conifer present large enough to play key roles in increasing channel complexity in Felton Creek. The time frame for recruitment is contemporary and probably storm driven.

Thermal problems

Describe the relationship between riparian condition and thermal problems in the aquatic system. Include locations and causes.

There are no known thermal problems in Felton Creek at this time. Again as observed in many other contributing tributaries to the mainstem, it is the maintenance of the current condition far into the future that will most benefit the summer temperature limitations experienced by the larger Yaquina mainstem.

Critical Contributing Areas (CCA)

There are no CCA's identified in Felton Creek.

Trib X field assessment

Trib x enters the Yaquina River immediately upstream of Felton Creek from the south side.

Migration barriers

There is a marginal temporary culvert just below the landslide on Trib A. Habitat potential above this culvert is non existent (no replacement recommended).

Temperature issues

No temperature data is available for Trib X. The large legacy beaver meadow from the confluence with the Yaquina to Trib A (the landslide trib) is entirely unshaded, and may experience summertime elevated temperatures.

Aquatic habitats overview

Spawning gravel

Describe the quantity, quality and location of spawning gravel.
There were 45 sq m of gravel in mainstem Trib X, and 8 in its major tributary, to the right at the forks. The majority of the gravel was observed low in the system, in the legacy beaver meadow described above. These gravels carried a high sediment load and 77% were classified as poor quality. The highest quality gravels (8 sq m) were observed in Trib A, the slide fork to the right.

Summer juvenile distribution

Describe the summer distribution of coho juveniles. Include a description of the resources used.

There were no coho observed in this tributary during the 1999 RBA snorkel inventory. 1999 was a record low abundance year for Oregon Coast Natural coho. The 2007 field survey conducted by Bio-Surveys, LLC, although not quantitative, observed juvenile coho rearing in approximately 3,900 ft of the mainstem and 1,800 ft in the two tributaries. No barriers to migration were observed in this inventory and summer distribution could extend higher in high adult abundance years.

Summer cover

Describe the character and distribution of summer cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

There is a general lack of woody debris recruited from the riparian in trib X. There is however, a significant quantity of legacy wood buried in deep depositions associated with the historic beaver terraces. This wood is continually being exposed to provide complex cover components. In addition, the heavy matting of inner riparian Reed Canary Grass is also providing extensive summer cover. This cover component is abundant in the lower reaches below Trib A and less frequent above the confluence of Trib A.

Winter cover

Describe the character and distribution of winter cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Winter cover is also abundant in the lower reach of Trib X (below the confluence of Trib A) as a result of the low interactive terrace in the old beaver meadow. There is a complex matrix of channels. The channels are well enshrouded in a thick mat of Reed Canary Grass that provides high quality winter refugia.

Channel form and floodplain interaction

Describe the channel form and degree of floodplain interaction.

Trib X is entrenched below the forks, where bed material formerly held by beaver dams has moved out of the system. This entrenched portion is highly sinuous. The entrenchment is recent and the stream has not yet completely abandoned the broad interactive floodplain, as evidenced by the elevated water table well out onto the full width of the floodplain (150 ft).

Channel complexity potential

Assess the potential for the development of meander, braiding, side channel, alcove, backwater channel forms.

The former beaver meadow has all the characteristics necessary for the re-establishment of complex channel characteristics. In addition, the level of floodplain abandonment is recent and minor. Increases in channel roughness would exhibit immediate benefit to the development of channel complexity.

Channel complexity limitations

List and rank the factors currently limiting the development of channel complexity.

1) Lack of channel roughness provided by inner riparian deciduous shrubs (this element also limits factor #2)
2) Beaver absence has allowed some entrenchment and lack of connectivity in the marsh area of this drainage.

Addressing the limitations

Are these limitations addressable through restoration work? Explain for each limitation listed above.

1) Planting inner riparian willows will increase channel roughness and provide a food source for the re-colonization of beaver.
2) Successful re-colonization of beaver would be the best tool for enhancing and maintaining the channel complexity..

Anchor Site 1

There were no anchor sites identified in Trib X.

Secondary Branch 1

Location and length

Trib X forks 1,700’ from its mouth. The right hand fork provides approximately 1,400 ft of high quality salmonid habitat.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

There are 8 sq meters of spawning gravel (18%of the total) in the right fork of Trib X.
A low terrace and old beaver meadow offer some winter rearing possibilities.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?

The low terrace's winter rearing potential is currently limited by a lack of complex woody structure.
The meadow has been abandoned by beavers and a trajectory of channel simplification has been initiated.
Entrenchment and floodplain disconnection limit production potential.

Gradient is increasing in this branch, limiting upstream habitat potential for coho.

Addressing the limitations

Are these limitations addressable through restoration work? Explain for each limitation listed above.

A similar approach would be recommended for these abandoned beaver terraces as suggested for the mainstem: plant inner riparian willow to boost channel roughness and provide a long term food source for the re-colonization of beaver.

Riparian corridor

Dimensions and location

Describe the lineal dimensions and location of deciduous, coniferous, and open canopy.

The majority of this streams lineal distance exists on the Harmsen property. The family has consistently maintained robust riparian buffers well beyond the minimum requirements of the Oregon Forest Practices Act. All portions of Trib X, excluding the beaver meadow, which is entirely covered with reed canary grass, have mixed species and a closed canopy.

Open canopy along the lower beaver meadow (~800' in length) of Trib X, gives way to extensive riparian areas along both forks, including large conifer. This intact riparian is the foundation of an extremely healthy and potentially productive upper basin tributary to the Yaquina River. The long term maintenance of the current condition is highly desirable for mitigating the current temperature limitations in the mainstem Yaquina.

Recruitment potential

What is the recruitment potential and time frame for delivery to the channel?

There is no recruitment potential in the marsh area. Below the meadow and above the forks, potential for full spanning LWD recruitment is high and contemporary.

Thermal problems

Describe the relationship between riparian condition and thermal problems in the aquatic system. Include locations and causes.

No temperature data was available for Trib X. The 2007 summer inventory conducted by Bio-Surveys did not detect the upslope conditions, the aspect or the solar exposure that would suggest temperature as a possible limitation.

Critical Contributing Areas (CCA)

Description and relation to core site

Identify the CCA's and describe the spatial relationship between each CCA and the Core Area and Anchor Site(s). Identify CCA's that contribute directly to specific Anchor Sites.

The upper mainstem of Trib X has been identified in the Landslide Risk analysis as a probable site for future slope failure. This site identified as Site J on the Buttermilk Landslide Risk Analysis map delivers upslope materials directly to salmon bearing habitats.

Trib A has also been identified as having the slope characteristics for failure. In this case the headwall slopes have already failed and a massive debris torrent jam forms the end of anadromous distribution approximately 400 ft above the confluence with the mainstem of Trib X.

Ranking

Rank the CCA's in order of importance to the Core/Anchor Site system. This ranking should consider the contribution of substrate, wood, flow, and temperature maintenance to the Anchor Site system.

Site J is the primary location, Site I has already failed (Appendix 7).

Young Creek field assessment

Migration barriers

A debris blockage at the upstream end, and pipe orientation at right angles to the stream channel creates a juvenile barrier at the first culvert, located on private property. This undersized 4.5' corrugated metal pipe is set in an 8' stream channel.

The second culvert on the same ownership is also undersized, and the bottom is rusting out. Water flows beneath this culvert, creating another juvenile barrier (Photo 8).

Temperature issues

From 6/10 to 9/23/2005 ODEQ monitored temperatures near the mouth of Young Creek. The average daily temperatures ranged from ~7-17C (Figure 3 Appendix 9).

Four significant ground water springs flow into Young Creek, helping to maintain cool summer water temperatures.

Aquatic habitats overview

Spawning gravel

Describe the quantity, quality and location of spawning gravel.

There was 62 Sq m of spawning gravel documented in Young Creek in May of 2007. Gravel was distributed regularly in the area above the agricultural land near the stream's mouth.

An estimated 47 Sq m, or 75% of the gravel was rated fair quality. The remaining 25% was rated poor quality due to silt and embeddedness.

Summer juvenile distribution

Describe the summer distribution of coho juveniles. Include a description of the resources used.

In 1999, when Bio-Surveys LLC conducted a rapid bio-assessment inventory of Young Creek, no coho were present. In May of 2007, numerous juvenile coho were observed throughout the surveyed area (to .4 miles from the mouth).

Summer cover

Describe the character and distribution of summer cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Young Creek has large quantities of legacy wood present in the channel, creating excellent summer cover. This instream wood is found on the Harmsen ownership where robust riparian canopies have functioned to deliver a continual supply to the active channel (Photo 9). This complexity has retained spawning substrates and continues to provide extensive summer cover for juvenile salmonids.

No surveys have been conducted in Young Creek to quantify its physical attributes.

Winter cover

Describe the character and distribution of winter cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Winter cover was abundant in Young Creek relative to its neighbors in the Buttermilk Sixth field. Old wood in the channel traps transient materials, creating excellent winter cover.

A large debris jam placed downstream of a new culvert under Clem Road provides supplemental winter cover and complexity.

Channel form and floodplain interaction

Describe the channel form and degree of floodplain interaction..

In the lower 800' of Young Creek the channel is incised as it passes through heavily used pasture. This is a highly sinuous area.

Above this area, the channel is stable, with no signs of historic debris flow. Low terraces are functional, with plentiful legacy wood retaining transient materials 3,500' upstream of the mouth there is a beaver meadow re-vegetated with ~six year old alder (Photo 10). The terrace is 1.5' high.

Several hundred yards upstream, another beaver meadow is dominated by reed canary grass. The dam is still functional here.

A 3' bedrock falls at ~1 mile from the mouth of Young Creek marks the end of wood complexity in the creek for several hundred feet. Wood complexity picks up again a few hundred feet upstream.

The 2007 survey ended at ~ 1.4 miles from the confluence with the Yaquina River. Gradient increases at that point, and habitat potential diminishes.

Channel complexity potential

Assess the potential for the development of meander, braiding, side channel, alcove, backwater channel forms.

Old beaver terraces throughout Young Creek present opportunities to restore channel complexity.

Channel complexity limitations

List and rank the factors currently limiting the development of channel complexity.

1) Old beaver meadows have reduced rearing potential as channels incise and floodplain interaction decreases.
2) Low terraces have less than optimal quantities of LWD associated with them

Addressing the limitations

Are these limitations addressable through restoration work? Explain for each limitation listed above.

1) Restored beaver populations will address this issue; fresh beaver sign was observed in Young Creek in 2007.
2) Large wood in full spanning structures could be placed at some low terrace sites. In addition, the planting of inner riparian willow could improve both channel complexity and the re-colonization of beaver.

Anchor Site 1

No anchor sites were observed in Young Creek

Secondary Branch 1

There were no notable secondary branches in Young Creek

Riparian corridor

Dimensions and location

Describe the lineal dimensions and location of deciduous, coniferous, and open canopy.

The lower 800' of Young Creek has an insignificant quantity of riparian vegetation in the form of an occasional tree; this area is classified as open canopy.

Above the 2nd culvert the riparian area is well vegetated with a mixed canopy including large conifer on the Harmsen's property. There are a couple of beaver meadows with limited canopy, including one with 150' of full solar exposure.

An old lake bed higher up in the system is an area of open canopy as well, which closes again 1.2 miles above the mouth of Young Creek.

At the upper end of the survey, the riparian consists of young plantation to the stream's edge.

Recruitment potential

What is the recruitment potential and time frame for delivery to the channel?

Above the pastureland on lower Young Creek (Harmsen) large conifers capable of creating full spanning structures are present in the riparian area. The abundance of instream wood is an indicator that regular recruitment here is the norm and this area probably represents an optimal functioning riparian segment.

Thermal problems

Describe the relationship between riparian condition and thermal problems in the aquatic system. Include locations and causes.

The lower 800' of Young Creek has full solar exposure, as does the reed canary dominated beaver meadow approximately one mile up from the mouth.

Critical Contributing Areas (CCA)

No CCA's were identified in Young Creek

Humphrey Creek field assessment

Migration barriers

On Trib A a bedrock slide prohibits upstream juvenile migration 2500' from the confluence with the Yaquina River (this is a natural barrier).

In May 2007, 4,300 feet from the mouth on the mainstem of Humphrey Creek an undersized culvert was blocked by a beaver dam ending anadromous passage. The dam was removed in July 2007.

2500' upstream of the dam a 4' culvert is undersized in the nine foot active channel. Habitat potential above this culvert is limited.

Temperature issues

ODEQ monitored temperatures from 7/18 to 9/26/2005. near the mouth of Humphrey Creek. Temperatures ranged from ~10 C to 20C, exceeding the state standard of 18C for water quality (Figure 4 Appendix 9).

Aquatic habitats overview

Spawning gravel

Describe the quantity, quality and location of spawning gravel.

A total of 48 m2 of spawning gravel was observed by Bio-Surveys LLC in May, 2007.

Below Trib A, there were 13 sq m of good quality, 10 of fair quality, and 3 of poor quality. Trib A had 8 m2 of fair quality, and 2 of good quality, 20% of the total gravel in Humphrey Creek.. Above trib A there were 6 m2 of fair, and 6 m2 of good quality gravel.

Summer juvenile distribution

Describe the summer distribution of coho juveniles. Include a description of the resources used.

Juvenile coho were observed to a 6'high debris jam at 3,700' from the mouth of Humphrey Creek in 1999, when Bio-Surveys LLC conducted a rapid-bioassessment survey (Figure 6).

In 2007, juvenile distribution ended at a blocked culvert, 4,200' from the mouth. The dam blocking this culvert has since been removed.

Summer cover

Describe the character and distribution of summer cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Two instream restoration projects have added key materials to Humphrey Creek. Photo 11 These in turn have captured transient material, and created deep pools. Eleven structures begin on the Hansler property just above the county road, and continue up through Hull Oakes property.

Winter cover

Describe the character and distribution of winter cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Although natural wood is limited in Humphrey Creek, the channel morphology in some areas is suitable for winter rearing of juvenile salmonids. The 2007 aquatic habitat inventory found five pieces of wood per 100 m of stream length. The ODFW habitat benchmark for wood is >20 pieces per 100 m. Likewise key pieces of wood came in at 1.4 pieces/100 m, far below the benchmark of >3.

Below the confluence with Trib A, on the Hansler property, habitat structures have aggraded the channel and caused channel migration accompanied by increased sinuosity. Above the confluence with Trib A the channel is sinuous, with low terrace nearby.

In 2007, Trib A had equivalent wood stocking to that cited above.

Channel form and floodplain interaction

Describe the channel form and degree of floodplain interaction..

Below the county road Humphrey Creek is in pasture. The channel is entrenched. Directly above this area, livestock have been excluded, large wood has been added, and floodplain reconnection is in progress. This area extends to the confluence with Trib A.

Trib A is sluiced to bedrock for 40' above its confluence with Humphrey Creek. Juvenile salmonids will not pass upstream here. There is a short area with a thin veneer of bed material, followed by over 400' of exposed bedrock, which appears to be the effects of a debris torrent.

There is a historical beaver terrace upstream of this area. There is no current beaver use, but dams have recently accumulated large quantities of mobile sands and spawning gravels. These will be lost without the presence of full spanning structures. The stream is entrenched in this area.

In the upper reaches of Trib A, four active beaver dams cause outstanding floodplain interaction, filling the entire valley width (Photo 12). Above the confluence with Trib A, Humphrey creek is highly sinuous, with low terraces.

A 350' historical beaver meadow is followed by a second, 100' meadow, just below an active beaver dam that blocks adult passage at an undersized culvert. The channel is aggraded above the beaver pond, and spawning gravel is available above this barrier. Above this beaver area the stream dimensions diminish to reduce production potential.

Channel complexity potential

Assess the potential for the development of meander, braiding, side channel, alcove, backwater channel forms.

The presence of a broad active floodplain (75 ft) and the presence of historical beaver impoundments suggest that this section of Humphrey Cr exhibits extensive potential for the development of complex channel features.

Channel complexity limitations

List and rank the factors currently limiting the development of channel complexity.

1) Low beaver abundance
2) Lack of LWD

Addressing the limitations

Are these limitations addressable through restoration work? Explain for each limitation listed above.

1) Allow beaver to expand their range unmolested within Humphrey Creek, consider reintroduction of beaver into this highly suitable habitat.

2) Add LWD near the low terrace above Trib A

Anchor Site 1

Location and length

Anchor Site 1 begins at RM 0.47 just above the first forest road crossing in section 35. This is a small anchor site that extends approximately 335 ft to a point where hillslope confinement reduces the potential for floodplain interaction.

Sinuosity

Sinuosity here is minimal because the anchor is short and the amplitude between lateral bends is moderate as a result of gradient. Wood treatment in this zone would not have a major impact on overall sinuosity.

Terrace structure

Terraces are broad and uniform in elevation here as a result of historical beaver impoundment. This is a site that has not been colonized by beaver for probably 20 years or more. The current terrace height is approximately 12”

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

This is an area exhibiting spawning gravels classified primarily as fair quality (moderate levels of sediment and fines associated with gravels). Actual spawning gravel volumes were not parsed out of the total within the anchor site. Both summer and winter rearing habitat exist here but the age of terrace abandonment (~20 years) suggests that much higher potential exists if channel complexity could be elevated .

Rearing limitations

Which functions limit the site’s production potential, and what causes these limitations?

The site is currently limited by the absence of both wood complexity and beaver dams.

Addressing the limitations

List and rank the restoration work at the site that would most effectively increase survival within the site and stabilize the core population at a higher base level.

1) Inject full spanning wood structures to encourage floodplain interaction on historical beaver terraces.
2) Reintroduce or allow for re-colonization of beaver to Humphrey Creek above Trib A, to enhance existing structure components in the anchor site.

Anchor Site 2

Location and length

Anchor Site 2 begins approximately 600 ft above Anchor Site 1 at RM 0.64. The Anchor extends for approximately 1,200 ft with a short hiatus of channel confinement near its midpoint.

Sinuosity

The channel lacks extensive sinuosity but the length of the anchor site provides an excellent opportunity for encouraging additional sinuosity with the addition of wood complexity.

Terrace structure

Terraces are broad and uniform in elevation here as a result of historical beaver impoundment. This is a site that has not been colonized by beaver for probably 20 years or more. The current terrace height is approximately 12". The potential for floodplain interaction is greater here than in Anchor Site 1.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

This is an area exhibiting spawning gravels classified primarily as fair quality (moderate levels of sediment and fines associated with gravels). Actual spawning gravel volumes were not parsed out of the total within the anchor site. Both summer and winter rearing habitat exist here but the age of terrace abandonment suggest that much higher potential exists if channel complexity could be increased.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?

The site is currently limited by the absence of both wood complexity and beaver dams.

Addressing the limitations

List and rank the restoration work at the site that would most effectively increase survival within the site and stabilize the core population at a higher base level.

1) Inject full spanning wood structures to encourage floodplain interaction on historical beaver terraces.
2) Reintroduce beaver to the reach (Humphrey Creek above Trib A) in an effort to get them to utilize structure components added to the anchor.

