Limiting Factors Assessment and Restoration Plan Rock Creek

Tributary to Devil's Lake

Lincoln County, Oregon

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Prepared by
Bio-Surveys, LLC
P.O. Box 65
Alsea, OR 97324
541-487-4338
Contact: Steve Trask

Sialis Company
154 SE Rivergreen Ave.
Corvallis, OR 97333
541-753-7348
Contact: Duane Higley

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775 Summer Street NE, Suite 360
Salem, OR 97301-1290

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Introduction

This document provides watershed restoration actions proposed to enhance the Coho Salmon population within the Rock Creek / Devils Lake basin in Lincoln County, Oregon. The stream is the principle tributary of Devil's Lake, a lake of natural origin that opens into the Pacific Ocean at the northern edge of Lincoln City, OR.

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 basin, 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.midcoastwatershedcouncil.org/GIS or by contacting the Midcoast Watersheds Council. Please refer to this document for detailed information on assessment, nomenclature, prioritization rationale and methodology.

Physical setting

The Rock Creek watershed comprises approximately 1,382 hectares in the Oregon Coast Range. In its upper reaches (above river mile 3.3), the stream lies within a moderately steep V-shaped valley, where aquatic habitats are dominated by rapids and riffles interspersed with a mix of dammed, scour and plunge pools. Downstream, the valley widens, and the channel is principally terrace constrained. Here, more gentle gradients and a wider floodplain prevail that produce riffles and a mix of beaver, dammed, scour, and plunge pools. At approximately river mile 1.6, the valley opens into a broad floodplain forming a large wetland, much of which has been highly modified for historical agricultural use. The stream channel is incised in much of the upper portion of the wetlands and lacks connectivity with the floodplain. Nearing its confluence with Devil's Lake, the channel becomes complex and has greater access to the floodplain.

Four principle tributaries enter Rock Creek. The two upper tributaries (C and D) are low gradient, narrow valley systems dominated by shallow pools and riffles. The two lowest tributaries (A and B), are steeper gradients with well sorted gravels and exhibit a higher frequency of rapid / plunge pool complexes.

The geologic setting is predominantly sandstone. Reflecting this, the dominant substrates are mobile gravels and fine sediments. As would be expected, fine sediments are more common lower in the system, and gravels are more common higher in the system. Boulders are rare, even in the upper reaches of the mainstem and in the tributaries.

Three general types of land use affect Rock Creek and its ability to support Coho production: Timber harvest on the hillslopes, agricultural use, and urbanization. Oregon State Parks owns the lower wetlands adjacent to Devil's Lake. above the wetlands (RM 0.8) the historical impact to aquatic habitats are observed in reduced amounts of instream wood, a general lack of complex pools, and an increase in the abundance of mobile sediments. In the upper wetlands, channelization and drainage have confined flow to a deeply incised active channel that lacks sinuosity and complexity. This portion of the basin is bordered by active and abandoned pastures with a limited riparian canopy.

Current status of Coho

The status of Oregon Coast Coho in the basin was reviewed in 1999 by the Midcoast Watershed Council utilizing the Rapid Bio-Assessment snorkel inventory. Distribution of juvenile Coho and Steelhead indicate that the area is underseeded. The total expanded Coho estimate for the basin in 1999 (including the tributaries and excluding the lake environment) was 9,000 summer parr. This number suggests an estimated escapement of approximately 70 adult Coho (assuming a 1:1 male / female ratio).

The basin will be resurveyed during the summer of 2003 and escapement and distribution are expected to be significantly higher than observed in 1999 due to a coast wide increase in ocean survival rates and good flows for adult migration during the winter of 2002 / 2003.This data will be available by September, 2003.

Resources used in developing the plan

Oregon Department of Fish and Wildlife aquatic habitat surveys conducted on Rock Creek and two of its tributaries in June 1994.

Summer snorkel surveys of the Rock Creek basin and its tributaries conducted in 1999. These "Rapid Bio Assay" fish inventories identify the species, age class, density and distribution of salmonids in pools (sampling frequency is every 5th pool).

Coho habitat assessment model developed by the Oregon Department of Fish and Wildlife Research Division. This model evaluates the quantity of spawning gravel, egg deposition rates, and amount of aquatic habitat by season in order to identify which seasonal habitat and Coho life stage limit the production of smolts from a stream section (referred to as the smolt production bottleneck).

Oregon Department of Forestry slide assessment maps, which identify failure-prone headwater slopes that are considered to be potential sources of wood and substrate to the aquatic corridor.

Bio-Surveys Field assessment conducted on June 10, 2003 in conjunction with the development of this restoration plan.

