APPENDIX A

Site Specific Restoration Plan

GRAYBACK SUCKER RESTORATION PRIORITIZATION

TEAM RECOMMENDATIONS SUMMARY

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Key Findings and Recommendations

1. The Team was able to gain consensus on objectives quite readily; consensus on treatments was a bit more elusive, but a great deal of common ground exists.

2. Vegetative treatments center on density management; key areas include previously treated stands located within or adjacent to habitat connectors and intact patches of interior habitat. Interior habitat maintenance is also an issue. Use of fire as a tool for density management was the preferred tool by some, and the last choice for others.

3. Lower Grayback Creek is the primary location identified for in-stream fish improvements, placement of whole trees is recommended. One member disagreed, all were concerned about environmental effects associated with the wood source. There are also some smaller opportunities in Bolan Creek and some diversion of high flow opportunities along the mainstem of Sucker near Cave Creek.

4. The road system is currently at high risk of damage associated with large storm events. Diversion potential correction is the preferred solution where obliteration is not feasible. Roads recommended for this are: 4611 (Grayback), 4611-070, 4611-079, 4612-098 (Upper Sucker), 4613 (Buck Pk), 4614-017 and 4614-024. 4612-080 past Left Fork is recommended for obliteration. There was no group consensus on the obliteration.

5. Vegetation treatments can be scheduled in a way that limits the need for high standard roads. There are many opportunities to complete commercial treatments that require lowboy access and then treat road template aggressively. (see list above).

6. The Team would like to see a moratorium on road-building, if this is not possible then minimize sediment production.

INTRODUCTION

This document contains the more detailed notes that accompany the November 15th memo addressed to the District Ranger regarding team recommendations and findings for the Grayback-Sucker restoration prioritization process. The document includes recommendations grouped by analysis areas, as well as some comments that cover the entire watershed.

SUMMARY OF APPROACH

Our group agreed that the best approach we could take in our attempt to prioritize restoration opportunities would be to focus on those activities which would best protect the ecological processes still functioning properly (or nearly so) in the watershed. This >protect the best= philosophy was a cornerstone for our work.

Secondly, while we recognized the interconnectedness of ecological processes, we felt that the only manageable way to work through this prioritization was to split into groups. We chose to focus on terrestrial processes, aquatic processes, and roads.

The terrestrial group used protection of large patches of interior habitat and the connecting land between those patches as the way to prioritize treatments. There is an accompanying document from that group that details their thoughts in more detail. Unfortunately, modeling of historic nor potential wild and/or prescribed fire was not included in this process. Therefore, risk of changed conditions due to this important process is not included in the prioritization. This will be addressed in the iteration of the Grayback-Sucker watershed analysis 1.1.

The Aquatic group identified five stream reaches that contained important habitat and populations as the focal areas to protect. Geomorphic processes that joined hill slopes to streams were identified, critical areas are highlighted on accompanying maps. Recommendations about roads were the by-product of discussions based on terrestrial and aquatic processes.

The lack of readily accessible data on private lands, and the non-conformity of BLM vs. FS data on federally managed lands made it difficult to extend our efforts off of the FS base. We made some small progress towards integration, most notably in sharing information about BLM roads and in brain-storming about processes in the lower, privately-owned portion of the watershed. Details regarding the lower portion of the watershed follow the sub-basin descriptions in this document.

DESCRIPTIONS OF THE SUB-BASINS

Each Sub-basin discussion is structured as follows: fish, gemorphology, vegetation, mining, land allocation, unique features, roads.

The District Ranger directed the group to document those areas of consensus and those areas of disagreement. In general, the statements listed below are those around which there was consensus. One team member asked to go on record as disagreeing with any road decommissionings. Several team members disagreed about the cutting of trees larger than 20" in any situation, others disagreed with the removal of any wood from either previously managed stands or unmanaged lands.

Main stem Sucker, Fehley Gulch to Left Fork

This reach supports winter steelhead and trout. It is characterized by high sediment transport and no instream structures for fish habitat improvement are recommended.

Due to the presence of granitics and steep slopes, especially in the Tannen, Grizzly, Deadhorse drainages and on the ridge between Sucker and the Left Fork, there is a high mass failure potential in this sub-basin.

The Tannen, Grizzly, Deadhorse drainages contain the patches of vegetation identified as the highest priority to protect; there are few opportunities to treat vegetation to improve mature and older forest characteristics.

Land allocations are mixed, both matrix and late-successional reserves are present.

Mining claims are present along the Main stem and several tributaries.

Road 4612-098 has a large number of pipes with diversion potential. Data also indicates that the spacing between drainage pipes (stream crossing and ditch relief) is high (widely spaced).

The group recommended that a physical scientist and an engineer review potential side cast conditions on 4612-098 immediately above the first bridge.

Left Fork Sucker

This reach supports primarily winter steelhead and trout, with some coho salmon in the lower reaches. There are no instream structures recommended in this reach.

This sub-basin has the highest percent of land at risk for mass failure in the Grayback Sucker watershed.