Anchor site rankings

Function

Rank the identified anchor sites in terms of current function (1= best).
Anchor Site 2
Anchor Site 1

Restoration potential

Rank the identified anchor sites in terms of restoration potential.
Anchor Site 2
Anchor Site 1

Secondary Branch 1

Location and length

Trib A enters Humphrey Creek from the East, 2,300'from the confluence with the mainstem Yaquina.. The 2007 AHI surveyed 0.55 mile of stream corridor to the current end of anadromous distribution at a series of large stable beaver ponds.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.
Trib A has 10 m2 of spawning gravel, 21% of the gravel available in Humphrey Creek. Former winter and summer rearing areas are now reduced to an entrenched channel in old beaver meadows.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?

The lack of full spanning structures (wood and/or beaver ponds) limits Trib A's ability to retain substrates, aggrade incised channels and connect with its floodplain.

Addressing the limitations

Re-colonization of former beaver sites would address the rearing limitations.

Secondary branch site rankings

Function

Rank the identified branch sites in terms of current function (1= best).

1 (Trib A)

Restoration potential

Rank the identified branch sites in terms of restoration potential.

1 (Trib A)

Riparian corridor

Dimensions and location

Describe the lineal dimensions and location of deciduous, coniferous, and open canopy.

Cages have been removed below the railroad trestle on an SWCD project within Hansler's pasture, allowing livestock access to well-established riparian plantings. Above the county road riparian planting are thriving in cages.

Hull-Oakes property exhibits excellent riparian protections, including mature conifer and maple on Humphrey Creek below Trib A. Old beaver meadows on Trib A allow for full solar exposure on 1500'of mainstem Humphrey Creek.

The riparian area above Trib A is 30/40 year old plantation with an alder buffer. There is 450' of open canopy on old beaver meadows above Trib A on the mainstem of Humphrey Creek.

Recruitment potential

What is the recruitment potential and time frame for delivery to the channel?

There is mature conifer present along portions of Humphrey Creek sufficient in size to create functioning LWD jams at this time. The retention of these well stocked buffers is critical to maintaining the current potential for LWD recruitment from the riparian.

Thermal problems

Describe the relationship between riparian condition and thermal problems in the aquatic system. Include locations and causes.

Water withdrawal in mainstem Humphrey Creek reduces the volume of cool water delivered to the temperature limited mainstem during critical pinch period summer flows. The ~2,000' of open canopy at old beaver meadows allows for full solar exposure.

Critical Contributing Areas (CCA)

Description and relation to core site

Identify the CCA's and describe the spatial relationship between each CCA and the Core Area and Anchor Site(s). Identify CCA's that contribute directly to specific Anchor Sites.

Slope failure is likely on both first order tribs which constitute the headwaters of Humphrey Creek. This area is 3,500' above the upper anchor site. An undersized culvert currently blocks any possibility of materials delivered via slope failure from entering the anchors.

Ranking

Rank the CCA's in order of importance to the Core/Anchor Site system. This ranking should consider the contribution of substrate, wood, flow, and temperature maintenance to the Anchor Site system.

Spilde Creek field assessment

Migration barriers

A 7' x 30' rusted out culvert just above the mouth of Spilde Creek is a low water barrier to juvenile and adult migration. Jam at top. Orientation of culvert is wrong for the efficient transport of migratory wood. The stream channel is 10' wide (Photo 13).

3 parallel pipes with a beaver dam on intake terminate upstream juvenile migration. Pipes are undersized and not passing transient wood or substrate efficiently. Some are rusted out and losing minor summer flows. Near first right hand tributary (unnamed), dry (Photo 14).

A 2' pipe at mouth of Lytle Cr. is a definitive adult and juvenile barrier, perched approximately 4' high. The channel is 4' wide.

A 4' pipe with a 10" perch is a juvenile barrier on Trib A. The crossing is approximately 920 ft from the confluence with Spilde.

The county road culvert on Spilde Creek is a juvenile barrier with sheet flow and a 10" drop. This is a low priority, due to its distance from the mouth of Spilde Creek and the low probability that juveniles would be traveling this far to escape mainstem temperature limitations. Concrete box culvert is passable for adults.

The 3rd culvert on Gassner's property passes adults at some flows, as evidenced by juvenile coho above. However, 16" perch onto riprap precludes adult passage at most flows, and creates a juvenile barrier. This is a new pipe installation (Photo 15).

The 4th culvert on Gassner's has a 4' drop, effectively ending coho migration. There is an impassable railroad culvert with an associated 60 ft fill approximately 1,700 ft above this culvert.

Temperature issues

There are no temperature data available for Spilde Creek. The lower mainstem area is subject to heavy livestock use, and may well exceed acceptable temperatures for juvenile salmonids during the low flow summer period.

Water withdrawals were noted in the lower portion of Spilde Creek. These appear to access a spring on the right hand side of the stream.

Aquatic habitats overview

Spawning gravel

Describe the quantity, quality and location of spawning gravel.
There was a total of 76 m2 of spawning gravel in Spilde Cr and its only secondary branch (Trib A). An estimated 93% of this gravel was classified as high quality and all of these high quality gravels were observed in mainstem Spilde above the confluence of Lytle Cr.

Summer juvenile distribution

Describe the summer distribution of coho juveniles. Include a description of the resources used.

Coho juveniles were observed at high densities throughout Spilde Creek to an impassable culvert 1.7 miles from the mouth in July of 2007, during the Bio-Surveys LLC field inventory.

In 1999 a rapid bio-assessment survey, also conducted by Bio-Surveys LLC, found no coho in Spilde Creek. That survey ended at Mr. Gassner's property, which was the most productive area in 2007.

Summer cover

Describe the character and distribution of summer cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Summer cover for juvenile salmonids is often expressed in quantitative inventories as the abundance of wood. Wood is abundant upstream of Gassner's downstream most property boundary. Below Gassner's property five beaver dams in a very low gradient stream channel provide deep pool habitat for summer rearing.

Winter cover

Describe the character and distribution of winter cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Spilde Cr maintains a very low gradient throughout most of its anadromous bearing distance. This feature combined with good wood densities on the Gassner ownership and the presence of beaver, suggest that winter habitats are abundant (unquantified, no aquatic habitat surveys have been conducted on this property).

Channel form and floodplain interaction

Describe the channel form and degree of floodplain interaction.

The stream is very low gradient, with slow flows. 5 beaver dams, two of which are not maintained, act as full spanning structures, maintaining floodplain interaction below the county road. Above the county road, the highly sinuous stream channel has abundant sources of hardwood to maintain floodplain interaction.

Channel complexity potential

Assess the potential for the development of meander, braiding, side channel, alcove, backwater channel forms.

Just above its mouth, Spilde Creek is deeply entrenched. A few hundred feet upstream, above a 4' bedrock falls, Spilde Creek becomes highly sinuous. Complex off channel habitats become more abundant here.

Channel complexity limitations

List and rank the factors currently limiting the development of channel complexity.

This is one of the few tributary reaches (with the exception of Young) that currently exhibit complex channel characteristics. This is a result of good wood densities and the higher than normal abundance of full spanning beaver dams.

Addressing the limitations

Are these limitations addressable through restoration work? Explain for each limitation listed above.

N.A.

Anchor Site 1

Location and length

Anchor Site 1 begins just above the county road, extending 1,200' upstream.

Sinuosity

Sinuosity is excellent in this section of stream.

Terrace structure

The dominant terrace here is 2" above summer flow, and covered with alder.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

Gravel was abundant and exclusively classified as high quality. This is without a doubt a primary destination for spawning coho and steelhead. Pool surface areas are small for summer rearing and 2007 field observations suggest that coho were near or above full seeding within the anchor. The availability of wood complexity, high sinuosity and low terraces combine to also provide excellent potential for winter rearing.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?

This site is highly functional. There are currently no limitations short of adequate adult escapement to seed the available habitat.

Addressing the limitations

List and rank the restoration work at the site that would most effectively increase survival within the site and stabilize the core population at a higher base level.

No treatments are recommended.

Anchor site rankings

Function

Rank the identified anchor sites in terms of current function (1= best).

Anchor site 1.

Restoration potential

Rank the identified anchor sites in terms of restoration potential.

Anchor site 1.

Secondary Branch 1

Location and length

Lytle Creek enters Spilde Creek 4,000’ from its mouth. The 1992 ODFW AHI inventory extended 0.28 mile, a minor contributor of summer flow.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

Lytle Creek is a cold water source for Spilde Creek, and a potential area of juvenile refugia from elevated summer temperatures (Access currently terminated by a perched culvert).

There is no spawning gravel suitable for coho present in Lytle Creek.

Rearing limitations

Which functions limit the site’s production potential, and what causes these limitations?

The primary limitation is an impassable culvert at the mouth. The secondary limitation is the minor summer surface areas that provide only limited rearing potential.

Addressing the limitations

Remove and replace current culvert to facilitate free passage for both adult and juvenile salmonids. This is a low priority site because of the limited benefit provided by the available rearing surface area.

Secondary Branch 2

Location and length

Trib A enters Spilde Creek from the East side 500’ upstream of Lytle Creek. It is approximately 2,000’ to the headwater split where habitat size diminishes to a point that limits significant rearing potential.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

There are 3 sq m of fair quality spawning gravel (4% of the gravel in the system) present in Trib A. A functioning, inactive beaver dam creates excellent summer and winter rearing habitat. In addition, there is a large legacy beaver flat just below the primary headwater split that historically provided extensive summer and winter rearing surface area. This site is currently abandoned.

Rearing limitations

Which functions limit the site’s production potential, and what causes these limitations?
Juvenile migration is blocked by a 4’ culvert perched 10”, located 880’ from its mouth. In addition, deep channel incision through 800 ft of pasture limits the development of channel complexity and the development of off channel habitat types.

Addressing the limitations

A properly placed culvert would allow juvenile migration. Livestock exclusion fencing could also benefit the development of a riparian canopy through open pasture ground that would benefit the issue of cumulative temperature limitations in the lower mainstem Yaquina. This is a short lineal treatment that could result in no net improvement in downstream temperature regimes.

Secondary branch site rankings

Function

Rank the identified branch sites in terms of current function (1= best).

2 Trib A
1 Lytle Creek

Restoration potential

Rank the identified branch sites in terms of restoration potential.

2 Trib A
1 Lytle Creek

Riparian corridor

Dimensions and location

Describe the lineal dimensions and location of deciduous, coniferous, and open canopy

The first 5,000' of Spilde Creek is in pastureland. The first ~2,800' (Humphrey) is managed as a livestock/timberland area. The right hand side of the creek has large timber present in ample quantities for future recruitment. The Gassner property begins directly upstream of the timbered area. Here, livestock use is heavy, and the riparian area ranges from shrubs, to a single tree buffer, to non-existent.

Above the county road Spilde Creek is in a closed canopy of mixed species, with the exception of one beaver meadow above the end of anadromous fish passage (a perched culvert defines this anadromous end point).

Trib A's lower portion is shaded only by shrubs. The canopy turns to big conifer, hardwood mix before the barrier culvert. The upper reaches of the stream appear to be well buffered.

Nightshade is present in this system.

ODF has a timber sale planned in Spilde Creek. This activity will involve road building. Impacts on the riparian area are expected.

Recruitment potential

What is the recruitment potential and time frame for delivery to the channel?

There are adequate large conifers in the riparian area above the county road for long term recruitment, if the current conditions are maintained. At this time a steady deposition of hardwoods creates excellent, ephemeral woody debris through the identified anchor site and above.

The riparian area on the Humphrey property also has excellent current potential to deliver key pieces of large wood to Spilde Creek.

Thermal problems

Describe the relationship between riparian condition and thermal problems in the aquatic system. Include locations and causes.

Temperature data are not available for the Spilde Creek subbasin.

Critical Contributing Areas (CCA)

Description and relation to core site

Identify the CCA's and describe the spatial relationship between each CCA and the Core Area and Anchor Site(s). Identify CCA's that contribute directly to specific Anchor Sites.

There are two slide prone areas likely to deliver materials into the fish bearing portion of Spilde Creek. One is a slope low on Lytle Creek, the other just below the end of anadromous fish migration at a perched culvert (Appendix 7, Spilde Cr). In general, the Spilde Cr 6^{th} field has been classified by ODF's GeoTech specialist as exhibiting very low potential for significant slope failure.

Ranking

Rank the CCA's in order of importance to the Core/Anchor Site system. This ranking should consider the contribution of substrate, wood, flow, and temperature maintenance to the Anchor Site system.

The gentle hill slopes and minor abundance of high risk slopes for landslide activity suggest that there are no critical concerns for additional riparian setbacks on first and second order tributary corridors.

Little Yaquina River field assessment

Migration barriers

Trib A, enters from the North side just above mouth of the Little Yaquina . An abandoned culvert blocks upstream juvenile migration 60' above its confluence with the mainstem. The culvert is rusted through, with subsurface flow, and serves a road that is no longer in use (Photo 16).

Trib A 2^{nd} culvert is ~60' x 5' functional for adults only. The pipe currently exhibits rust in the bottom and may develop into a juvenile barrier in the next decade if low summer flows are lost through the pipe.

Temperature issues

The Little Yaquina River exceeded the DEQ average daily temperature standard from 7/18 through 8/23 in the 2005. Temperatures ranged from ~11 to 20 C (Figure 5 Appendix 9). There is a high likelihood that these elevated temperatures are in part a result of the ponded surface areas in Hamer Lake.

Elevated temperatures high in the Little Yaquina headwaters degrade downstream habitats during low summer flows and contribute significantly to a cumulative impact on the mainstem Yaquina that eventually leads to a seasonal temperature limitation. Water quality is low as a result of elevated temperatures, and dissolved oxygen could also be low from decomposition occurring in Hamer Lake (unquantified).

Aquatic habitats overview

Spawning gravel

Describe the quantity, quality and location of spawning gravel.
There were two 0.5 m2 spawning gravel sites in the Little Yaquina River. Gravel quality was rated as fair (Photo 17).

Summer juvenile distribution

Describe the summer distribution of coho juveniles. Include a description of the resources used.

Coho use ended 1,400’ from the mouth of the Little Yaquina River in 1999, as documented in the Bio-Surveys LLC rapid bio-assessment (Figure 7). Coho were present and abundant in July of 2007 to a 14’ vertical falls 2,500’ from the confluence with the Yaquina River (Photo 18).

Summer cover

Describe the character and distribution of summer cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Very low wood densities (8 pieces/100 m of stream length; ODFW benchmark > 20 pcs/100 m) exist in this steep and confined channel. Summer cover is provided by large substrates and increased turbulence associated with the extensive average gradient (~6%).

Winter cover

Describe the character and distribution of winter cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

There is no winter habitat in the Little Yaquina River. Steep gradients and a highly confined active channel suggest that winter habitats are negligible.

Channel form and floodplain interaction

Describe the channel form and degree of floodplain interaction..

The channel form is a V shaped valley, with no terraces, hence no floodplain interaction.

Channel complexity potential

Assess the potential for the development of meander, braiding, side channel, alcove, backwater channel forms.

None.

Channel complexity limitations

List and rank the factors currently limiting the development of channel complexity.

Natural channel morphology currently limits the development of complex off channel habitat.

Addressing the limitations

Are these limitations addressable through restoration work? Explain for each limitation listed above.

No.

Anchor Site 1

Location and length

There are no anchor sites in the Little Yaquina River.

Secondary Branch 1

Location and length

Trib A enters the Little Yaquina River on the North side, just above the confluence with the mainstem Yaquina. It forks 3,400’ from its mouth.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

There was no spawning gravel documented in Trib A during the 2007 field inventory conducted by Bio-Surveys. In 1999 coho juveniles were present at the highest densities noted in the combined three sixth fields (Figure 7). Distribution was to 2,200 ft from the mouth. No barriers were noted at that time.

Spawning obviously occurs here but surveys to identify these gravels suggest that spawning is likely very marginal. Observed densities were highest in the lowest pools as a result of upstream temperature dependant migrations from the mainstem Little Yaquina.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?

In July 2007 the juvenile coho density observed during the Bio-Surveys stream inventory was 10 fish/m2 for the pool below the culvert low on this tributary. The culvert is a barrier to juvenile migration and this culvert is the greatest limitation for production.

Addressing the limitations

The culvert serves no purpose, as the road is long un-used. Removing it would solve the problem.

Secondary branch site rankings

Function

Rank the identified branch sites in terms of current function (1= best).

1) Trib A.

Restoration potential

Rank the identified branch sites in terms of restoration potential.

1) Trib A.

Riparian corridor

Dimensions and location

Describe the lineal dimensions and location of deciduous, coniferous, and open canopy.

The riparian area consists of large conifer and alder. The canopy is 100% closed.

Recruitment potential

What is the recruitment potential and time frame for delivery to the channel?

Large wood is available for future and current recruitment

Thermal problems

Describe the relationship between riparian condition and thermal problems in the aquatic system. Include locations and causes.

The water was noticeably warm, and smelled nutrient laden in July 2007. In the 2005 ODEQ study, the Little Yaquina exceeded temperature standards for salmonids; temperatures were recorded just above the mouth.

The Little Yaquina has been logged to its edges above Hamer Lake. The entire watershed above the lake is managed on "the industrial model" (inadequate buffering of the stream corridor) initiating the limited summer habitat conditions on the mainstem Yaquina.

Dace, indicators of warm water, are numerous in the Little Yaquina River.

Critical Contributing Areas (CCA)

Description and relation to core site

Identify the CCA's and describe the spatial relationship between each CCA and the Core Area and Anchor Site(s). Identify CCA's that contribute directly to specific Anchor Sites.

Trib A has slope failure potential along its entire north western slope. It is 4,800' in length. It provides cold water to the mainstem Little Yaquina River. Juvenile coho were observed stacked up below this trib in July 2007.

Ranking

Rank the CCA's in order of importance to the Core/Anchor Site system. This ranking should consider the contribution of substrate, wood, flow, and temperature maintenance to the Anchor Site system

Trib A.

Yaquina River field assessment

This survey encompassed the mainstem Yaquina River from the confluence of Bales Creek at RM 41.1 to an anadromous barrier falls at RM 54.2

Migration barriers

A 12' falls ends anadromous fish use at RM 54.2

Temperature issues

The Yaquina River exceeds DEQ water quality standards for temperature everywhere tested below the confluence with Bailey Creek (tributary upstream of the anadromous barrier), during summer low flows as documented in 2005 by ODEQ. Probes placed above the mouth of every fish bearing tributary in the three combined 6^{th} fields showed elevated temperatures.

A probe just above the confluence of the Little Yaquina indicates that temperatures reached and exceeded the upper threshold for salmonids (18 C) within the 3.5 miles between the confluence of Bailey Cr and the Little Yaquina.

As observed in the example of the Little Yaquina, the inadequate protection of the riparian canopy on Department of Forestry ownership during upslope harvest operations has likely had a direct impact on aquatic temperature conditions in the mainstem. Ambient air temperatures are elevated without an intact canopy (basal area criteria do not result in a functional riparian canopy), and increased solar exposure of stream surface areas is currently peaking post harvest in this 3.5 mile corridor. Figures 6 -12 Appendix 9 show temperatures during 2005 above the mouths of many of the tributaries discussed in this report.