Questions that guide the assessment

- How well and in what mode is the current system functioning for Coho production (what part does each of the habitat subdivisions play)
- What temperature problems are apparent?
- Where are temperature refugia located?
- Where are the barriers to fish migration?
- What is the sedimentation state of system
- Where are the spawning areas, and how are they integrated with the summer and winter rearing sites?
- What needs to be done to make the Core habitat function for all life phases, and to function at a higher level?
- What work should be done in each area to facilitate a more completely functional whole?
- What is the best upslope work that supports the instream work?
- How are the fish currently using the system?
- What problems are generated by the current habitat status (eg, temperature dependant movements that expose juveniles to predation)
- How and when are the greatest losses generated to the population?
- Within the Core habitat, what are the dominant limiting factors?
- Within the 6th field, what are the dominant limiting factors?
- Within the 4th field, what are the dominant limiting factors?
- Does the presence or absence of adequate winter habitat outside the spatial boundaries of the 6th field suggest or preclude the need for expanding the quantity or quality of winter habitat

Pre-survey Mapping / Location of habitat subdivisions

Core Areas

The Core area describes the current summer distribution of juvenile Coho. The Core extends from Devils Lake to a point 5.4 miles up the mainstem of Rock Cr. In addition, the Core extends up Tributaries A,B,C,D. See habitat distribution Map.

Anchor Habitats (prioritized for greatest potential for restoration)

1) Lower 2,941 lineal ft, largest active channel width, greatest potential for increases in sinuosity, lowest terraces, lowest anchor in system for providing summer and winter refuge, moderate potential for improving gravel quality with wood loading. Current function rated as fair.
2) Middle 3,088 lineal ft, moderate active channel width (Trib A & B contribute below this anchor), moderate potential for increases in sinuosity, some low terraces, highest potential for improving gravel quality with wood loading (higher gradient for effective sorting). Current function rated as fair.
3) Upper 441 lineal ft, narrow active channel width (Tribs A,B,C,D contribute below this anchor), High potential for increase in sinuosity, current function rated as poor.

Secondary Branch Habitats

Trib A contains 29 sq.meters of spawning gravel
Trib B contains 43 sq.meters of the highest quality spawning gravel
Trib C contains 15 sq. meters of spawning gravel.
Trib D contains 32 sq. meters of spawning gravel.

Critical Contributing Areas

- Overall Prioritization of critical contributing areas (considers all attributes: spawning, rearing, resource contribution, water quantity, water quality)
  Trib A
  Trib B
  Trib D
  Trib C
- Tributaries below Core Area / Anchor Sites
  None
- Tributaries above Core Area / Anchor Sites
  1) Trib B delivers above the lower anchor site (highest priority), therefore its potential for contribution of substrate resource to the priority anchor is significant. Trib B is critical for temperature and water quality maintenance in the mainstem downstream from it. Because of the abundance of spawning gravel, the spring application of industrial herbicides in stream adjacent harvest units could impact embryonic salmonid juveniles during incubation. In addition, a steep road cut 200 yds below the bedrock falls has failed and blocked anadromous passage to the last small section of available habitat. The potential habitat above the blockage is minor, but a higher future risk may be associated with the failure site.
  2) Unnamed tributaries and stream adjacent slopes above the middle anchor site are rated as priorities 1-7 as indirect contributors to the Core Area. These sites all exist with the Siuslaw National Forest Boundaries and may be guaranteed a higher level of protection from future resource extraction that could impact there ability to deliver wood and substrate to the Rock Cr. Core Area. Some of the sites classified on the ODF risk assessment map as indirect contributors are actually direct contributors to the Core (5,6,7,9,11,12)
- Tributaries that contribute directly to Anchor Sites
  1) Trib A delivers directly to the lower and highest priority Anchor site. It contains ODF's highest potential for slope failure. The tributary was the site of a recent dam break flood event that delivered large quantities of gravel to the mainstem of Rock Cr. This event was initiated by a plugged culvert on a deep road fill. It did not involve slope failure. Critical for temperature maintenance.
  2) Trib D delivers directly to the middle anchor site. It contains stream adjacent slopes that are ODF's lowest potential for failure and recruitment. Critical for temperature maintenance.
  3) Trib C delivers directly to the middle anchor site. It contained no high risk slopes for recruitment in ODF's risk assessment. Critical for temperature maintenance.

Lower Mainstem Area

- Winter habitat Potential
  The lower mainstem is a zone from approximately RM 0.8 – 1.6. It has a very low rating for functional winter habitat because of its deeply entrenched, low wood density and low sinuosity channel. This zone traverses four owners French, Smith, Neal and Fox.
- Summer habitat Potential
  This same zone provides summer habitat for juveniles but is also the zone where most of the temperature impacts to the aquatic corridor occur from a lack of significant riparian canopy.