Aquatic habitats overview

Mussels are present but not abundant (unquantified) in Upper Yaquina 6^{th} field.

Spawning gravel

Describe the quantity, quality and location of spawning gravel.

There was a total of 300 m2 of spawning gravel documented during the 2007 Bio-Surveys field inventory in the mainstem Yaquina from the confluence of Spilde Cr to the barrier falls at RM 54.2. No spawning gravels for coho or steelhead were recorded below the confluence of Spilde Cr. This was primarily a function of low gradients and poorly sorted and embedded substrates. Limited riffle surface areas exist in the lower mainstem

Summer juvenile distribution

Describe the summer distribution of coho juveniles. Include a description of the resources used.

The 1999 Bio-Surveys LLC rapid bio-assessment documented very limited coho use below the confluence with Spilde Creek. There were 195 total coho parr (expanded) observed in the nine miles from the confluence of Bales Creek to the confluence of Spilde Creek.

In 1999, coho use was documented to the 4m falls located at RM 54.2 (Photo 19). This portion of the mainstem Yaquina has increased gradient which develops a pool / riffle complex. This in turn provides the foundation for the delivery of a diverse food source for juvenile salmonids, a condition not present in the lower mainstem. Densities were consistently low, primarily the result of the lowest adult escapement to the Yaquina headwaters on record (1998, Figure 9).

Summer cover

Describe the character and distribution of summer cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

In the lower mainstem below the confluence of Spilde Creek the Yaquina is a series of long sinuous pools. These pools average 155 ft long and 25 ft wide during summer flow regimes. There are long simplified segments with a deeply incised channel and limited summer cover from predation. There are however segments of extremely high cover complexity in the form of overhanging inner riparian vegetation (Nine Bark, Willow).The few juvenile salmonids observed in the 1999 snorkel inventory were tightly associated with these cover components.

Above the confluence of Spilde Creek complex summer cover is sparse until entering the Mayo property (Photos 20 and 21). Here there are beaver present and enough wood accumulated to form three full spanning jams. Above the confluence of the Little Yaquina, instream cover is sparse below the habitat structures above the bridge on Hull Oakes property. Seven habitat structures are present in this short reach with beaver dams built on two, creating excellent summer habitat.

Winter cover

Describe the character and distribution of winter cover. Note that this evaluation generally lacks quantitative measurement, and relies on professional judgment.

Winter cover is available throughout the low gradient portions of the mainstem below Spilde Creek. Inner riparian shrub roots and overhanging vegetation provide some roughness; low gradient (0.2%)conditions help create low velocity edges during high flow events.

Above the mouth of Spilde Creek, winter cover is available at a few sites, mentioned in the summer cover section.

At the railroad trestle there is a notable jam. The adjacent landowner pares away at this to avoid flooding of his pasture.

There are low terraces at the Mayo property, and high sinuosity on the Brusatori property, and three alder log jams that all currently interact to provide interactive floodplains during winter flow regimes. Above the mouth of the Little Yaquina, a short low terrace provides some winter refugia just downstream of an MCWC restoration project, which in conjunction with beaver activity creates some excellent off channel winter rearing habitat.

Channel form and floodplain interaction

Describe the channel form and degree of floodplain interaction.

The channel is entrenched from the mouth of Spilde Creek to the Harmsen Mill site.

There is a radical transition in stream channel morphology at Mayo's downstream property boundary. Substrates transition immediately from sand and gravel to cobble and small boulder. This begins an area of floodplain connectivity, extending to the end of anadromous use, 2.2 miles upstream

There is a 250' stretch of exposed bedrock above the mouth of the Little Yaquina River.

Channel complexity potential

Assess the potential for the development of meander, braiding, side channel, alcove, backwater channel forms.

At the Harmsen mill site right hand side there is an old channel and a lower terrace that has potential to function as an anchor site. This site is not sufficiently long to be classified as a significant Anchor. The highest unutilized potential for the development of complex channel forms exists on the Mayo and Brusatori properties. This zone exhibits the highest potential return on a restoration prescription designed to boost floodplain interaction. This is a 4,200 ft segment that begins at approximately RM 52.

Channel complexity limitations

List and rank the factors currently limiting the development of channel complexity.

There is 1,700' of exposed bedrock between Spilde Creek and Harmsen's mill., a total distance of 3,200'. There's another 1,400' of exposed bedrock in the very straight channel running from Harmsen's to Mayo's, a distance of 1.1 miles. These are morphological limitations generated by hillslope confinement. Within the Mayo and Brusatori reach the primary limitation is the lack of large woody structure that would be stable over a long period.

The Yaquina River below the confluence of Spilde Cr is limited by the adjacent morphology. This portion of the channel is generally deeply incised, and conversion to an interactive floodplain with complex channel forms is not realistic.

Addressing the limitations

Are these limitations addressable through restoration work? Explain for each limitation listed above.

Full spanning large wood structures would aggrade bed materials in areas away from rural residences. In addition, if full spanning log structures are available, the reintroduction of beaver could add value to structures that can form a foundation for dam building. This structure placement should be confined to the stream segment between the confluence of Spilde Cr and the anadromous barrier above the confluence of the Little Yaquina.

Anchor Site 1

Location and length

Anchor Site 1 begins at RM 52 and extends upstream to the mouth of the Little Yaquina River, at RM 52.8, a distance of 4,200' (Photos 22 and 23).

Sinuosity

Sinuosity within the anchor is the highest observed in the entire Yaquina mainstem (unquantified). In addition, there is additional potential for boosting sinuosity even higher with the addition of large wood complexity.

Terrace structure

The anchor also exhibits the lowest and most interactive terraces in the entire mainstem Yaquina (1-2 ft). There is currently a high level of function, with channel braiding and the presence of off channel habitat types (backwaters, alcoves). There is additional potential within the reach for optimizing this interaction for the provision of additional winter habitat.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

The majority of the large anadromous spawning that occurs in the mainstem Yaquina takes place in the zone from RM 52 to the barrier falls at RM 54.2. This encompasses the full extent of Anchor Sites 1 and 2. Gravels are abundant , well sorted and heavily utilized as demonstrated by the large number of redds still visible during summer inventories. Because of the high sinuosity, wood complexity and low terraces mentioned above the anchor performs at a high level of function for the provision of both summer and winter habitat.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?
Within the anchor site, wood complexity is less than optimum. In addition, peak summer temperatures here exceed DEQ standards for extended periods. This likely inhibits production potential as summer rearing juveniles respond to temperature stress by seeking out refugia in spring seeps and tributary habitats. Juvenile salmonids are often observed in lower rearing densities in temperature limited habitats.

Addressing the limitations

List and rank the restoration work at the site that would most effectively increase survival within the site and stabilize the core population at a higher base level.

Inject higher densities of LWD by placing both full spanning and edge orient log structures.

Anchor Site 2

Location and length

Anchor Site 2 begins at RM 53.6 and extends upstream to the barrier falls at RM 54.2, a distance of 3,200'.

Sinuosity

This is still a broad active channel with low complexity and roughness. This condition limits the anchors ability to develop high levels of sinuosity.

Terrace structure

Terraces are present and interactive. The addition of structure logs in this reach by the MCWC has radically improved both the development of new terraces and the interaction of existing terraces (Photo 24). In addition, beaver have recently constructed large stable dams on two of the seven existing structure sites optimizing the relationship between the active channel and the adjacent floodplain terraces.

Rearing contribution

Describe how the site contributes to spawning, incubation, summer rearing, and winter rearing.

This is a zone that exhibits the highest density of adult coho and steelhead during spawning migrations because of its location just below a definitive anadromous barrier. Spawning gravels are abundant and heavily utilized as noted in the incredible density of redds still visible during the 2007 summer inventory. The fry emergence that occurs here is capable of seeding vast downstream surface areas of the mainstem.

Rearing limitations

Which functions limit the site's production potential, and what causes these limitations?

The primary functional deficiency appears to be the elevated stream temperatures that exceed ODEQ standards for salmonids. Juvenile rearing occurs here, but elevated temperatures likely result in lower pinch period densities, higher inter specific competition and higher stress levels. All of these sub lethal impacts resulting in lower production potential. In addition, the temperature impacts occurring in this headwater reach combine with other downstream issues to form increasingly more devastating cumulative impacts on juvenile salmonids in lower mainstem reaches.

Addressing the limitations

List and rank the restoration work at the site that would most effectively increase survival within the site and stabilize the core population at a higher base level.

1) Protect existing riparian canopies on head water public lands with a long term Riparian Management Plan that extends beyond the bounds of current forest practice guidelines which are inadequate for protecting such a broad active channel from solar exposure.
2) Protect any intact riparian canopy on small private and industrial forest land with a conservation easement that extends to a one tree site potential.
3) Lastly, establish conservation easements on these same private properties that have contributed to the problem by over harvesting the riparian corridor. This effort to insure that riparian recovery has a chance of succeeding beyond the next harvest rotation (Photo 25).

Anchor site rankings

Function

Rank the identified anchor sites in terms of current function (1= best).

2
1

Restoration potential

Rank the identified anchor sites in terms of restoration potential.

2
1

Secondary Branch 1

Location and length

All secondary branches to the mainstem have been reviewed individually in this analysis. See the discussions in this document for all of the primary tributaries to the mainstem Yaquina above the confluence of Bales Cr.

Riparian corridor

Dimensions and location

Describe the lineal dimensions and location of deciduous, coniferous, and open canopy.

The riparian area in the 8.9 miles from the mouth of Bales Creek to the mouth of Spilde Creek is primarily active or old pastureland. 30% of the lineal distance is open canopy, 43% is closed. The remaining 27% is partially shaded, ranging from 25 to 75% closed canopy, with more in the latter condition.

From Spilde Creek to Harmsen Mill site (3,000') the canopy is mostly open, with abundant reed canary grass.

The canopy is closed (~ 65%) from Mill site to the railroad bridge (2,500'). There is a new plantation in the mill meadow. Knotweed was flourishing just above the railroad trestle.

Rural residential on left hand side of creek limits riparian to a single tree width, and Green Diamond ownership has a single line of large conifer to Trib A (2,200').

At Mayo's property there is full canopy closure, which extends upstream 1.3 miles to portions of Hull Oakes ownership. At this point, single large conifers are backed by young plantation, and solar exposure is notable on the south side of the river. This condition extends up on to State Forestry property. Nightshade is present on the Mayo property.

As in other streams surveyed for this report, much of the riparian area on Hull Oakes ownership is a model for industrial ownership. Riparian areas are true buffers, with diverse species in multiple age classes, a forest rather than a riparian management area.

Recruitment potential

What is the recruitment potential and time frame for delivery to the channel?

There are large conifers scattered throughout the Yaquina Headwaters that are adequate to create full spanning structures right now. There is 160 year old timber on DOF property adjacent to the river, beginning where anadromous fish use ends, and extending upstream. There are many young conifer that are decades away from recruitment age, should they not be harvested.

Thermal problems

Describe the relationship between riparian condition and thermal problems in the aquatic system. Include locations and causes.

The mouth of Bailey Creek is the only point on the mainstem Yaquina where temperatures are cool in the summer, according to the DEQ monitoring in 1999. At that time, Bailey Creek maintained average temperatures of 9.5 to 14.5 C, with 15.8 C the highest temperature recorded.

The next lowest probe on the Yaquina was placed above the mouth of the Little Yaquina River. There, summertime temperatures ranged from 12 – 21 deg C, exceeding water quality standards for salmonids.

Between Bailey Creek and the Little Yaquina (3.5 miles), logging on public and private land has reduced the riparian canopy to the minimum density allowed under basal area calculations which are incapable of maintaining cool stream temperatures.

This large river can't be shaded by a single line of widely spaced large conifer, backed by hundreds of acres of young plantation. Ambient air temperatures are elevated in these areas, relative to the mature forests surrounding much of the upstream area on DOF and BLM lands.

A bedrock dominated stream channel, with no protection from solar radiation is a formula for elevated stream temperatures. Once warmed, the Yaquina continues downstream through some of its best mainstem habitat, as a temperature limited system. Both anchor sites on the mainstem are subject to unacceptable summer water temperatures. This problem is compounded below Spilde Creek, where large segments of the riparian area are in pasture.

Critical Contributing Areas (CCA)

Description and relation to core site

Identify the CCA's and describe the spatial relationship between each CCA and the Core Area and Anchor Site(s). Identify CCA's that contribute directly to specific Anchor Sites.

In the Buttermilk sixth field, delivery of upslope wood and substrate resources is most likely from Trib 10 just upstream of and across the river from Randall Creek at RM 45.5. This small stream, located on private land contains 5 of the 21 failure prone slopes identified in ODF's Landslide Risk Analysis provided as an attachment to this document (sites A,B,C,F,Q). A Railroad crossing on a large terrace probably would terminate delivery to the mainstem.

Trib 11 entering the Yaquina from the South at RM 46.6., also has high risk potential for slope failure and a very short delivery distance to the mainstem.

Trib 24 enters the Yaquina River at RM 51.4. It is 4,800' in length. It provides cold water to the mainstem Yaquina River. Juvenile coho were observed stacked up below this trib in July 2007. It possesses the slope characteristics found in landslide prone areas (Site F of the Yaquina Headwaters 6^{th} field Landslide Risk Analysis).

Above the confluence with the Little Yaquina River slide prone slopes on first order tributaries and along the mainstem offer multiple opportunities for wood and substrate delivery. Without exception, these areas are above the end of anadromous fish use. However, given the size of the river, materials entering this reach have a high probability of contributing to both Anchor Sites 2 and 1 (Appendix 7, Yaquina Headwaters).

Ranking

Rank the CCA's in order of importance to the Core/Anchor Site system. This ranking should consider the contribution of substrate, wood, flow, and temperature maintenance to the Anchor Site system.

The sites identified in ODF's Landslide Risk Analysis are labeled in terms of their ranking (A=highest likelihood of failure). All sites A- M (excluding L and K) are above the endpoint of anadromous distribution. L is unlikely to reach the mainstem because of interference by a county road.

Lower mainstem area

The lower mainstem is described as the 18 miles of riverine habitat that extends from the Head of Tide above Elk City to the confluence of Bales Cr.

Winter habitat potential

This section of the mainstem Yaquina is extremely low gradient (<0.1%), sinuosity is very high with ample opportunities for creating low velocity inside edge habitat during winter flow regimes. This habitat type is abundant both inside the analysis area and in this lower mainstem. The abundance of winter habitat is currently not the primary limiting factor for the Yaquina basin.

Summer habitat potential

This lower mainstem exhibits multiple weeks during summer flow regimes of diurnal temperature fluctuations between 18 and 22 deg C (ODEQ, 2004). Even night time temperatures don't decrease enough to meet the maximum standard for juvenile salmonids.

This is a zone where most rearing salmonids either flee or perish. It is well documented by the ODFW life history monitoring data from Bales Cr that large quantities of salmonid fry enter this mainstem reach during spring freshets shortly after emergence. It is also well documented that by mid July they can not be found in this lower mainstem reach.

The destination of these migrants is poorly understood. We assume that if temperature limitations in the mainstem could be decreased with riparian enhancement, that juvenile salmonids could eventually colonize and rear in these habitats.

Lowland habitats

Describe lowland habitats and locations outside the 6th field.

There is approximately 23 miles of inter tidal habitat in the mainstem from the head of Tide above Elk City to the jetties in Yaquina Bay. This zone includes extensive tidal marsh surface areas that are known to harbor both summer and winter rearing salmonid juveniles. Because low tide habitats within these marsh surface areas limit the production potential of these areas, we are considering only the scoured channels as additional rearing surface area.

Recent restoration of tidal marsh habitats has re-linked the access to these habitats at many Yaquina Bay marshes. These habitats however, can not currently function as a summer surrogate for the dysfunctional mainstem of the Yaquina that exhibits severe temperature limitations as flows recede to summer levels. This is primarily a function of two factors: Distance from the upper basin spawning locations (31 miles), and normal fry distribution patterns.

Spring fry flow into the mainstem from all primary tributaries seeking edge oriented low velocity habitat for rearing. Some fry emerging low in the system (below Bales Cr) likely find suitable habitats in the upper ends of tidal marsh channels. Upper basin fry taking up residence in the mainstem are exposed to a gradual increase in stream temperature and are unlikely to migrate downstream through miles of increasingly warmer water. More likely, these juveniles will seek the first available cold water tributary entering the mainstem and proceed upstream (this is a well documented behavior on the mainstem Yaquina).

Restoration analysis

Nickelson Model results

Smolt capacity calculations were prepared for the analysis area for both 1993 and 2007. Both the Nickelson Limiting habitat analysis model and seasonal survival rates from the Jim Halls Alsea Watershed Study were utilized. Two model runs were deemed appropriate due to the large difference in the abundance of beaver dam habitat between the 1993 AHI data and the 2007 AHI and Bio-Surveys field inventory. It was clear from the 2007 field work that a recent legacy (10 years) of beaver was visible on the landscape, but that there very few functional beaver dams remained to provide salmonid habitat.

The model run utilizing the habitat data from 1993 (Appendix 4) suggests that the abundance of summer habitat is the primary seasonal limitation using either the Nickelson or the Alsea Watershed Study seasonal survival rates. You will note that the smolt production capacity is actually slightly lower for spawning and incubation in this scenario, but we consider the quantification of spawning gravel built into this model conservative by design in both quality and quantity to test the hypothesis that spawning gravel could possibly be limiting.

We have determined from our LFA questionnaire above that there are additional limitations to summer habitat in the upper mainstem (temperature) which have not been factored into the model's calculation (all of the mainstem habitat surface areas below the confluence of Spilde Cr were removed from the model run because of severe temperature limitations). In this modeling scenario, the available winter habitat far exceeded the capacity of the gravels or existing summer habitats to seed it. In large part this was due to the extensive abundance of beaver pond habitat known to have been present on the landscape from historical AHI data.

The model run utilizing the 2007 data was very similar in its analysis of the seasonal limitation. There was. however, less agreement between the Nickelson and the Alsea Watershed Study outputs of season smolt survival. The Nickelson model results suggested a much closer balance between the capacity of the summer and winter habitats to produce smolts with the winter capacity slightly lower. The Alsea Watershed Study results continue to strongly indicate summer as the primary seasonal limitation.

It has been an easy step to compare these two scenarios and identify the abundance of high quality summer habitat as the primary seasonal habitat limitation, with or without beaver on the landscape. The primary driver here again is the ODEQ data suggesting serious temperature limitation in all of the mainstem Yaquina, including the headwaters to the barrier falls at the end of anadromous distribution.

Most striking from this analysis are the comparative results between the 1993 habitat data set and the 2007 habitat data set. There were 160 beaver dams present in the analysis area circa 1993. That number has shrunk to 27 in 2007. The 2007 numbers are based on actual basin scale survey data. The 1993 numbers are based on a combination of actual data and estimations derived from the abundance of abandoned beaver terraces exhibiting partial legacy dams and young seral stage alder < 15 years old. The trend is the significant observation here. We do however have actual habitat inventory data for both years from some subbasins that suggest that this basin scale comparison is valid. Buttermilk Cr contained 61 beaver dams in 1993 and only 7 in 2007.

Defining the production bottleneck

Does the seasonal bottleneck identified by the Nickelson Model remain the primary limiting habitat when each of the other issues identified in the assessment process are factored in? Explain.

As we have discussed in the modeling results section, when you consider that the habitat based model suggests that the abundance of summer habitat is the key seasonal limitation and then you factor in the attribute of summer water temperatures that exceed ODEQ standards for juvenile salmonids for the entire length of salmonid distribution, it becomes clear that we have a powerful case for representing the functional state of the system.

There are additional issues identified in the assessment process that give this scenario even more reliability. The abundance of impassable culverts on cold water tributaries throughout the assessment area suggests that juvenile salmonids attempting to escape this summer limitation of elevated water temperatures do not succeed in many locations, limiting available summer habitat surface areas even more than the model suggests.

Potential for lowlands contribution

If the abundance of winter habitat has been determined as the primary factor limiting coho production, discuss how lowland habitats existing outside the boundaries of the 6th field might function to provide winter habitat for smolts produced in the 6th field.

N.A.

Ownership issues

To what degree would land use and ownership allow restoration work?

In the Yaquina Headwaters, much of the slide prone slope area is in public ownership, BLM or ODOF. Preservation of these areas should be easily achieved. Some of the slopes fall within the 100' riparian management area, and are currently stocked with high quality large conifer ~160 years old.

The remainder of the basin is a mix of industrial timber owners and small private landowners with highly variable riparian management styles. Indications are that some of these owners already value the concept of a properly functioning riparian as observed by the buffers that exceed current ODF criteria for fish bearing streams.

It is these landowners that offer the greatest potential for developing future partnerships and agreements designed to benefit the long term health and productivity of Yaquina Basin streams and riparian canopies.

Channel complexity potential

What is the potential to increase channel complexity in the long term through natural recruitment processes, with and without restoration?

The long term potential for increasing channel complexity is excellent for some tributary habitats (Young, Trib X, Felton, Stoney and Bryant) and for the upper Yaquina mainstem above the anadromous barrier at RM 54. However there is limited long term potential for natural recruitment in Randall, Humphrey, Buttermilk and large segments of the lower Yaquina mainstem.

This analysis suggests that without restoration that includes an instream component in at least Randal, Humphrey and Buttermilk, these tributaries will struggle to approach a properly functioning condition for the foreseeable future. Recall that the provision of complex winter habitat (the usual target of instream wood placement) is not the primary limitation within the system. However, the presence of key wood components could significantly aide the recovery of functional beaver dams that will persist in the system to help address the current limitation of summer habitat surface area.

Restoration prescriptions

Potential restoration sites

High priority sites are marked with *.

Mainstem Yaquina

1) Instream structure treatment proposed for the 4,200 ft reach defined as Anchor Site 1 on the Brusatori and Mayo Property. This treatment would preferably be completed with a helicopter but the distance to a suitable log source may preclude the use of helicopter and require excavator placement.

2) Livestock exclusion fencing and riparian planting prescriptions are highly desirable on any ownerships along the mainstem Yaquina that exhibit open canopy conditions (this prescription encompasses many mainstem owners). The highest priorities exist in the stream segment from the confluence of Spilde Cr to the confluence of Bryant Cr.

3) Conservation easement on Hull Oakes property in Sec19. to guarantee long term protection of current intact riparian canopy.

Buttermilk Creek

4) First culvert crossing above the County road is a juvenile barrier *

5) Willow planting in Reed Canary dominated beaver terraces to provide a future food source for beaver recolonization.

6) Transplant beaver from downstream mainstem Yaquina locations.

7) Increase full spanning wood complexity in Anchor Site 1

Bryant Creek

8) County Road culvert at Bryant Creek *

9) Trib A on Bryant Creek has a culvert that will block delivery of large wood, install ford.

10) First road crossing above county road is a possible adult barrier. .25 meter perch, spills onto bedrock slide

11) Reconstruct channel meander in lower 400 ft. Zone of highest potential for developing floodplain interaction.

12) Conservation easement on Starker Property to guarantee long term protection of current intact riparian canopy.

Stony Creek

13) Fish ladder below county road crossing creates juvenile barrier, this condition could be substantially improved with minor adjustments in baffle height and frequency,*

14) Conservation easement on Green Diamond Property to guarantee long term protection of current intact riparian canopy.

15) Willow planting in Reed Canary dominated beaver terraces to provide a future food source for beaver recolonization.

16) Transplant beaver from downstream mainstem Yaquina locations.

Randall Creek

17) First road crossing on Starker property has an undersized culvert (5.5'CMP in a 12' channel), beaver dammed at upstream end. Juvenile barrier ~1200' from mouth *

18) Increase full spanning wood complexity in both Anchor Sites 1 and 2

Felton Creek

19) Riprap below railroad culvert creates 1' juvenile barrier.*

20) 3rd culvert on this stream blocks delivery of wood, 3'CMP in 6' channel
Humphrey Creek
21) 1st culvert crossing at old beaver dam blockage (removed), undersized, rusted.*

22) 2nd Culvert crossing on mainstem Humphrey is undersized, a 4’ pipe in a 9’ channel. Habitat potential limited above but headwater delivery of upslope resources is highly likely.

23) Increase full spanning wood complexity in both Anchor Sites 1 and 2

Young Creek

24) Blockage and pipe orientation at first culvert creates juvenile barrier. *

25) Second culvert also undersized, rusting out.*

26) Conservation easement on Harmsen Property to guarantee long term protection of current intact riparian canopy.

27) Willow planting on beaver terraces above road crossing to provide a future food source for beaver recolonization.

28) Transplant beaver from downstream mainstem Yaquina locations.

Trib X

29) Willow plantings in historic beaver flats below the confluence of Trib A

30) Transplant beaver from downstream mainstem Yaquina locations.

31) Conservation easement on Harmsen Property to guarantee long term protection of current intact riparian canopy.

Spilde Creek

32) Rusted out Culvert just above mouth 7' x 30' currently (low water) barrier to all. Jam at top. Orientation of culvert is wrong. The stream channel is 10'wide.*

33) 3 parallel pipes with beaver dam at upstream end terminates any upstream juvenile migration. Pipes are undersized and not passing transient wood or substrate efficiently. Some are rusted out and losing minor summer flows. Near first right hand tributary (unnamed), dry *

34) 2' pipe at mouth of Lytle Cr. is a definitive adult and juvenile barrier. *

35) 4' pipe with a 10" perch is a juvenile barrier on Trib A. *

36) The county road culvert on Spilde Creek is a juvenile barrier with sheet flow and a 10" drop. This is a low priority, due to its distance from the mouth of Spilde Creek. Concrete box culvert is passable for adults.

37) The 3rd culvert on Gassner's property passes adults at some flows, as evidenced by juvenile coho above. However, 16" perch onto rip rap precludes adult passage at most flows, and creates a juvenile barrier. This is a new pipe installation *

38) The 4th culvert has a 4' drop, effectively ending coho migration. There is an impassable railroad culvert with an associated 60 ft fill approximately 1700 ft above this culvert.*

39) Conservation easement on Humphrey and Gassner property to guarantee long term protection of current intact riparian canopy.

40) Transplant beaver from downstream mainstem Yaquina locations.

Little Yaquina River

41) Trib A, enters from the North side just above mouth of the Little Yaquina . An abandoned culvert blocks upstream juvenile migration 60' above its confluence with the mainstem. The culvert is rusted through, with subsurface flow, and serves a road that is no longer in use.*

Issues

All of the prescriptions listed above are included in the following condensed discussion of general issues, goals, methods, complications and results.

1) Mainstem Yaquina temperature limitations that extend throughout the entire extent of anadromous distribution. This is a cumulative problem that initiates in the Little Yaquina and in the upper mainstem with the impacts of abusive upslope forest harvest where basal area riparian prescriptions or alder conversion strategies provide no significant protection from solar exposure to the broad active stream channel.
2) Because temperature limitations in the mainstem limit its summer carrying capacity, it is important to provide unimpeded escape routes to upstream cold water refugia. Therefore the restoration of passage for juveniles at all tributary culverts is critical.
3) The extensive low gradient habitats of this complex of 6^{th} fields that make up the upper Yaquina basin exhibit a vast legacy of high densities of beaver and their associated dam structures. Almost all of the habitat complexity that was a result of the presence of beaver is currently missing on the landscape. This comparative analysis between 1992 conditions and current conditions has revealed the magnitude of this decline and its impact on rearing capacity and system function. The ability of beaver dams to raise the stream adjacent water table and to provide vast summer water storage capacity to mitigate for elevated summer flows is well established.
4) Because temperature limitations in the mainstem limit its summer carrying capacity, it is also important to maintain the high quality riparian buffers that currently exist on small private and industrial timber ownership.

Goals

1) The goal would be to begin to tackle this temperature limitation from a broad based perspective that simultaneously addresses multiple issues that combine to create the limitation. This analysis suggests that the abundance of cool water habitats during summer flow regimes is the primary seasonal limitation to the production of salmonids.
2) Replace or retrofit all culverts identified in the 2007 Bio-Surveys summer inventory as passage issues for juvenile salmonids.
3) Restore historical densities of beaver to the Yaquina basin as a whole. The added rearing capacity provided by beaver dams and their ability to mitigate summer temperatures through water storage within the floodplain will directly address the current summer habitat limitation.
4) Protect existing healthy riparian canopies that are providing significant levels of temperature maintenance for the entire complex of 6^{th} fields.

Method

1) Riparian management areas must be established on public and private industrial forest land that parallel the mainstem Yaquina all the way to the headwaters of the basin. The prescription for these areas would include a no cut buffer for a minimum of a 1 tree site potential. Basal area prescriptions for the riparian would not be allowed in these areas. This is unlikely to be accomplished with current regulatory processes so the purchase of a conservation easement on these riparian bands would be a possible alternative. Lower on the mainstem, riparian livestock exclusion and the planting of riparian buffers on historical pasture lands would also assist in the long term recovery of mainstem temperature profiles.
2) Culvert replacements are expensive, the methodology would be to address passage in a prioritized fashion that tackles the access to the largest tributaries first (higher rearing capacity) and the smaller systems last.
3) Transplant lower mainstem rearing beaver (non dam builders) to head water tributary locations. Establish a basin scale ban on beaver trapping (include exceptions for damage control). Concurrently establish a food source in zones exhibiting legacy beaver characteristics with willow planting.
4) Develop an attractive easement program to encourage landowners to limit the future conversion of these highly significant riparian canopies to younger seral stages.

Potential complications

1) *Conservation Easements*: On private industrial forest land, this has not been a well tested restoration tactic. This would require significant commitment and long term planning. In addition, methodologies would have to be developed to create the infrastructure necessary to hold and maintain these conservation easements.
2) *Culverts replacements:* These are generally considered low hanging fruit for restoration with ample willingness from a multitude of partners. No complications anticipated.
3) *The transplant of beaver and a concurrent trapping ban:* This would be a formidable change in how we view the places where we live. With their history as a nuisance species, the education of landowners and agencies on the importance of beaver in system function would have to be accomplished with extensive outreach. This would require a form of support that funding agencies with a desire to show progress on the ground would struggle with.
4) Because these high quality riparian buffers have obviously been left intact from previous harvest rotations, it may be a harder sell to funding agencies that these sites would be money well spent for a *long term conservation easement* (the current owner has already left it once, why wouldn't they continue to do so).

Expected results

1) *Conservation Easements:* This is a long range restoration objective that attempts to deal with the root source of system dysfunction. There would be no quick recovery in mainstem temperature profiles but there may be immediate impacts on the trajectory of degradation (more upslope harvest impact that could continue to exacerbate the current condition). Recovery trends could be detectable in 40-50 years when the shade provided by recovering canopies could begin to impact mainstem temperatures.
2) *Culverts replacements:* Each culvert replacement or retrofit for passage unlocks the access for temperature dependant summer migrations of juvenile salmonids to cool water refugia. This has an immediate benefit on survival to smolt and increases production.
3) *The transplant of beaver and a concurrent trapping ban:* The restoration of beaver in the basin, if successful, will have a rapid and profound effect on system function. This single task immediately mitigates for much of the damage currently observed from upslope industrial forestry impacts on stream temperature profiles.
4) *Long term conservation easement:* Providing long term protection for the last remaining high quality riparian corridors would help truncate further decline in pinch period temperature profiles in the mainstem and be a component of initiating a trajectory toward recovery.

Restoration rankings

From the recommendations listed above, list and rank the restoration work that most effectively stabilizes the population at a higher base level and prioritizes the recovery of ecosystem function.

Please refer to Prescription Locations above for a description of the sites numerically listed below. The sites are also identified on the prescription maps (Appendix 7).

Highest short term priorities include all of the high priority culvert issues, and are identified in the prescription section with an asterisk (*).

1, 4, 8, 13, 17, 19, 21, 24, 25, 32, 33, 34, 35, 37, 38, 41

All of these culverts are ranked as equally high priority for unlocking blocked access to cooler tributary habitats for summer limited juvenile salmonids.

The following culverts and wood placement projects and channel reconstructions are classified as moderate priorities for restoring short term function:

1, 7, 9, 10, 11, 18, 20, 22, 23

The following culvert is classified as low short term priority:

36

The highest long term priorities which deal with the restoration of system function to deal with summer temperature limitations include both the preservation of existing riparian canopies, the creation of new canopies in historical agricultural lands and the recolonization of beaver are as follows:

2, 3, 5, 12, 14, 15, 26, 27, 29, 31, 39

The following sites all involve the active recolonization of beaver through live trapping and transporting. We consider this a moderate priority only because beaver could recolonize on their own. Beaver recolonization is a primary key to restoring proper function.

6, 16, 28, 30, 40

APPENDICES

Appendix 1. Buttermilk/Spilde/Yaquina Headwaters 6th field complex drainage systems

#	Name	River Mile	Enters from	Slope faces	Valley description	Relative size	Relative Summer Flow	Comment
1	None	0.39	L	S	Steep, narrow	F	F	Non perennial
2	None	0.85	R	NE	Steep, Narrow	E	E	Minor contributor
3	None	1.11	L	S	Steep, Narrow	F	F	Non perennial
4	None	1.36	L	S	Steep, Narrow	F	F	Non perennial
5	Buttermilk Crk	1.37	R	NE	Low gradient, moderate floodplain	C	C	Key contributor, high dysfunction
6	None	1.77	L	SW	Steep, Narrow	F	F	Non perennial
7	Bryant Crk	1.98	L	S	Moderate gradient, narrow floodplain (minor exception just above mouth)	D	D	High water quality, moderate contributor
8	Stony Crk	2.33	L	E	Low gradient, moderate floodplain	C	C	Key contributor, moderate dysfunction
9	Randall Crk	4.28	L	S	Low gradient moderate floodplain	C	C	Key contributor, moderate dysfunction

10	None	4.54	R	N	Low gradient, moderate floodplain	D	E	Access denied / Significant slope failure characteristics
11	None	5.56	R	N	Steep, narrow	F	F	Non perennial
12	Davis Crk	5.91	L	S	Extremely low gradient, moderate floodplain	D	D	Access denied
13	None	6.52	R	NW	Moderate, narrow floodplain	E	E	Minor contributor
14	Felton Crk	6.87	L	S	Extremely low gradient. Moderate floodplain	D	D	Moderate potential
15	Trib X	6.97	R	N	Moderate gradient, moderate floodplain	D	C	High potential
16	None	7.15	L	S	Steep, narrow	F	F	Non perennial
17	Young Crk	7.87	R	NE	Moderate gradient, moderate floodplain in upper	D	C	High Potential
18	Humphrey Crk	8.12	L	S	Moderate gradient, moderate floodplain	D	D	High potential
19	Spilde Crk	8.87	R	NE	Low gradient, deeply entrenched	C	D	High potential, summer flow limited
20	None	9.50	R	E	Steep, narrow	F	F	Non perennial

21	None	9.86	R	NE	Steep, narrow	F	F	Non perennial
22	None	10.07	R	E	Steep, narrow	F	F	Non perennial
23	None	10.11	R	E	Steep, narrow	F	F	Non perennial
24	None	10.25	R	SE	Steep, narrow	F	F	Non perennial
25	None	10.94	L	W	Steep, narrow	F	F	Non perennial
26	Little Yaquina R	11.40	L	SW	High gradient, deeply entrenched	B	B	Lowest Water quality, initiation site of severe water quality degradation for remainder of mainstem
27	(Mainstem headwaters)	11.40	na	SE	Moderate gradient, broad floodplain in anchors	A	A	Most important reach, highest production potential

Appendix 2. Habitat features and survey status of streams within the Buttermilk/Spilde/Yaquina Headwaters 6th field complex which have coho bearing potential.