Lowland Area

- Estuarine Marsh Habitat
  None
- Freshwater Marsh Habitat (Winter Potential)
  The zone from RM 0 – 0.8 can be classified as fresh water marsh. The condition and complexity of the marsh in this zone is variable, intact below the East Devils Lake Rd. and recovering above the Rd. The zone provides vast surface areas of high quality winter habitat for salmonid juveniles. The zone below the bridge is a complex labyrinth of backwater and overflow channels during most winter flow regimes. The zone was estimated to contain approximately 38 acres of wetted marsh surface area. For Limiting factor analysis we assumed that ½ of this wetted area (77,541 sq. meters) was utilizable during the winter for juvenile salmonids. The zone above the bridge has been simplified by historical agricultural activities. It does however contain significant surface areas of high quality winter habitat. A very conservative estimate utilized only the wetted open backwaters and sloughs to estimate 13,547 sq.meters of available winter habitat for salmonid juveniles.
- Freshwater Marsh Habitat (Summer Potential)
  This same zone is also providing high quality summer habitat that is well utilized by salmonid juveniles. Coho were abundant throughout this stretch during the 2003 inventories. The abundance of summer habitat was quantified utilizing the ODFW Aquatic Habitat Inventory Data.
- Lake Habitat (Winter Potential)
  The Rock Cr. system drains into Devils lake. Lake rearing life histories for Oregon Coast Coho are common and often produce very large and vigorous smolts. For the purpose of this Limiting Factors Assessment we have assumed that Lake rearing is occurring and that a very conservative estimate of it's available habitat for juvenile Coho would be calculated by taking the lake perimeter multiplied by a 1 meter wide band that would describe the zone with the highest likelihood of providing adequate cover for juvenile Coho. This resulted in an estimate of 19,795 sq. meters of potential winter habitat.
- Lake Habitat (Summer Potential)
  If the lake contains 19,795 sq.meters of winter habitat, it also provides at least that much potential summer habitat. However, we chose not to include this surface area into the limiting factors analysis because it requires an assumption that does not seem to fit most coastal Coho populations. To include the lake surface area as available summer habitat we are assuming that spring fry and summer parr make density independent migrations downstream. This type of movement has been well documented during the fall, especially in systems with lakes and unique lowland habitats (Coquille). We do believe that some level of nomadic spring fry migration probably occurs in the Devils Lake system but we also suggest that these lake habitats are not available to the majority of the population during summer flow regimes. The Lake becomes a more significant source of summer rearing when density dependant behaviors begin to influence summer population in the mainstem that are nearing seeded capacity.

Location of other resources

- Spawning sites
  See Distribution of spawning gravel graphic
- Landmarks
  See General Location Map
- Road crossings
  See General Location Map
- High risk slopes
  See ODF Risk Assessment graphic
- Land use

Juvenile coho

- Summer distribution profile
  The Rock Cr. system was surveyed for juvenile salmonids during the summer of 1999. This was classified as a low abundance year on the Oregon coast with many watersheds exhibiting very depressed adult escapement. This was also observed in the Rock Cr. subbasin with very suppressed juvenile distribution. Adult Coho passage was definitively terminated at the 6 ft bedrock falls at RM 3.6. However, juvenile abundance patterns suggest that the majority of adults terminated their upstream spawning migration at the 3-4 ft (depending on dam board levels) concrete water diversion dam at RM 3.1. Juvenile abundance suggests that potentially only five females successfully passed the diversion dam. The basin wide estimate of abundance based on summer juvenile densities suggests there were approximately 35 females total returning to the system. These are very rudimentary estimates utilizing the limited information available.
- Goal: Determine correspondence with Anchor habitat location
  An overlay of 1999 summer juvenile Coho distribution on morphologically based Anchor sites finds excellent agreement within the boundaries of the middle anchor site below the confluence of Trib C. The 1999 distribution did not observe Coho in the zone of the upper anchor site (due to the falls terminating all adult migrations) and there is poor agreement between the abundance of juveniles and the location of the lower anchor site. This comparison was designed to test the theory that anchor sites could be identified by determining the relative abundance of juveniles between differential habitats during summer snorkel inventories. In the case of Rock Cr., two of the three key habitat locations would have been overlooked. This may be a function of the low abundance year (1999) that was utilized to assess habitat preference. It also may suggest that no habitat preference exists during summer flow regimes.

Field Assessment

Evaluate habitat quality and Coho production

- Riparian vegetation
  Lineal distance / location of deciduous
  11,616 ft. mixed deciduous from RM 1.6 – 3.8 (40% of mainstem corridor)
  Lineal distance / location of coniferous
  8,448 ft. conifer dominated from RM 3.8 - 5.4 (30% of mainstem corridor) Calculated to end of summer Coho distribution
  Lineal distance / location of open canopy
  8,541 ft. early seral stage from RM 0 – 1.6 (30% of mainstem corridor)
  Contains 1993 ft. of complex intact and diverse wetland canopy that begins at Devils Lake 20% exposure
  Contains 2,084 ft. of simplified wetland community classified as recovering just above East Devils Lake Rd. 40% exposure
  Contains 4,464 ft. of totally dysfunctional pasture trench habitat that is deeply entrenched 80% exposure
- Recruitment potential and time frame
  No recruitment potential exist from the riparian from RM 0 – 1.6

  Short term potential for recruitment is high from RM 1.6 – 3.8 because deciduous component is older age class and because private industrial harvest adjacent to riparian in the upper ½ of this stretch has resulted in extensive wind throw in narrow riparian buffer. Current wood densities are high in upper ½. Long term recruitment has been dealt with by the recent planting of private industrial slopes with conifer.