Curr Rch ID	Stream	Survey River Mile			Survey Resource			Valley Morphology			Aquatic Habitats			
		Beg	End	Len	Type	Year	Surv Rch ID	Grad (%)	Valley Width	Con straint	Pools (%)	Bvr Pnds (#)	Wood (pcs/mi) Total	Wood (pcs/mi) Key
1992-3 Surveys														
1	Buttermilk Crk	0.00	0.11	0.11	ODFW AQI**	1993	1	1.7	Very broad	Terrace	19	2	140	nd
2	Buttermilk Crk	0.11	0.83	0.71	ODFW AQI**	1993	2	1.4	Narrow	Terrace	11	4	145	nd
3	Buttermilk Crk	0.83	2.92	2.10	ODFW AQI**	1993	3	1.8	Broad	Terrace/Hillslope	91	37	68	nd
4	Buttermilk Crk	2.92	3.12	0.20	ODFW AQI**	1993	4	3.8	Very narrow	Hillslope	94	7	163	nd
1	Buttermilk/Trib A	0.00	0.22	0.22	ODFW AQI**	1993	1	5.7	Narrow	Terrace	64	11	109	nd
2	Buttermilk/Trib A	0.22	0.35	0.13	ODFW AQI**	1993	2	10.0	Very narrow	Hillslope	0	0	3	nd
1	Davis Crk	0.00	0.15	0.15	ODFW AQI*	1992	1	1.9	Very broad	Terrace	48	2	76	nd
1	Randall Crk	0.00	1.41	1.41	ODFW AQI**	1993	1	2.4	Very broad	Terrace	14	0	183	nd
2	Randall Crk	1.41	1.87	0.45	ODFW AQI**	1993	2	5.9	Narrow	Hillslope	32	0	401	nd
1	Randall/ Bones	0.00	0.37	0.37	ODFW AQI**	1933	1	5.0	Narrow	Hillslope	0	0	177	nd

1	Randall/ Buckhorn	0.00	0.41	0.41	ODFW AQI**	1933	1	4.2	Narrow	Hillslope	1	0	85	nd
1	Spilde/ Lytle	0.00	0.28	0.28	ODFW AQI*	1992	1	2.0	Broad	Terrace	10	0	214	nd
1	Stony Crk	0.00	0.15	0.15	ODFW AQI**	1993	1	1.8	Very broad	Terrace	9	0	6	nd
2	Stony Crk	0.15	0.91	0.76	ODFW AQI**	1993	2	2.8	Broad	Terrace/Hillslope	31	4	39	nd
3	Stony Crk	0.91	1.59	0.67	ODFW AQI**	1993	3	3.3	Very narrow	Hillslope	67	0	129	nd
1	Yaquina River	0.00	4.60	4.60	ODFW AQI*	1992	1	0.2	Broad	Terrace	29	2	132	nd
2	Yaquina River	4.60	11.30	6.70	ODFW AQI*	1992	2	0.2	Broad	Terrace	39	2	167	nd
3	Yaquina River	11.30	13.40	2.10	ODFW AQI*	1992	3	0.6	Narrow	Terrace/Hillslope	44	10	130	nd
2007 Surveys														
1	Buttermilk Crk	0.00	0.95	0.95	ODFW AQI***	2007	1	1.4	Moderate	Terrace	63	3	96	7
2	Buttermilk Crk	0.95	1.94	0.99	ODFW AQI***	2007	2	1.8	Moderate	Terrace	64	3		
3	Buttermilk Crk	1.94	2.57	0.63	ODFW AQI***	2007	3	1.8	Moderate	Terrace	52	1		
4	Buttermilk Crk	2.57	2.72	0.15	ODFW AQI***	2007	4	1.8	Narrow	Hillslope	21	0		
5	Buttermilk Crk	2.72	3.40	0.68	ODFW AQI***	2007	5	1.8	very broad	Hillslope	99	0		
6	Buttermilk Crk	3.40	3.61	0.21	ODFW AQI***	2007	6	3.8	Narrow	Hillslope	19	0		

1	Buttermilk/Trib A	0.00	0.24	0.24	ODFW AQI***	2007	1	5.7	Narrow	Terrace	11	0	117	8
1	Humphrey	0.00	0.43	0.43	ODFW AQI***	2007	1	6.9	Broad	Terrace	71	0		
2	Humphrey	0.43	0.53	0.10	ODFW AQI***	2007	2	2.5	Moderate	Terrace	70	0	81	22
3	Humphrey	0.53	1.44	0.91	ODFW AQI***	2007	3	2.5	Moderate	Terrace	54	4		
1	Humphrey/Trib A	0.00	0.55	0.55	ODFW AQI***	2007	1	2.9	Moderate	Terrace	69	3	87	5
1	Little Yaquina	0.00	0.32	0.32	ODFW AQI***	2007	1	6.4	Narrow	Hillslope	30	1	249	7
2	Little Yaquina	0.32	0.44	0.12	ODFW AQI***	2007	2	8.5	Narrow	Hillslope	32	0		
1	Little Yaquina /Trib A	0.00	0.36	0.36	ODFW AQI***	2007	1	4.7	Narrow	Hillslope	24	0	130	3
No Surveys														
1	Bryant Crk	0.00	0.45	0.45	None			13.5	Narrow	Hillslope	21	0	nd	nd
1	Felton Crk	0.00	0.12	0.12				1.8	Broad	Terrace	33	0		
2	Felton Crk	0.12	0.42	0.29	None			4.3	Moderate	Terrace	33	0	nd	nd
3	Felton Crk	0.42	0.96	0.54				2.1	Narrow	Hillslope	9	0		
1	Spilde Crk	0.00	0.70	0.70	None			4.9	Moderate	Terrace	70	2	nd	nd
2	Spilde Crk	0.70	1.44	0.74				4.9	Moderate	Hillslope	62	2		
1	Spilde/ Trib A	0.00	0.41	0.41	None			2.0	Moderate	Terrace	10	0	nd	nd

1	Stony/ Trib A	0.00	0.51	0.51	None	6.9	Narrow	Hillslope	33	0	nd	nd
1	Trib X	0.00	0.32	0.32	None	4.6	Broad	Terrace	33	0	nd	nd
2	Trib X	0.32	0.98	0.66		3.7	Moderate	Terrace	33	0		
1	Trib X/ Trib A	0.00	0.08	0.08	None	5.0	Narrow	Hillslope	33	0	nd	nd
1	Young Crk	0.00	0.79	0.79	None	3.4	Moderate	Hillslope	97	0	nd	nd
2	Young Crk	0.79	1.67	0.88		3.4	Moderate	Hillslope	66	2		

*Survey conducted by ODFW AQI personnel
** Survey conducted by AG Crook Company using ODFW AQI protocol
*** Survey conducted by Lincoln County Soil and Water Conservation District using ODFW AQI protocol
Buttermilk Creek: The % pools includes Buttermilk Lake. The lake represented 48% of Reach 3 wetted surface area in 1993 and 67% of Reach 5 in 2007.
2007 wood data: Total Pcs and Key Pcs not available at the reach level. Therefore presented at stream level.
"No Surveys" streams: Sections of these streams representing probable reach divisions were defined based on field assessment and map data. Pool % and # Bvr ponds were also estimated based on field assessment work.

Appendix 3. Buttermilk/Spilde/Yaquina Headwaters 6th field complex spawning gravel estimates

These counts represent the number of spawning sites occupying a minimum of 1 sq m which are located in a zone having hydraulics suitable for successful spawning by adult coho or steelhead. Assessments of gravel condition are based on professional judgment that considers embeddedness in relation to the abundance of fines, silt and sand associated with gravel depositions. The assessments do not represent the availability of spawning sites appropriate for adult Chinook or cutthroat.

Stream	Reach	Poor	Fair	Good
Buttermilk	1	1	36	1
(Above falls)	2		30	
Trib A	1		2	
Bryant	1		7	
Stoney	1		8	30
Trib A	1		12	7
Felton	1	6	6	2
Randall	1	6	8	3
(Above Bones)	2	7	55	16
Bones	1	1	1	
Trib X	1	33	3	9
Trib A	2	8		
Young	1	5	47	10
Humphrey	1	3	10	13
(Above Trib A)	2		6	6
Trib A	1		8	2
Spilde	1	4	1	71
Trib A	1		4	
Little Yaquina	1		2	
Trib A	1			3
MainYaquina*	1		30	270
Total		**74**	**276**	**443**

* Mainstem Yaquina Spawning gravel inventory begins at the confluence of Spilde Cr because spawning potential for coho and steelhead does not exist below this junction.

Appendix 4. Buttermilk/Spilde/Yaquina Headwaters 6th field complex limiting habitat analysis based on the Nickelson model

Explanation

This sheet accumulates the results of the calculations performed on the other sheets to estimate the number of coho that can be supported by the rearing system under analysis.
The specific goals are to: 1) Estimate the number of coho that can be supported during each season of the year, and 2) Rank the seasonal habitats in terms of their ability to generate "potential smolts"; this identifies which seasonal habitat most limits the production of smolts from the system.
Ideally, this evaluation would utilize spawning gravel data along with habitat data describing spring, summer and winter rearing conditions. However, physical habitat surveys are almost always conducted during the summer. In practical terms, winter and spring survey data are not available.

To accommodate these deficiencies, we use a work-around to estimate winter rearing capacity, but currently are unable to estimate the spring rearing capacity.
The work-around method for estimating winter rearing capacity utilizes a polynomial regression equation that relates winter rearing capacity to summer habitat conditions. This equation is provided by ODFW research. No such work-around exists for estimating spring capacity, and it is not estimated.

The current evaluation thus aims at determining whether spawning gravel, summer conditions, or winter conditions are most limiting in the rearing system.
The model used to identify the limiting seasonal habitat is "Version 5.0. Coho Salmon Carrying Capacity Model", provided by Tom Nickelson of ODFW Research Division. This model uses season-to-season survival rates to estimate potential smolt production for each seasonal habitat. We have two sets of survival rates, one provided by ODFW research and the other by Jim Hall's Alsea watershed study. We compare model results using both sets of rates.
Results presented
Five tables are presented.:
Table A lists the summer rearing density for each stream habitat type. The same table is presented in the Summer Uplands sheet, where it is used to calculate rearing capacities. It is included here only to illustrate how strongly reach habitat structure affects rearing capacity.
Table B lists the two sets of survival rates used to evaluate potential smolt production.

Table C lists spawning, summer and winter rearing capacities that have been calculated for each upland stream and lowland habitat.
Table D lists potential smolt production for each upland stream and lowland habitat based on ODFW survival rates.
Table E lists potential smolt production for each upland stream and lowland habitat based on Alsea study survival rates.
Table F lists habitat capacity and potential smolt production for each seasonal habitat. This table comprises the primary product of the analysis.

Model results for 1992-3

Table A. Stream summer rearing densities

Table A. Coho rearing density for each summer stream habitat type.

Habitat type	Fish/sq m
Cascades	0.24
Rapids	0.14
Riffles	0.12
Glides	0.77
Trench Pools	1.79
Plunge Pools	1.51
Lateral Scour Pools	1.74
Mid Chan Scour Pools	1.74
Dam Pools	1.84
Alcoves	0.92
Beaver Ponds	1.84
Backwaters	1.18

Data of Tom Nickelson based on ODFW research.

Table B. Survival rates to smolt

Table B. Season (life stage) to smolt survival rates.

ODFW Research		Alsea study data	
Life stage	Survival rate	Life stage	Survival rate
Egg to smolt	0.3200	Egg to smolt	0.0270
Spring to smolt	0.4600	June to Smolt	0.0644
Summer to smolt	0.7200	Fall to smolt	0.1110
Winter to smolt	0.9000	Winter to smolt	0.2870

Rates used by Tom Nickelson (ODFW)

Rates provided by Jim Hall (OSU Dept of F & W)

Table C. Rearing capacities

Table C1. Upland rearing capacities.

Stream ID		Rearing capacity (# eggs or fish)		
Number	Name	Spawning	Summer	Winter
Stream 1	Buttermilk	16,771	49,063	87,302
Stream 2	Buttermilk/Trib A	833	1,125	1,515
Stream 3	Bryant	2,917	501	
Stream 4	Stony	21,250	5,914	6,068
Stream 5	Stony/Trib A	10,833	714	307
Stream 6	Felton	5,417	4,039	4,763
Stream 7	Randall	33,594	2,829	2,545
Stream 8	Randall/Bones	625	162	277
Stream 9	Trib X	3,906	15,500	3,555
Stream 10	Trib X/Trib A	1,667	70	44
Stream 11	Young	21,719	15,791	17,682
Stream 12	Humphrey	17,344	6,169	6,722
Stream 13	Humphrey/Trib A	3,750	5,383	2,305
Stream 14	Yaquina	237,500	21,969	127,289

Stream 15	Randall/Buckhorn		71	315
Stream 16	Davis		251	274
Stream 17	Spilde	60,417	9,360	6,672
Stream 18	Spilde/Lytle		272	273
Stream 19	Spilde/Trib A	1,667	1,346	614
Stream 20	Little Yaquina	833	1,698	622
Stream 21	Little Yaquina/Trib A	2,500	301	315
Stream 22				
Stream 23				
Stream 24				
Stream 25				
	Totals	443,542	142,528	269,460

Table C2. Lowland rearing capacities.

Habitat type	Rearing capacity (# fish)	
	Summer	Winter
Stillwater with edge habitat		
Wetland channels		
Flooded wetlands		
Total		

Table D. Potential smolt production based on ODFW survival rates

Table D1. Upland potential smolt production based on ODFW survival rates.

Stream ID		Potential smolt production (# fish)		
Number	Name	Spawning	Summer	Winter
Stream 1	Buttermilk	5,367	35,325	78,572
Stream 2	Buttermilk/Trib A	267	810	1,363
Stream 3	Bryant	933	361	
Stream 4	Stony	6,800	4,258	5,461
Stream 5	Stony/Trib A	3,467	514	276
Stream 6	Felton	1,733	2,908	4,287
Stream 7	Randall	10,750	2,037	2,291
Stream 8	Randall/Bones	200	117	249
Stream 9	Trib X	1,250	11,160	3,199
Stream 10	Trib X/Trib A	533	51	39
Stream 11	Young	6,950	11,370	15,914
Stream 12	Humphrey	5,550	4,442	6,050
Stream 13	Humphrey/Trib A	1,200	3,876	2,075
Stream 14	Yaquina	76,000	15,817	114,560
Stream 15	Randall/Buckhorn		51	284
Stream 16	Davis		181	246
Stream 17	Spilde	19,333	6,739	6,005
Stream 18	Spilde/Lytle		196	246
Stream 19	Spilde/Trib A	533	969	553
Stream 20	Little Yaquina	267	1,223	560
Stream 21	Little Yaquina/Trib	800	217	283

	A			
Stream 22				
Stream 23				
Stream 24				
Stream 25				
	Total	141,933	102,620	242,514

Table D2. Lowland potential smolt production based on ODFW survival rates.

Habitat type	Rearing capacity (# fish)	
	Summer	Winter
Stillwater with edge habitat		
Wetland channels		
Flooded wetlands		
Total		

Table E. Potential smolt production based on Alsea study survival rates

Table E1. Upland potential smolt production based on Alsea study survival rates.

Stream ID		Potential smolt production (# fish)		
Number	Name	Spawning	Summer	Winter
Stream 1	Buttermilk	453	5,446	25,056
Stream 2	Buttermilk/Trib A	23	125	435
Stream 3	Bryant	79	56	
Stream 4	Stony	574	656	1,742
Stream 5	Stony/Trib A	293	79	88
Stream 6	Felton	146	448	1,367
Stream 7	Randall	907	314	731
Stream 8	Randall/Bones	17	18	79
Stream 9	Trib X	105	1,720	1,020
Stream 10	Trib X/Trib A	45	8	13
Stream 11	Young	586	1,753	5,075
Stream 12	Humphrey	468	685	1,929
Stream 13	Humphrey/Trib A	101	598	662
Stream 14	Yaquina	6,413	2,439	36,532
Stream 15	Randall/Buckhorn		8	90
Stream 16	Davis		28	79
Stream 17	Spilde	1,631	1,039	1,915
Stream 18	Spilde/Lytle		30	78
Stream 19	Spilde/Trib A	45	149	176
Stream 20	Little Yaquina	23	189	179
Stream 21	Little Yaquina/Trib A	68	33	90
Stream 22				
Stream 23				
Stream 24				
Stream 25				
	Total	11,976	15,821	77,335

Table E2. Lowland potential smolt production based on Alsea study survival rates.

Habitat type	Rearing capacity (# fish)	
	Summer	Winter
Stillwater with edge habitat		
Wetland channels		
Flooded wetlands		
Total		

Table F. Overall rearing and smolt production capacities.

Table F. Combined upland and lowland rearing capacity and potential smolt production. Smolt production is estimated using both ODFW and Alsea watershed survival rates.

Life stage (season)	Rearing capacity (# fish)	Potential smolt production (# fish)	
		ODFW rates	Alsea rates
Spawning (# eggs)	443,542	141,933	11,976
Spring (# fish)	no data	no data	no data
Summer (# fish)	142,528	102,620	15,821
Winter (# fish)	269,460	242,514	77,335

No estimate of spring capacity or potential smolts produced is possible with current data.
Calculation of Spawning (# eggs) is based on the assumptions of 2500 eggs/redd and 3 m2/redd

Model results for 2007

Table A. Stream summer rearing densities

Table A. Coho rearing density for each summer stream habitat type.

Habitat type	Fish/sq m
Cascades	0.24
Rapids	0.14
Riffles	0.12
Glides	0.77
Trench Pools	1.79
Plunge Pools	1.51
Lateral Scour Pools	1.74
Mid Chan Scour Pools	1.74
Dam Pools	1.84
Alcoves	0.92
Beaver Ponds	1.84
Backwaters	1.18

Data of Tom Nickelson based on ODFW research.

Table B. Survival rates to smolt

Table B. Season (life stage) to smolt survival rates.

ODFW Research		Alsea study data	
Life stage	Survival rate	Life stage	Survival rate
Egg to smolt	0.3200	Egg to smolt	0.0270
Spring to smolt	0.4600	June to Smolt	0.0644
Summer to smolt	0.7200	Fall to smolt	0.1110
Winter to smolt	0.9000	Winter to smolt	0.2870

Rates used by Tom Nickelson (ODFW)

Rates provided by Jim Hall (OSU Dept of F & W)

Table C. Rearing capacities

Table C1. Upland rearing capacities.

Stream ID		Rearing capacity (# eggs or fish)		
Number	Name	Spawning	Summer	Winter
Stream 1	Buttermilk	33,542	94,061	12,502
Stream 2	Buttermilk/Trib A	833	196	149
Stream 3	Bryant	2,917	501	
Stream 4	Stony	28,333	4,979	3,499
Stream 5	Stony/Trib A	10,833	714	307
Stream 6	Felton	5,417	1,413	1,251
Stream 7	Randall	44,792	2,767	4,750
Stream 8	Randall/Bones	625	162	277
Stream 9	Trib X	15,625	1,435	867
Stream 10	Trib X/Trib A	1,667	70	44
Stream 11	Young	28,958	11,822	6,205
Stream 12	Humphrey	23,125	4,749	4,536
Stream 13	Humphrey/Trib A	5,000	2,440	1,642
Stream 14	Yaquina	237,500	15,349	71,255

Stream 15	Randall/Buckhorn		71	315
Stream 16	Davis		138	153
Stream 17	Spilde	60,417	9,496	4,773
Stream 18	Spilde/Lytle		272	273
Stream 19	Spilde/Trib A	1,667	424	502
Stream 20	Little Yaquina	833	1,698	622
Stream 21	Little Yaquina/Trib A	2,500	308	315
Stream 22				
Stream 23				
Stream 24				
Stream 25				
	Totals	504,583	153,066	114,236

Table C2. Lowland rearing capacities.

Habitat type	Rearing capacity (# fish)	
	Summer	Winter
Stillwater with edge habitat		
Wetland channels		
Flooded wetlands		
Total		

Table D. Potential smolt production based on ODFW survival rates

Table D1. Upland potential smolt production based on ODFW survival rates.

Stream ID		Potential smolt production (# fish)		
Number	Name	Spawning	Summer	Winter
Stream 1	Buttermilk	10,733	67,724	11,252
Stream 2	Buttermilk/Trib A	267	141	134
Stream 3	Bryant	933	361	
Stream 4	Stony	9,067	3,585	3,149
Stream 5	Stony/Trib A	3,467	514	276
Stream 6	Felton	1,733	1,017	1,126
Stream 7	Randall	14,333	1,992	4,275
Stream 8	Randall/Bones	200	117	249
Stream 9	Trib X	5,000	1,033	780
Stream 10	Trib X/Trib A	533	51	39
Stream 11	Young	9,267	8,512	5,584
Stream 12	Humphrey	7,400	3,419	4,082
Stream 13	Humphrey/Trib A	1,600	1,757	1,478
Stream 14	Yaquina	76,000	11,051	64,129
Stream 15	Randall/Buckhorn		51	284
Stream 16	Davis		100	138
Stream 17	Spilde	19,333	6,837	4,295
Stream 18	Spilde/Lytle		196	246
Stream 19	Spilde/Trib A	533	305	452
Stream 20	Little Yaquina	267	1,223	560
Stream 21	Little Yaquina/Trib	800	222	283

	A			
Stream 22				
Stream 23				
Stream 24				
Stream 25				
	Total	161,467	110,207	102,812

Table D2. Lowland potential smolt production based on ODFW survival rates.