  Short and long- term recruitment is functioning at an optimum level within the zone from RM 3.8 – 5.4. This zone describes the portion of the basin managed by the USFS. Mixed age class conifers (including late successional components) are abundant and providing the material to the aquatic corridor that is responsible for retaining the majority of the high quality spawning substrate in the basin. Protection of the riparian canopy in this portion of the watershed is also critical for mitigating for the thermal impacts present below RM 1.6. Any future activities planned for the basin above RM 3.8 could adversely impact a thermal regime that is currently hovering just below summer thermal thresholds for juvenile salmonids.
- Potential for thermal problems
  Where
  Potential thermal problems exist primarily in the zone of open canopy from Devils Lake to RM 1.6
  Why
  Portions of this zone have experienced significant historical impacts that have compromised the function of the transitional habitats between the forest and the wetlands associated with Devils Lake. The large legacy spruce component that appears in deep substrates is evidence of a coastal spruce / marsh ecosystem. Channel manipulation and draining was undoubtedly practiced to convert wetland to grazing and agriculture. Road construction bisecting this marsh environment has impacted botanical succession and altered flow regimes. All of these issues have left portions of this 1.6 mile reach in varying stages of exposure to direct sunlight and are responsible for increases in water temperatures between the forest and the East Devils Lake Rd. that have been documented by the SDWC.
- Channel form and floodplain interaction
  Lineal distance / location of functional anchor habitat
  Three distinct Anchor site locations were identified that total 1.1 miles of mainstem corridor (20% of total mainstem lineal distance). See figure 1 for physical location of Anchor sites. None of these sites can be classified as fully functional. The 3 sites (lower , middle, upper) have varying levels of functionality and potential. The greatest potential for developing complex floodplain interaction exists in the lower site, and the lowest potential exists in the upper site.

- Quality, quantity and location of spawning gravel
  Collected as a function of probable redd sites
  502 sq.meters of spawning gravel was identified in the entire Rock Cr. basin. 24% of these substrates were observed in tributaries of the mainstem (119 sq.m). 71% of these tributary gravels were classified as good quality (low sediment content <30%). Only 60% of the gravel observed in the mainstem was categorized as good quality. 88% of this good quality gravel was contained on USFS ownership in reaches 6 and 7 (see figure 3). Because the gravel assessment also describes available redd locations, an estimate of adult carrying capacity can be made utilizing assumptions from the Nickelson / Lawson Coho model. 3 redds / female = 167 females… 1/1 male to female ratio = 334 Coho adults as a low end estimate of the number of adults required to utilize the available gravel resource. A high end estimate would utilize a common redds/female average in the literature of 2, resulting in a total adult estimate of 502.
- Character and distribution of Summer Cover (lacks quantitative evaluation and relies on professional judgement)
  Habitat complexity is known to be an important component for summer survival as it relates to the provision of cover and protection from avian and pisciverous predation. Most reaches range from fair to good as a qualitative estimate of potential summer cover. The cover types vary from overhanging vegetation in reaches 1 and 2 (lowlands) to legacy wood in reaches 2 and 3, riparian contributions from blow down in reaches 4 and 5 and functional riparian wood and debris jam accumulations in reaches 6 and 7.

- Character and distribution of Winter Cover (lacks quantitative evaluation and relies on professional judgement)

  Habitat complexity is also known to be important for the provision of low velocity winter refuge. The distribution of winter habitat is much more complex than observed during summer flow regimes. The lowland habitats from Devils Lake to RM 0 – 0.8 is extremely complex and exhibits high quality potential for winter refuge. The zone from RM 0.8 – 1.6 is extremely entrenched and simplified at winter flow regimes and lacks any significant potential for winter habitat. The remainder of the Core area that maintains a summer population of Coho juveniles from RM 1.6 – 5.4 contains only 1.1 miles of aquatic habitat that exhibits some level of floodplain interaction and thus the potential for providing high quality winter habitat. This 1.1 mile area exists in the 3 separate anchor sites identified in figure 1. Because no winter habitat inventory data is available for this system, it is currently not possible to quantify the actual abundance of high quality winter habitat. However, enhancement within these sites will result in immediate increases in the abundance of winter habitat.

Locate migration barriers

- Location of barriers

  There are two barriers to anadromous migration in the Rock Cr. system.

  1) a manmade concrete dam at RM 3.1, 3ft vertical, currently in use with dam boards for increasing head, active water withdrawal during 2003 survey, water withdrawal is a small submersible pump designed for domestic use, destination unknown (see photo 1). The dam is currently passable for large adult salmonids during mean winter flow events. However, the 1999 inventory results suggest that the diversion dam may have been a partial barrier to Coho adults with the majority of the summer juvenile production observed below the dam (see Rock Cr. Coho Densities graphic). The status of adult Cutthroat passage is unknown.
  2) A 6 ft vertical bedrock falls at RM 3.6. This falls has a step pool pocket midway up and is passable for most anadromous adults during mean winter flows. The falls has however, terminated anadromous distribution during years of low flow and low abundance (see Rock Cr. Coho Densities graphic). Current salmonid distribution however indicates that the site is passable (see photo 2).

- Species and age class affected

  Both of these sites are partially passable (flow dependant) for adult Coho and Steelhead at mean winter flows. The natural falls is probably also passable to anadromous Cutthroat adults. Both sites are definitive barriers to the temperature dependant upstream migration of juveniles during low summer flows. Current temperature profiles suggest that upstream temperature dependant migrations of juvenile salmonids are probably not occurring at either location. Rectifying the diversion dam site location for juveniles would only increase the potential for upstream migration of juveniles by 0.5 miles because of the location of the natural bedrock falls upstream.

Identify potential sites for restoration work

- Location (See Restoration Site Map for these locations)
  1) Recovering wetland from East Devils Lake Rd. upstream to boundary of horse ranch (RM 0.8)
  2) Entrenched / exposed pasture land from downstream boundary of horse ranch to forest interface (RM 0.8 – 1.6)
  3) Isolated historical wetland with evidence of old meander channels on Fox property (RM 1.2 – 1.6)
  4) Lower Anchor site location
  5) Middle Anchor site location
  6) Undersized culvert on mainstem at horse ranch at RM 0.9
  7) Concrete water diversion dam at RM 3.1
  8) Priority 1 slopes from ODF risk analysis in headwaters of Trib A

- Problem
  1) Limited vegetative diversity, probable location of channel manipulation and historical draining efforts
  2) Lack of sinuosity, lack of wood complexity, loss of floodplain interaction, limited canopy, limited riparian protection from livestock, undersized culvert at horse ranch
  3) Reduced ecosystem function, limited water retention in abandoned wetland, reduced summer and winter rearing capacity, simplification of multiple habitat strata (aquatic, terrestrial)
  4) Low instream wood complexity, active channel abandoning its potential for floodplain interaction
  5) Moderate instream wood complexity, active channel abandoning its potential for floodplain interaction
  6) Culvert restricts flow and stream flows over road bed during high winter flow events, site increases hydraulic impacts on adjacent stream banks and riparian, culvert does not impact adult or juvenile passage at any season
  7) Active manipulation of structure elevation with dam boards may terminate anadromous adult Cutthroat migrations, definitively terminates juvenile salmonid migrations, may impact natural migration of spawning gravel resources required to replenish scoured habitats downstream. In addition, inventory data suggests a potential barrier may exist for adult Coho on years of low flow.
  8) Natural recruitment of wood resources have been reduced by shortened harvest rotations, the loss of this wood component has led to reductions in channel and floodplain interaction that is critical for the provision of salmonid habitat.

- Goal
    1) Maintain current recovery trajectory
    2) Initiate long term recovery of riparian function for the provision of shade and future wood recruitment
    3) Restore ecosystem function, increase the abundance of both summer and winter habitat by initiating wetland recovery
    4) Increase floodplain interaction for the provision of low velocity winter refuge and boost summer rearing complexity
    5) Increase floodplain interaction for the provision of low velocity winter refuge and boost summer rearing complexity
    6) Reduce local erosion and provide unimpeded movement of substrates and migratory wood
    7) Remove manmade structure that has been abandoned to facilitate the restoration of substrate migration and reduce the risk of potential impacts to salmonid migrants.
    8) Begin to restore the long term natural function of the basin by developing prescriptions that provide a long term source of large wood on high risk slopes in the basin. Prioritize these sites by there ability to deliver materials directly to identified anchor habitats in the basin
- Method
    1) Investigate the potential for acquisition to secure current recovery trajectory into perpetuity
    2) Propose culvert replacement, riparian fencing, riparian planting. Seek long term recovery and ignore the short term instream prescriptions because of the risk of significant channel diversion.
    3) Propose reconnection of historical meander channel and wetland development, includes planting and some instream wood placement to maintain reconnection
    4) Propose significant instream large wood placement (Helicopter)
    5) Propose significant instream large wood placement (Helicopter)
    6) Replace Culvert with full spanning bridge or properly sized culvert
    7) Removal by track excavator
    8) Explore acquisition, exchange, carbon banking, conservation easement, etc.
- Expected problems
    1) The relationship between the East Devils Lake road causeway and the recovering wetland ecosystem above the causeway are integrally linked. The existing road bed restricts and impounds winter flows creating an expansion of existing wetland habitats through silt deposition and impoundment. This relationship has been positive for juvenile salmonids seeking low velocity winter refuge in complex wetland habitats. Any proposed acquisition needs to consider the long term impacts to the current wetland habitats that would result from any proposed maintenance or reconstruction of the East Devils Lake Rd.
    2) Wood placement in this section could easily alter the current location of the active channel
    3) Deep entrenchment of the current active channel will require some level of large wood placement to maintain connectivity to the restored wetland surface area. The diversion could require additional long term maintenance
    4) Very low risk, no problems anticipated
    5) Very low risk, no problems anticipated
    6) Current restriction may be reducing active channel entrenchment for a short distance upstream due to impoundment and deposition, alteration may exacerbate entrenchment locally
    7) Impoundment above dam is currently providing a large surface area of both summer and winter habitat for salmonids that is rated as very high quality, removal would reduce the surface area of the habitat that is currently limiting salmonid production (summer pool surface area). Removal would also increase sediment delivery in the short term to the lower basin, this impact would be confined to the day of implementation and to a series of days during the first fall freshets.
    8) New approach, new partnerships, significant commitment of time for orchestration.
- Expected results
    1) Development of a diverse and highly complex coastal spruce wetland that offers niche habitats for many aquatic, terrestrial and avian biota.
    2) Restore long term riparian function to a reach that has had the majority of the historical impacts. Resulting in shade, vegetative bank stability and future wood recruitment resource.
    3) Development of large surface areas of complex aquatic habitats (both riverine and wetland). Restoration of sinuosity and vegetative complexity
    4) Large increase in floodplain interaction resulting in increased winter habitats for juvenile salmonids and complex woody components for providing summer cover.
    5) Large increase in floodplain interaction resulting in increased winter habitats for juvenile salmonids and complex woody components for providing summer cover.
    6) Minor positive increases in hydrologic function that allows natural migration of wood and substrate resources
    7) Restore hydrologic function to substrate migrations and remove potential impediments to any salmonid migrations
    8) Restore natural process to those sites that exhibit the greatest potential for delivery