Habitat type	Rearing capacity (# fish)	
	Summer	Winter
Stillwater with edge habitat		
Wetland channels		
Flooded wetlands		
Total		

Table E. Potential smolt production based on Alsea study survival rates

Table E1. Upland potential smolt production based on Alsea study survival rates.

Stream ID		Potential smolt production (# fish)		
Number	Name	Spawning	Summer	Winter
Stream 1	Buttermilk	906	10,441	3,588
Stream 2	Buttermilk/Trib A	23	22	43
Stream 3	Bryant	79	56	
Stream 4	Stony	765	553	1,004
Stream 5	Stony/Trib A	293	79	88
Stream 6	Felton	146	157	359
Stream 7	Randall	1,209	307	1,363
Stream 8	Randall/Bones	17	18	79
Stream 9	Trib X	422	159	249
Stream 10	Trib X/Trib A	45	8	13
Stream 11	Young	782	1,312	1,781
Stream 12	Humphrey	624	527	1,302
Stream 13	Humphrey/Trib A	135	271	471
Stream 14	Yaquina	6,413	1,704	20,450
Stream 15	Randall/Buckhorn		8	90
Stream 16	Davis		15	44
Stream 17	Spilde	1,631	1,054	1,370
Stream 18	Spilde/Lytle		30	78
Stream 19	Spilde/Trib A	45	47	144
Stream 20	Little Yaquina	23	189	179
Stream 21	Little Yaquina/Trib A	68	34	90
Stream 22				
Stream 23				
Stream 24				
Stream 25				
	Total	13,624	16,990	32,786

Table E2. Lowland potential smolt production based on Alsea study survival rates.

Habitat type	Rearing capacity (# fish)	
	Summer	Winter
Stillwater with edge habitat		
Wetland channels		
Flooded wetlands		
Total		

Table F. Overall rearing and smolt production capacities.

Table F. Combined upland and lowland rearing capacity and potential smolt production. Smolt production is estimated using both ODFW and Alsea watershed survival rates.

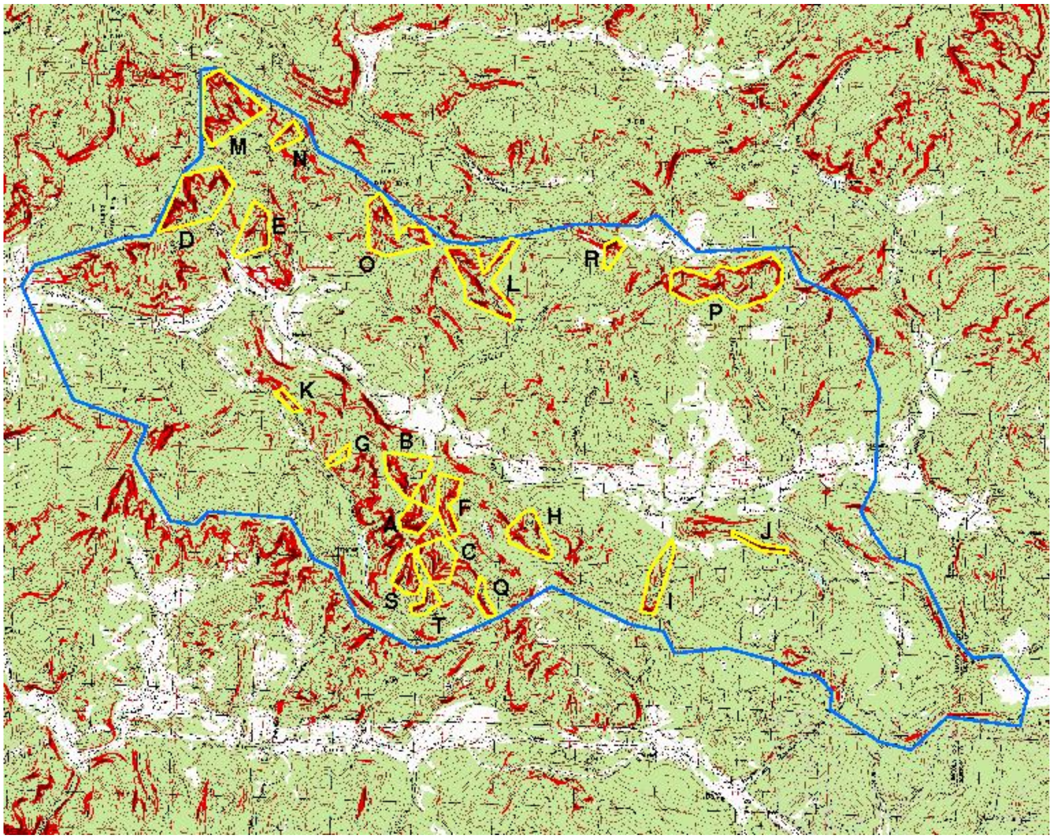
Life stage (season)	Rearing capacity (# fish)	Potential smolt production (# fish)	
		ODFW rates	Alsea rates
Spawning (# eggs)	504,583	161,467	13,624
Spring (# fish)	no data	no data	no data
Summer (# fish)	153,066	110,207	16,990
Winter (# fish)	114,236	102,812	32,786

No estimate of spring capacity or potential smolts produced is possible with current data.
Calculation of Spawning (# eggs) is based on the assumptions of 2500 eggs/redd and 3 m2/redd

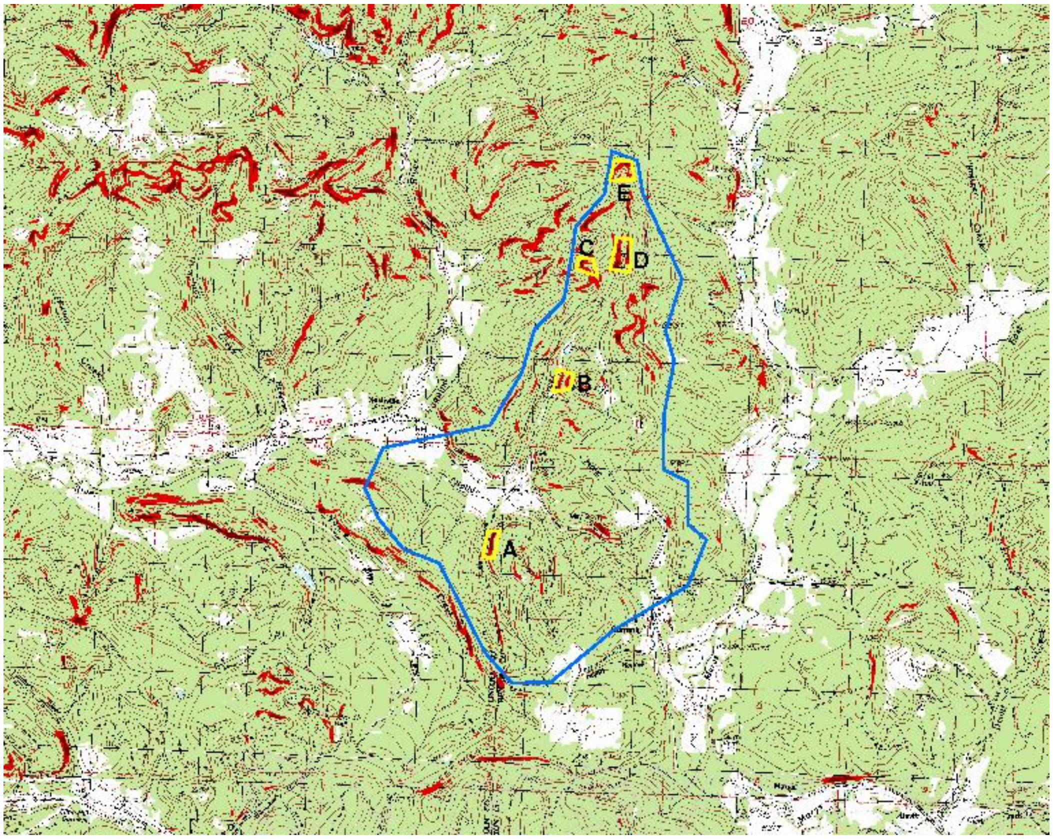
Appendix 5. Buttermilk/Spilde/Yaquina Headwaters 6th field complex ODF slope risk analysis maps

Legend
Blue - watershed boundary
Red - slopes over 60%
Dark Red - slopes over 80%
Yellow - leave tree sites in the path of potential landslides likely to deliver to a Type F stream

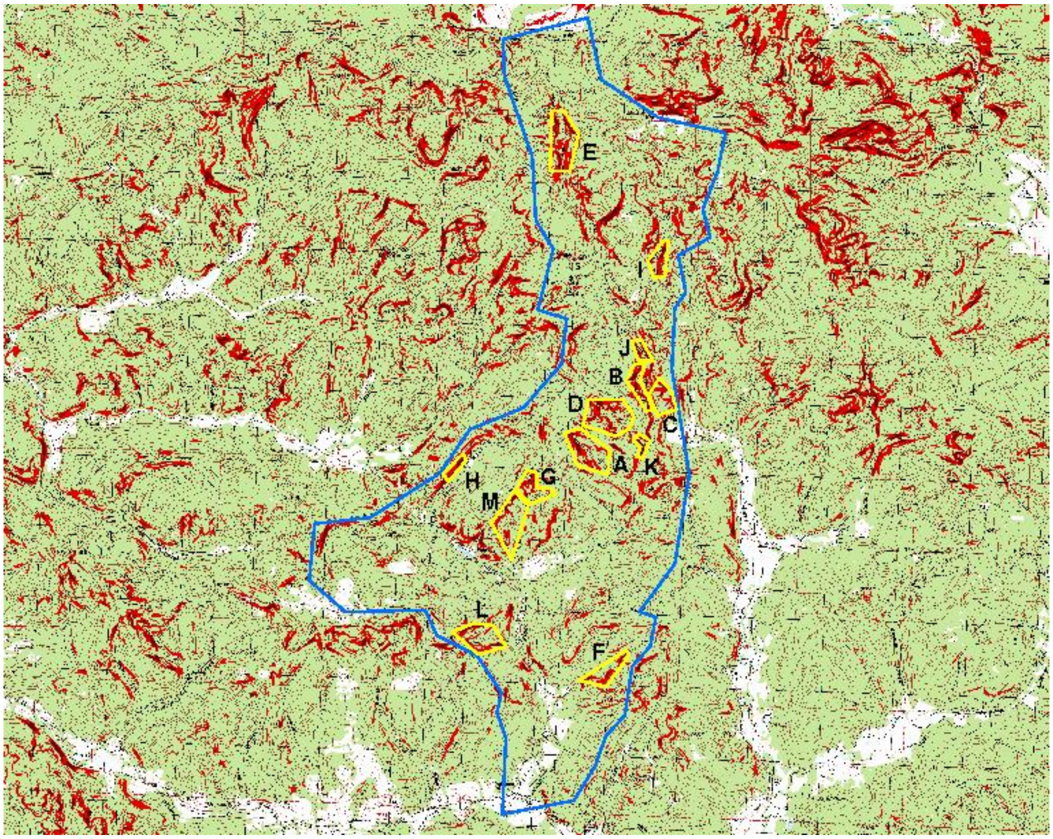
Buttermilk subbasin slope risk analysis map



Spilde subbasin slope risk analysis map



Yaquina Headwaters subbasin slope risk analysis map



Appendix 6. Buttermilk/Spilde/Yaquina Headwaters 6th field complex summer coho distribution charts