Document potential restoration sites with photos

1) No photo
2) See Photo #6
3) See photo #5
4) See photo #7
5) See photo #8
6) See photo #3
7) See photo #1
8) No Photo

List and rank the factors currently limiting Coho production

- Include professional judgement of potential lowland habitats existing outside the boundaries of the 6th field analysis for the provision of winter habitat

A limiting factor analysis was completed utilizing Version 5.0 of the ODFW Carrying Capacity Model provided by Tom Nickelson of the ODFW Research Division. This analysis relies heavily on the summer data collected utilizing ODFW's Aquatic Habitat Inventory protocol and on inventories conducted by Bio-Surveys to assess the quantity and quality of available spawning gravel in the system. The spawning gravel surveys only measured gravels that were located in areas known to be utilized by Coho for redd development and gravels that were the appropriate size for adult Coho. Three categories of gravel quality were utilized that visually assessed the abundance of sediment and fines in the gravel. Gravel quantities in the Good category were multiplied by a coefficient of 1.0, for gravels in the Fair category we utilized a coefficient of 0.5 and for gravels in the Poor category we utilized a coefficient of 0.25. This step in the analysis was utilized to adjust the actual quantities of gravel utilized in the carrying capacity model. Consultation in the literature suggests that these coefficients are optimistic and may still tend to overestimate egg/fry survival rates in the degraded systems that dominate the Oregon Coast Range watersheds.

The results of this modeling effort are presented in the appendix. Note that two sets of life stage to smolt survival rates are presented in Table B1 and B2. These represent the vastly different ranges in life history budgeting that exist in the literature. One is the ODFW Research model which assumes a 70% egg/fry survival rate and the other is the Alsea Watershed Study model that utilizes a 42.5% grand mean for egg/fry survival.

The output tables from each of these models are presented in Tables F1 and F2. For the Rock Cr. system you will note that even though production capacity values differ between each of the models, they are in agreement that the abundance of summer rearing habitat is the dominant factor currently limiting Coho production.

This assessment suggests that given adequate adult escapement to utilize the spawning gravels currently available within the range of Coho distribution, that the 1)abundance and 2)quality of summer pool habitats would be the primary and secondary issues limiting Coho production (we are assuming that optimum temperature regimes in the available summer habitat would result in higher summer densities).

Rank the list of restoration efforts

- 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.

- Short Term (prioritized)

  Item #
  4
  5
- Long Term (prioritized)

  Item #
  1
  3
  7
  2
  6
  8
- Combined prioritization

  Item #
  1
  3
  7
  4
  5
  2
  6
  8

Explain how the modifications will interact and increase production

- Primarily relevant to modifications that effect passage. An estimate of increased production should be developed for all habitats where access to salmonids has been denied or compromised. This will facilitate an evaluation of cost /benefit and assist in the development of prioritized culvert replacement program

The only proposed restoration opportunity that deals with passage is Item # 7 (Concrete water diversion dam). Passage for adult Steelhead is probably not affected with or without the dam boards in place. Passage for adult Coho may be compromised during years of low winter flow regimes. The dam may also affect adult Cutthroat with or without dam boards removed. The upstream migration of juvenile salmonids will definitively be terminated with or without dam boards in place. Upstream temperature

dependant migrations probably are not occurring at this location because of stream temperatures that stay below the threshold for salmonids throughout the summer. Therefore, the most likely condition for adverse impact is the retention of dam boards from August – May when adult Coho and Cutthroat are known to be migrating upstream for spawning or feeding. A lower risk of impact would be present with dam boards removed during this migration window. There is however a potential migration impediment at the dam site for adult Cutthroat during these months even with dam boards removed (unquantifiable risk).