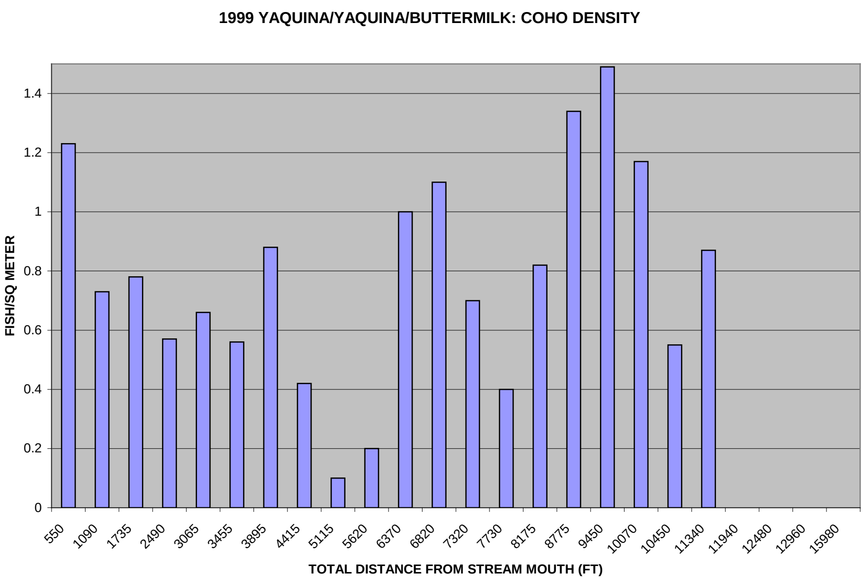


Figure 1. Buttermilk Creek

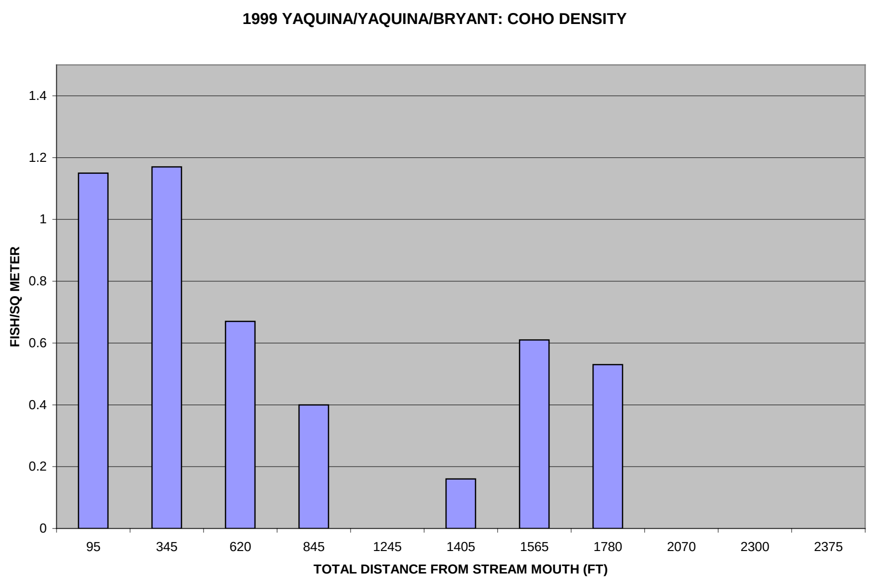


Figure 2. Bryant Creek

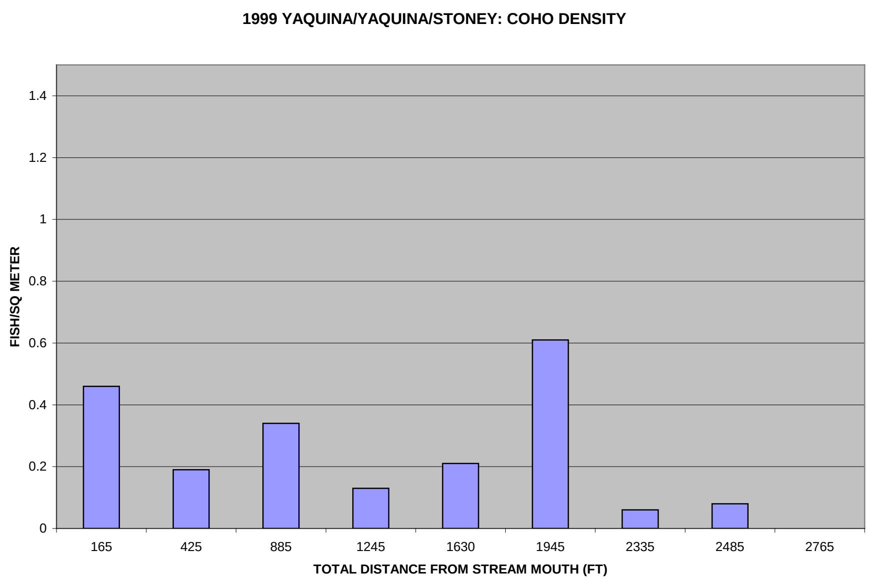


Figure 3. Stony Creek

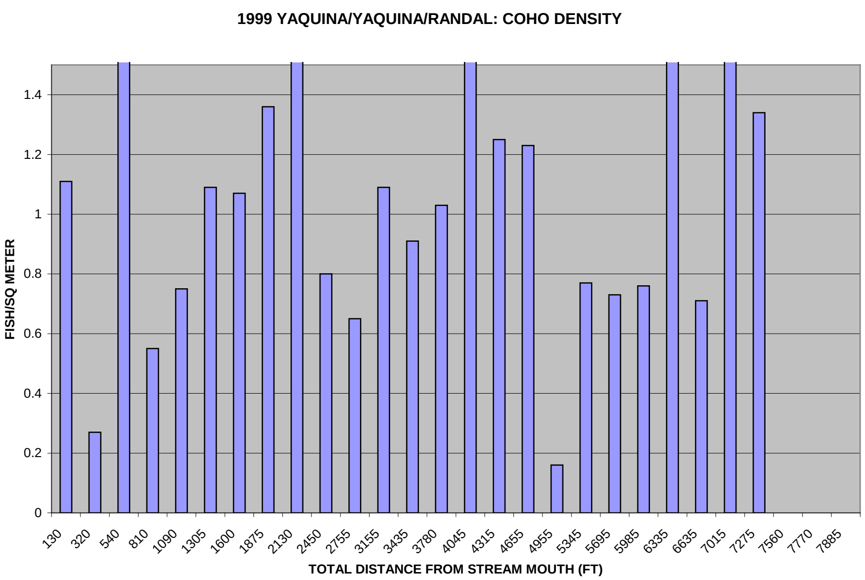


Figure 4. Randall Creek

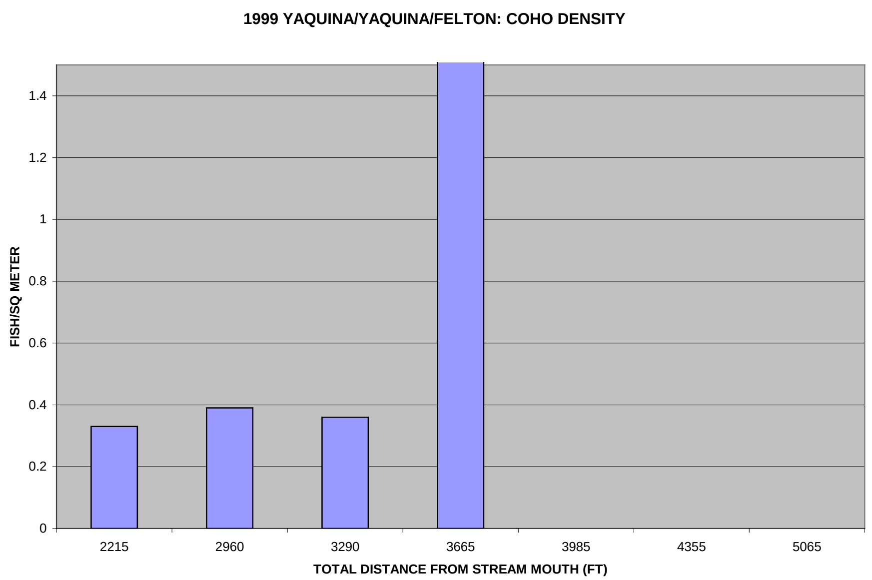


Figure 5. Felton Creek

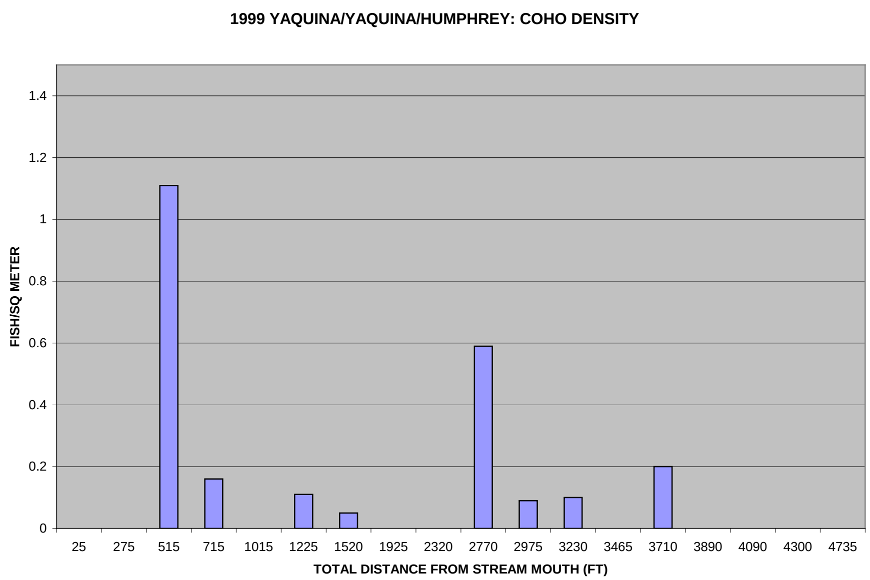


Figure 6. Humphrey Creek

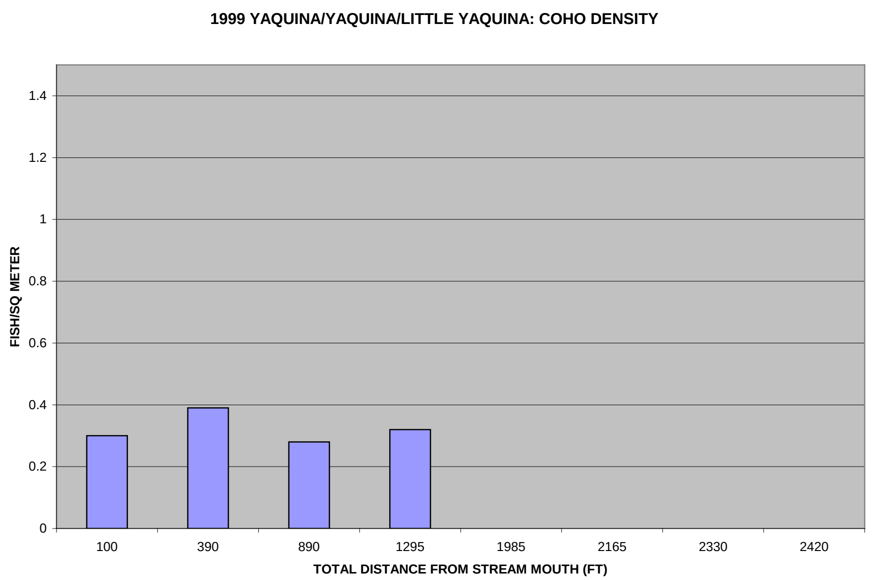


Figure 7. Little Yaquina River

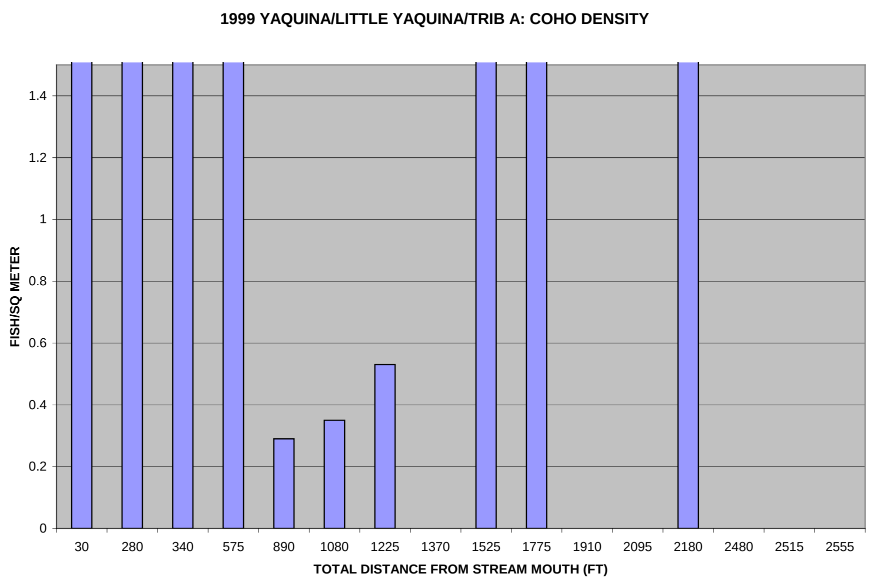


Figure 8. Little Yaquina River Trib A

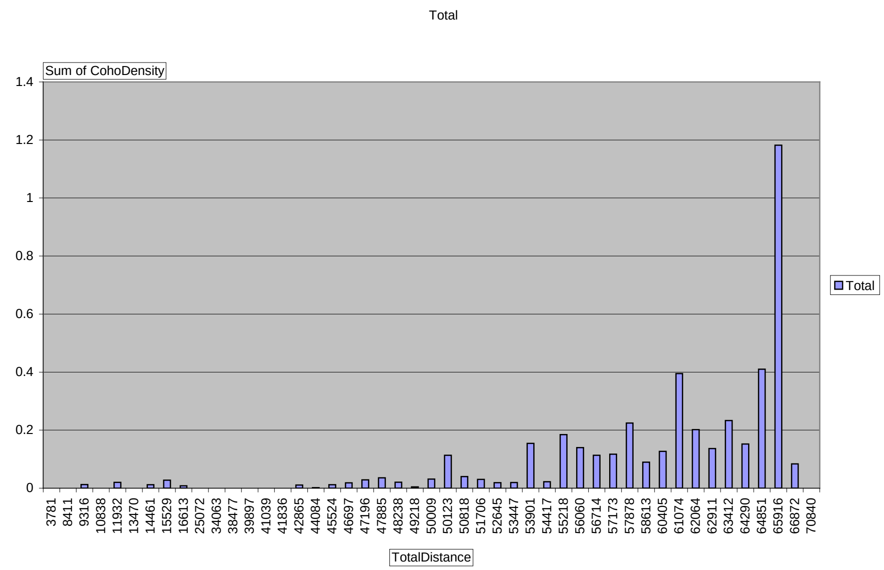
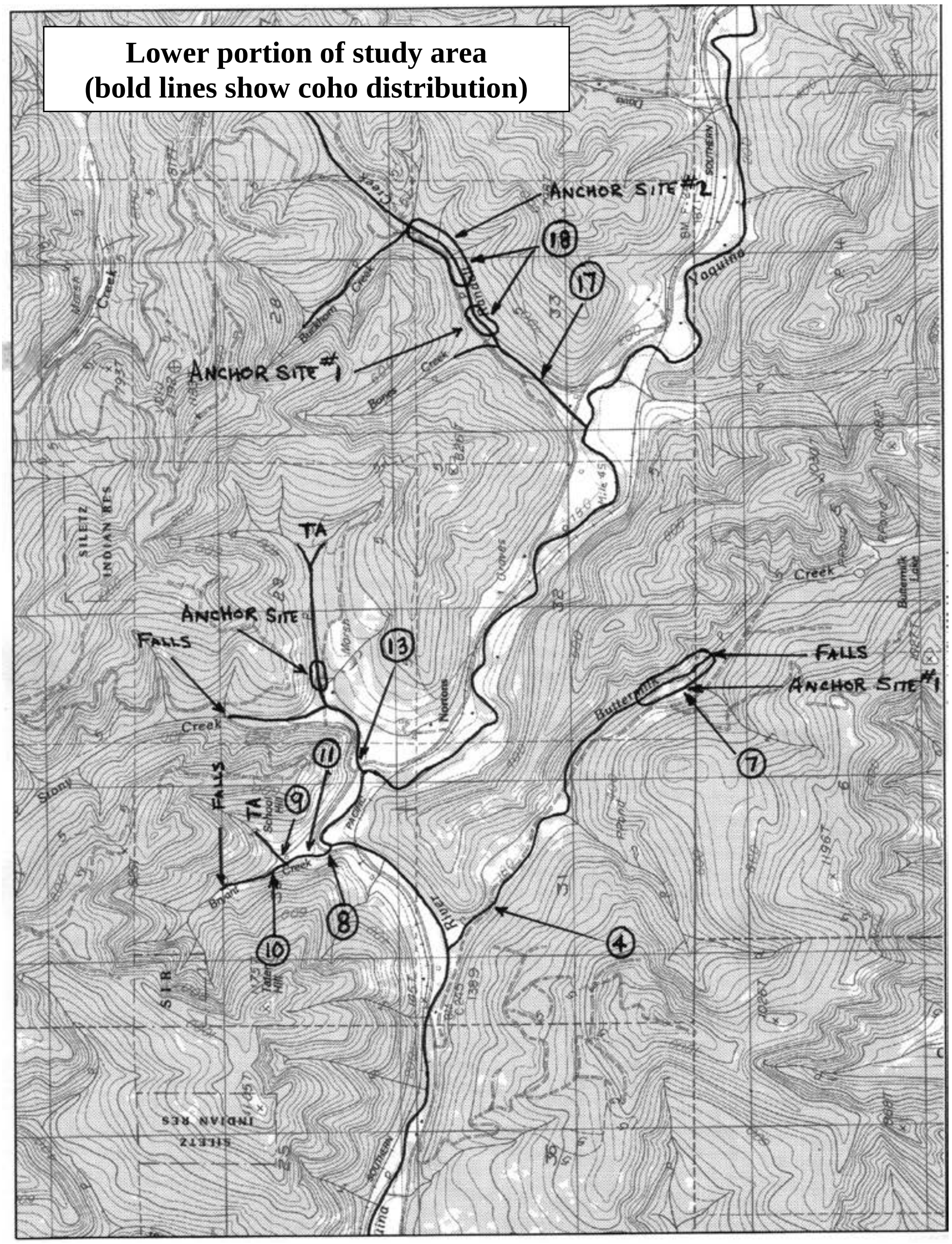
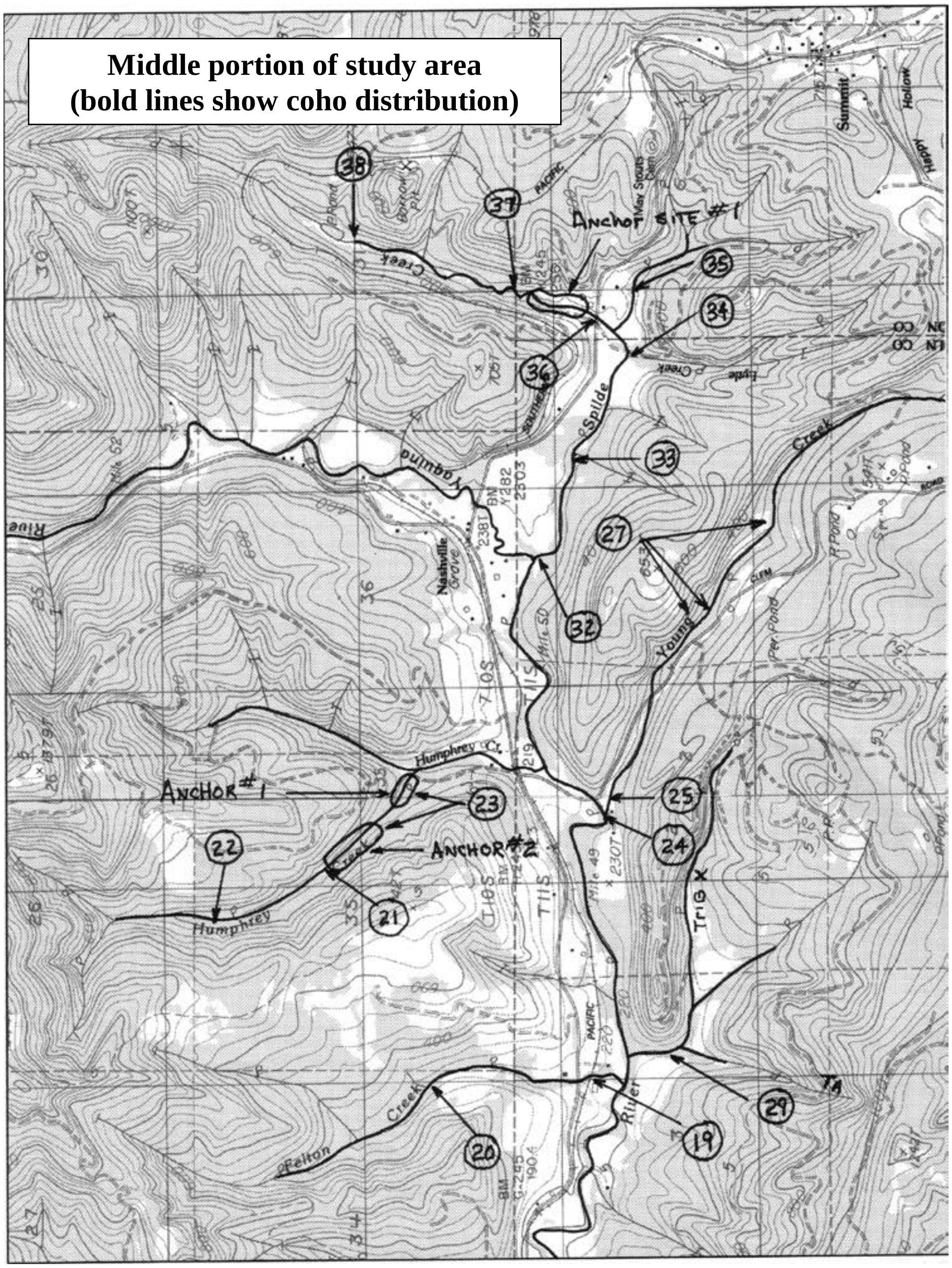


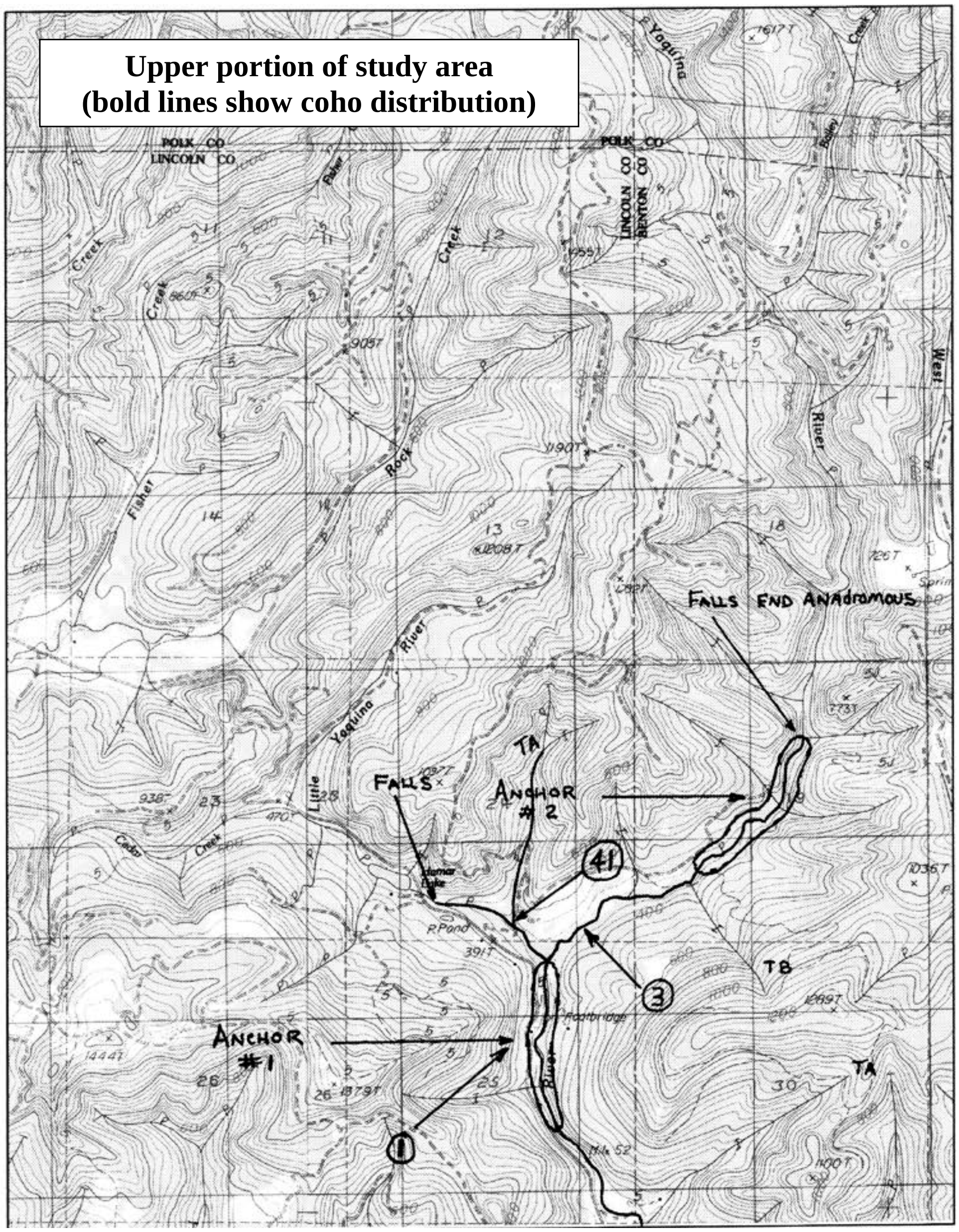
Figure 9. Yaquina River Bales Creek to the Barrier Falls

Appendix 7. Buttermilk/Spilde/Yaquina Headwaters 6th field complex prescription location maps





Middle portion of study area
(bold lines show coho distribution)



Upper portion of study area (bold lines show coho distribution)

Appendix 8. Buttermilk/Spilde/Yaquina Headwaters 6th field complex photos

Photo 1. Double culvert on Buttermilk Creek

Photo 2. Road failure on Buttermilk Creek

Photo 3. Juvenile Barrier at county road culvert Bryant Creek

Photo 4. Second Bryant Creek culvert juvenile barrier

Photo 5. Stony Creek juvenile barrier at county road culvert

Photo 6. Barrier Falls Stony Creek

Photo 7. Beaver Dam on Randall Creek culvert ends upstream juvenile migration

Photo 8. Second culvert on Young Creek with rusted bottom, flow beneath.

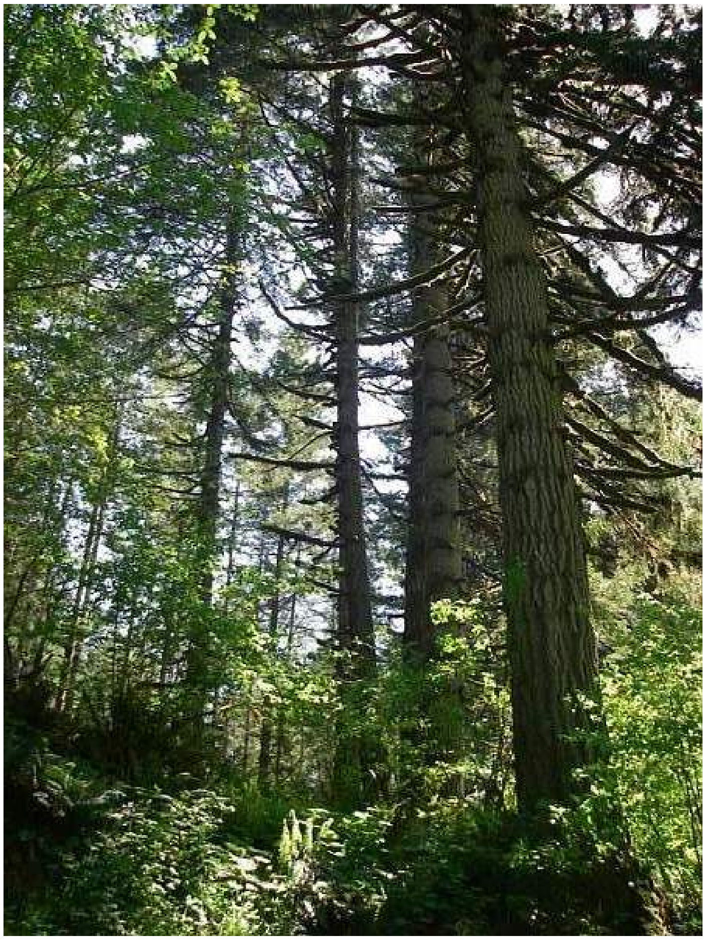


Photo 9. Young Creek Riparian

Photo 10. Young Creek channel illustrating effects of functional riparian area

Photo 11. Highly functional Structure on Humphrey Creek illustrates value of small wood in structure design

Photo 12. Beaver Pond Trib A Humphrey Creek

Photo 13. First pipe on Spilde Creek

Photo 14. Three Culverts on Spilde blocking juvenile migration

Photo 15. Coho found above this 16" drop onto riprap. 1st pipe above county road on Spilde Creek

Photo 16. Trib A Little Yaquina River juvenile barrier

Photo 17. Substrate Little Yaquina River

Photo 18. Falls on Little Yaquina ends coho migration

Photo 19. Barrier Falls Yaquina River

Photo 20. Mainstem Above Spilde Creek

Photo 21. Yaquina River below Mayo Property illustrating lack of channel complexity

Photo 22. Entering Mayo property, Upper Yaquina River.

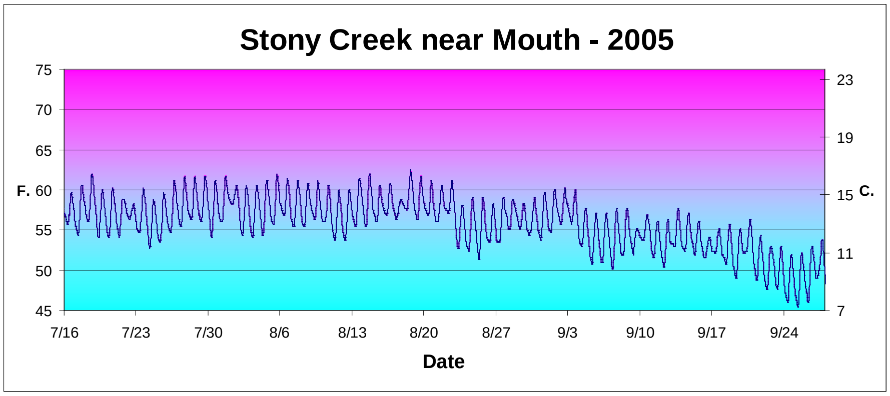
Photo 23. Low terrace in Anchor Site 1, Yaquina Headwaters

Photo 24. Beaver dam on ODFW structure, Hull Oakes, Upper yaquina

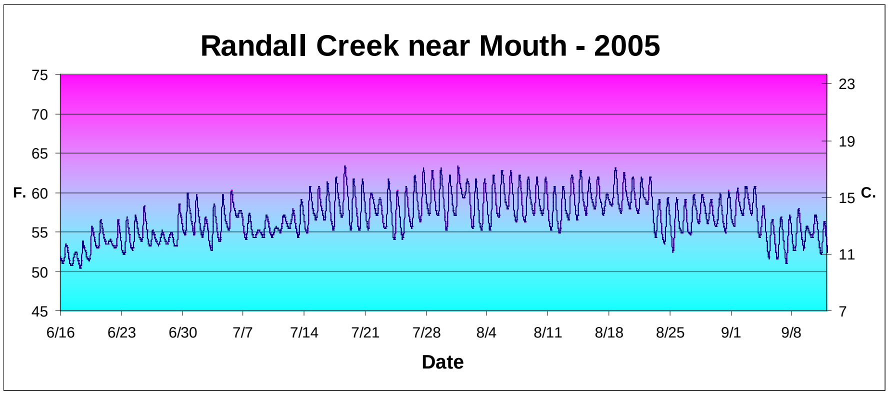
Photo 25. Riparian area suitable for easement purchase, Upper Yaquina

Photo 26. Typical 2007 beaver flat, no beavers

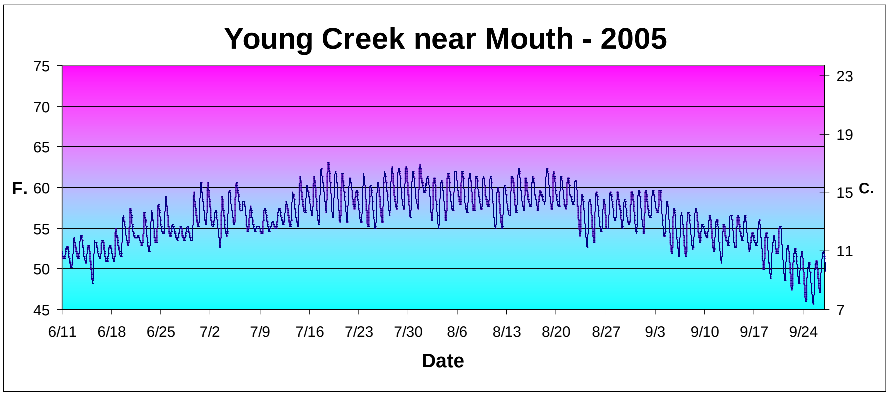
Appendix 9. Yaquina mainstem stream temperature charts



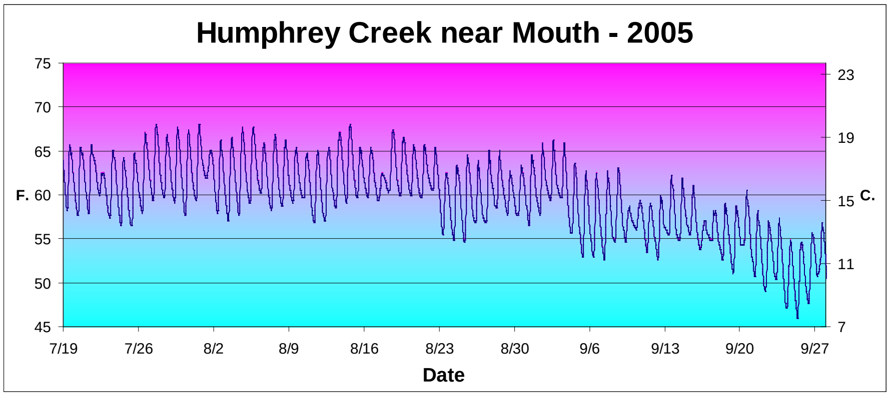
Graph 1 Stony Creek



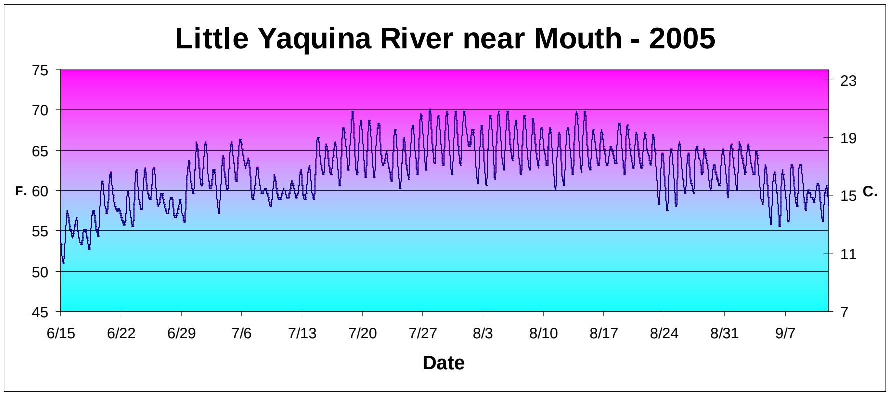
Graph 2 Randall Creek



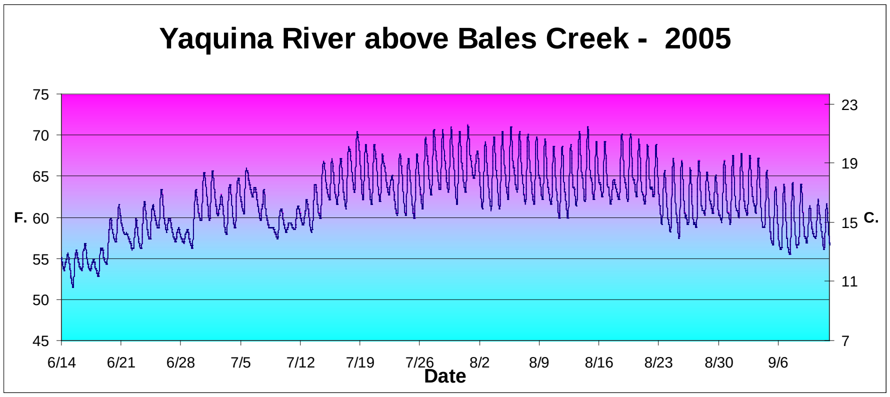
Graph 3 Young Creek



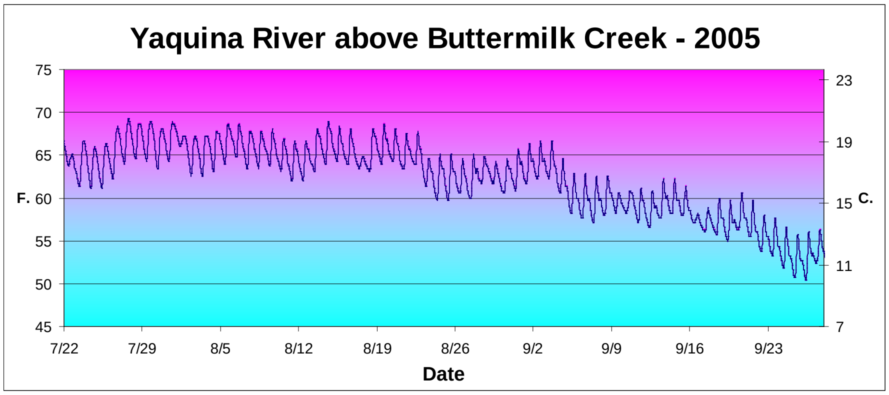
Graph 4 Humphrey Creek



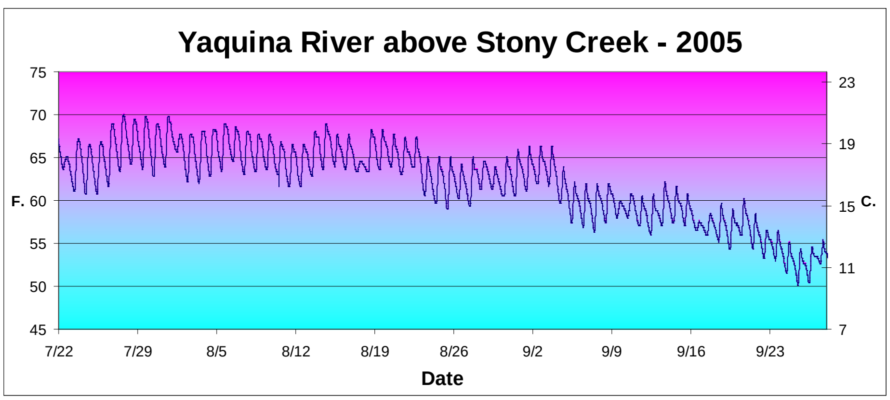
Graph 5 Little Yaquina River



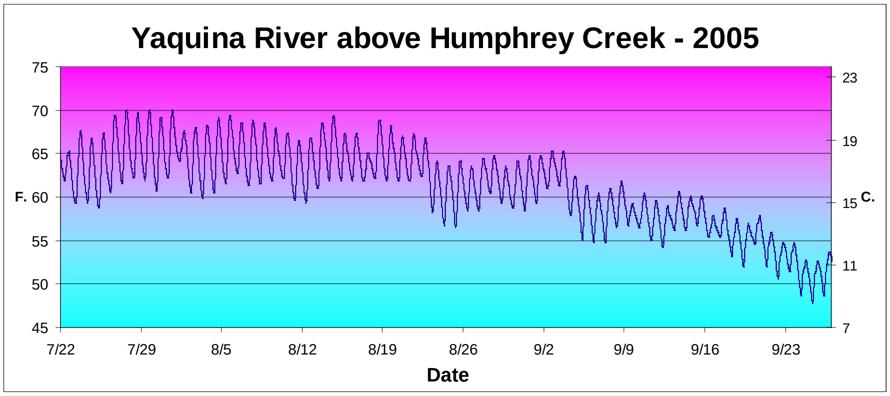
Graph 6 Mainstem upstream of Bales Creek



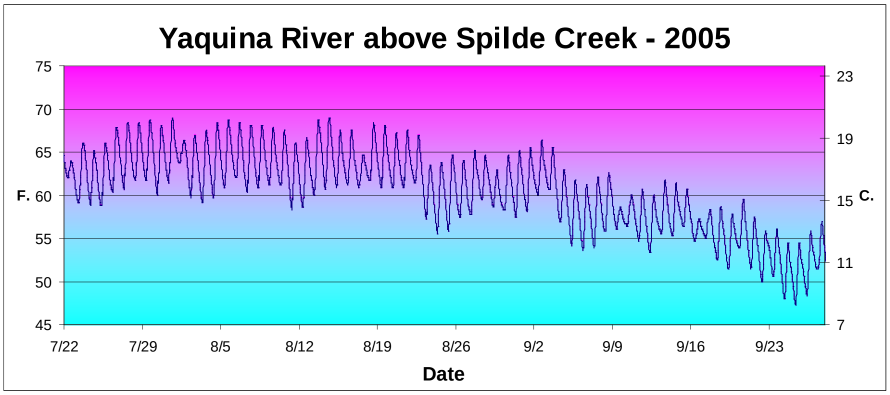
Graph 7 Mainstem upstream of Buttermilk Creek



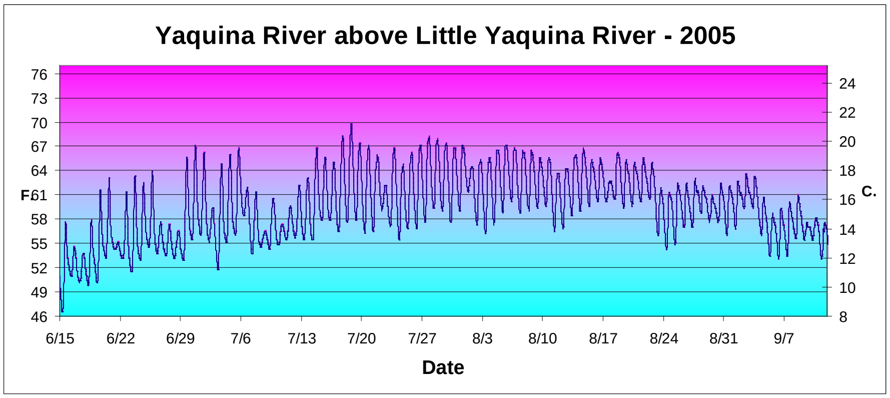
Graph 8 Mainstem upstream of Stony Creek



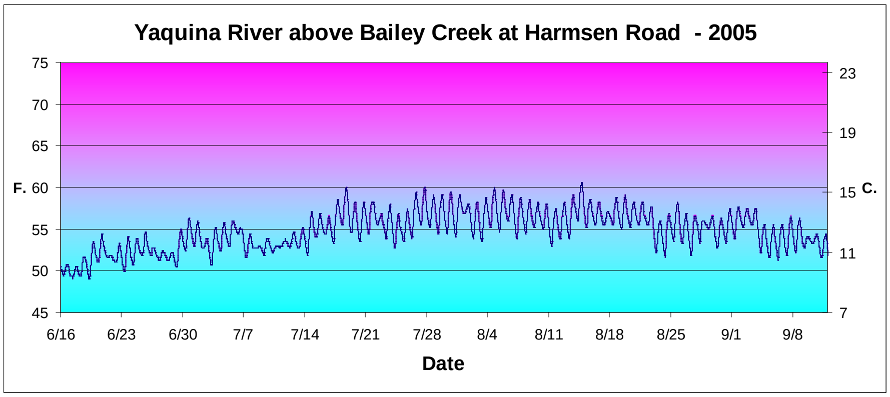
Graph 9 Mainstem upstream of Humphrey Creek



Graph 10 Mainstem upstream of Spilde Creek



Graph 11 Mainstem upstream of Little Yaquina River



Graph 12 Mainstem upstream of Bailey Creek

All graphs courtesy of Bobbi Lindberg ODEQ (541) 686-7838