- Modifications to Critical contributing habitats, riparian corridors and instream reaches will be difficult to quantify and will rely on existing evaluations of restoration activities

Assessment questionnaire

Morphology

- Describe the valley form, constraint, and floodplain.
  Three distinct reaches exist:
  1) Devils Lake to the forest interface (RM 0 – 1.6) Broad valley, no hillslope confinement, upper1/2 is terrace constrained, lower ½ is complex and interactive.
  2) Forest interface to the confluence of Trib C (RM 1.6 – 3.8) Moderate v slope, oscillating hillslope confinement, contains some interactive floodplains classified as anchor sites.
  3) Confluence of Trib C to the end of Coho distribution (RM 3.8 – 5.4) Narrow valley floor, opposing hillslope confinement common, contains some interactive floodplain classified as anchor sites.
- Assess the potential for the development of meander, braiding, side channel, alcove, backwater channel forms.
  1) Very high potential exists in manipulated and/or isolated wetland habitats for developing channel meander and backwater habitats
  2) Very high potential exists in identified anchor sites for the development of meander, braiding, alcove and backwater habitats
  3) Only minor potential exists for developing meander or braiding, moderate potential exists for developing backwater habitats
- What is the current status of development of these channel forms? Include a description of entrenchment as the alternate state.
  1) None of these positive channel form characteristics are developing in the upper1/2 of this zone. In fact channel entrenchment is classified as severe here with only a negative trajectory in sight. The lower ½ below the horse ranch, is recovering naturally with the help of the East Devils Lake Rd. impoundment and lack of agricultural utilization.
  2) Complex channel characteristics are highly dependant on riparian recruitment which has been accelerated in portions of this reach by wind throw associated with harvest activity. Near term increases in floodplain interaction are expected but the improved function will be short lived because the resource is primarily alder.
  3) There are currently very low levels of LWD to boost floodplain interaction. There are however some excellent riparian conifers positioned to be recruited in the future and recovering harvest units on USFS ownership provide a long term source of recruitment. The development of complex channel forms within the reach will probably be static in the short term and relying on natural debris flow cycles for significant recruitment.
- What proportion of the system's Coho production appears to be provided by this zone? Describe in terms of spawning, incubation, summer rearing, and winter rearing ability.
  1) This zone provides the overwhelming bulk of the available winter habitat in the system (not limiting). It provides significant summer rearing habitat (all the way to the lake) and very low levels of spawning substrate for Coho.
  2) This zone contains 3 of the 4 major tributaries, it provides approximately 20 % of the high quality gravel in the mainstem and the bulk of the pool surface area for summer rearing.
  3) This zone exhibits diminishing habitat surface areas for the provision of summer habitat. It contains the majority (80 %) of the high quality gravels available in the mainstem.
- List and rank the factors currently limiting the development of channel complexity.
  1) Zone 1: Low densities of instream LWD, no riparian canopy for recruitment, no roughness to encourage aggradation and interaction
  2) Zone 2: Low densities of instream LWD, Low densities of riparian conifers for short term recruitment.
  3) Zone 3: Low densities of instream LWD, hillslope confinement.
- Are these factors addressable through restoration work?
  1) Zone 1: Increased wood densities would elevate risk of channel meander in agricultural zone, wetland reconnection would locate and control meander.
  2) Zone 2: Wood densities could be boosted with a short term restoration prescription that injects large conifers into the active channel within the identified Anchor sites that have the potential for floodplain interaction.
  3) Zone 3: Wood densities could be boosted within identified anchor sites

Riparian corridor

- Describe the riparian corridor and its potential to provide wood. How long before recruitment?

1) Zone 1: Virtually no riparian exists. The majority of the reach is fully exposed. Only minor recruitment potential currently exists.
2) Zone 2: A nearly complete canopy exists from approximately RM1.6 – 2.9. From RM 2.9 – 3.8 there are alternating blocks of narrow riparian buffers that have blown down extensively. The lower ½ exhibits excellent short term potential for deciduous recruitment and the upper 1/2 is realizing it's recruitment potential now. Harvest units have been restocked and the long term potential is present and growing.
3) Zone 3: The riparian is well stocked and improving. Recruitment potential is static and storm driven.

- To what degree would land use and ownership allow restoration work?
  1) This zone contains agricultural livestock use.
  2) This zone is primarily industrial timber ownership
  3) This zone is primarily National Forest
- What is the potential to increase channel complexity in the long term through natural recruitment processes, with and without restoration?
  1) Without restoration, none. With restoration, limited.
  2) Without restoration, fair providing that harvest does not remove site potential trees. With restoration, excellent.
  3) Without restoration, fair providing that harvest does not remove site potential trees. With restoration, good.

Core Area

Anchor sites

- Do anchor site(s) exist?
  Yes
- If so, describe the location, dimensions, gradients, and salient habitat features.
  1) Lower 2,941 lineal ft, largest active channel width, greatest potential for increases in sinuosity, lowest terraces, lowest anchor in system for providing summer and winter refuge, moderate potential for improving gravel quality with wood loading. Current function rated as fair.
  2) Middle 3,088 lineal ft, moderate active channel width (Trib A & B contribute below this anchor), moderate potential for increases in sinuosity, some low terraces, highest potential for improving gravel quality with wood loading (higher gradient for effective sorting). Current function rated as fair.
  3) Upper 441 lineal ft, narrow active channel width (Tribs A,B,C,D contribute below this anchor), High potential for increase in sinuosity, current function rated as poor.
- Describe how the site contributes to spawning, incubation, summer rearing and winter rearing.
  1) 69 sq.meters of spawning gravel, high sediment levels in substrate, reduced egg/fry survival, good winter habitat potential
  2) 67 sq.meters of spawning gravel, moderate sediment levels, gravel good but not excellent, limited winter habitat
  3) 22 sq.meters of spawning gravel, moderate sediment levels, gravel is best in system but not excellent, limited winter habitat
- What proportion of the system's summer Coho production appears to be provided by this site?
  1) Moderate (may be related to under seeding)
  2) High
  3) Lower (reduced habitat surface areas)
- Rank the site in terms of each of these functions (abundance of pool surface area, spawning gravel, % of summer production).
  1
  2
  3
- Which function(s) limits the site's production potential, and what causes this limitation?
  1) high sediment loading in gravel resource, low wood densities to scour and sort
  2) Poor floodplain interaction, low wood densities to impound and accumulate
  3) Limited pool surface area, morphological restraints, hillslope confinement, gradient
- List and rank the restoration work at this site that would most effectively increase survival within the Anchor site and stabilize the core population at a higher base level.
  1) Large wood placement

Secondary Branch sites

- Do secondary branch site(s) exist?
  Yes

- If so, describe the location, dimensions, gradients, and salient habitat features.
  Trib A contains 29 sq.meters of spawning gravel, 4%
  Trib B contains 43 sq.meters of the highest quality spawning gravel, 4%
  Trib C contains 15 sq. meters of spawning gravel, 2%
  Trib D contains 32 sq. meters of spawning gravel, 2%
- Describe how the site contributes to spawning, incubation, summer and winter rearing
  Trib A- Always accessible for spawners, well sorted, low sediment, higher egg/fry survival than mainstem, limited summer pool surface area, no winter habitat.
  Trib B- Always accessible for spawners, well sorted, low sediment higher egg/fry survival than mainstem, highest quality gravel in system, limited summer pool surface area, no winter habitat.
  Trib C- Intermittently accessible to spawners, poorly sorted, high sediment, harvest legacy substrates, some summer pool surface areas because of low gradient, only minor abundance of winter habitat.
  Trib D- Intermittently accessible to spawners, poorly sorted, low sediment, limited summer pool surface area, no winter habitat.
- What proportion of the system's summer Coho production appears to be provided by this site(s)?
  During the 1999 inventory only 6% (545 juveniles) of the summer Coho production was observed rearing in Tribs A and B. Tribs C and D were above the extent of Coho distribution. We know that during the 2003 surveys that Coho are present in both C and D and that Tributary contribution will be slightly higher numerically.
- Rank the site in terms of each of these functions (abundance of pool surface area, spawning gravel, % of summer production).
  A
  B
  C
  D
- Which function(s) limits the site's production potential, and what causes this limitation?
  A – Pool surface area, flow and morphology
  B – Pool surface area, flow and morphology
  C – High sediment levels, wood density, harvest legacy
  D – Pool surface area, flow and morphology
- List and rank the restoration work at this site that would most effectively increase survival and stabilize the Core population.
  1) Protect water quality (temperature, reduce delivery of inorganic compounds during incubation)

Critical contributing areas

- Do Critical contributing areas exist? Yes
- If so, describe the location, dimensions, gradients, and salient habitat features
  ODF slope failure risk assessment has identified 15 separate critical contributing areas in the basin that exhibit varying degrees of slope failure potential for the natural recruitment of wood and substrate resources. See ODF risk assessment map for locations and prioritization's.
- How is each CCA related spatially to the Core and it's Anchor sites?
  Site 1 - The highest priority site exists in the head waters of Trib A. This site delivers to the highest priority anchor site location (Lower) The site has not been ground truthed, CLAMS vegetative layers suggest that there are residual pockets of later successional conifers within a general landscape of early successional conifer.
  Site 2 – Delivers to the middle anchor site and exhibits the good potential for direct resource delivery. The tributary has been completely harvested on the left bank and remains intact on the right bank
  Site 3 – Is a steep stream adjacent slope that delivers directly to the middle anchor site, The site has been partially harvested and currently exhibits only minor potential for wood recruitment.

  The other 12 sites identified are within National Forest Ownership or are classified as indirect contributors to the Core. These sites are inherently lower priority because the likelihood of delivery to actual fish bearing portions of the subbasin is lower.

Lowlands outside the 6th field subbasin

- Do lowland habitats exist that could function as potential winter habitat for Coho?
  Yes. Lowlands are a dominant feature within the Rock Cr. basin. They have been included in this assessment and have not been excluded in any of the limiting factors analyses.
- If so, describe the location, dimensions, gradients, and salient habitat features.
- What is the spatial relationship of the lowland habitat to spawning and incubation sites in the watershed?
- What are the problems associated with the abundance, location or condition of these lowlands