There are several plantations that are contained in and/or adjacent to mature forest patches that are high priorities for treatment. Some of these stands are of commercial size, some are pre-commercial. There is good consensus that it would be best if the stands were encouraged to grow larger trees more quickly. There was some concern about the use of fire due to smoke and potential health effects. There was also some disagreement about considering the removal of commercial sized trees from plantations as restoration. The group did agree that cutting of trees would spur others to grow, but some members preferred to leave the wood on site.

There are a fair number of Port Orford Cedar trees which are currently uninfested on the Main stem of the Left Fork. Some group members advocated closing the 4612-080 road as the best way to protect these trees from infestation. There was no consensus on this.

There are some mining claims along the lower portions of the Left Fork.

The land allocation includes matrix and late seral reserves.

Road 4612-080 has few pipes with diversion potential, but pipes are widely spaced. Placement of additional pipes should be considered. Road 4614-048 has 50% of its stream crossing pipes with diversion potential and widely spaced ditch relief pipes. Road 4612-080-472 has 33% of its stream crossing pipes with diversion potential.

Bolan

This stream does not support high numbers of fish, although it does support some winter steelhead and trout. Its most important feature is that is supplies clear, cool water to downstream reaches. It also appears to observers that it supplies a lot of water relative to other drainages of similar size.

This sub-basin has a low overall risk of mass failures with the exception of a high risk location in deep metamorphic soils where the two forks of Bolan join.

There is a large interior patch in this sub-basin. There are three stands that are high priority for treatment.

There is a stand of Port Orford Cedar near the bottom of Bolan Creek that some team members felt would be best protected if the road that crosses lower Bolan was closed. Some team members believe that road is no longer driveable and felt there would be little trouble meeting this suggestion.

The land allocation is a mixture of partial retention matrix and late successional reserve.

There is a mining claim along lower Bolan.

There was no field data collected on the roads in Bolan creek, nor were any culvert spacing calculations performed. In general, the roads in this drainage perform well during storm events and there was little emphasis given to this watershed in regards to the road network.

<u>Main stem Sucker, Left Fork downstream to Johnson Gulch</u>

High numbers of winter steelhead and trout in this reach, with marginal coho and chinook habitat and populations. The upper portions of this reach are best. Water quality is good, the reach is dominated by bedload transport and the presence of bedrock outcrops.

Mass failure potential is fairly low, Yeager Creek has a few locations with higher risk of failure.

There are several stands suggested for treatment within this sub-basin, including those along the riparian of Yeager Creek. These riparian stands are of especially high value due to the rarity of opportunities for low to mid elevation stands adjacent to mature forest patches.

Land is this sub-basin is managed by both the BLM and the FS, a mixture of LSR and matrix lands are present.

Mining occurs along Main stem Sucker in this reach.

The group recommended that the road system in upper Yeager be reviewed for opportunities to limit the risk of spread of POC root disease.

<u>Main stem Sucker, Johnson Gulch to Grayback</u>

This reach has the highest concentration of spawning coho in the Rogue. There is good potential for additional fish numbers, but habitat is heavily impacted from mining. *The team recommends that we try to influence mining operation designs such that activity is confined to small portions that are subsequently reclaimed prior to moving to a new area to mine. An opportunity to create a low flow channel was also identified, the location is shown on accompanying map. Flood plain revegetation with hardwoods was recommended.*

There are very few acres that are considered to be at a high risk of mass failure in this reach.

There are two low elevation stands adjacent to a large mature and old growth patch that are a high priority for treatment.

The land allocations are late seral reserve on FS-managed lands and matrix on BLM-managed lands.

Road 4612-013 was damaged in the January 1995 storm. There is no known on-going damage, but the road is not passable for its full length.

<u>Cave Creek</u>

Coho are present in the first 0.5 mile of Cave Creek, steelhead use the creek beyond this point. No anadromous fish habitat improvement work is recommended.

There are a few acres of high risk of failure ground in Cave Creek. Cave Creek has been subject to debris torrents in 1964 and in 1997.

There are numerous stands that are high priorities for treatment located along roads 4614-017 and 4614-024. These roads are also a high priority for road treatment as they have many plugged pipes and are located on soils that pose a high erosion risk (decomposed granitics). *The team recognized this area as a point of contradiction where two resource areas had strong needs that did not compliment each other.* Road storm proofing is planned for these roads in 1998.

There are also large stands that connect patches >e= and >g= (see map) that are a high priority for treatment.

POC occupies a fairly long, continuous, currently uninfested portion of the riparian area in upper Cave Creek. There is an infestation that includes the first tributary on the west facing bank downstream from the campground, and goes down Cave Creek from there.

Land allocation in Cave Creek is late seral reserve.

The Cave Creek Campground and the Caves National Monument are two unique features.

Roads 4614-017 and 4614-024 have already been discussed. Additionally road 4611-070 from Pepper Camp to Bigelow Lakes is mapped as a high risk road. Failures have occurred here in past storms. There are 7 sites associated with the January 1, 1997 event. *Subsequent to the team process, the hydrologist proposed that rather than repair the road, that it be decommissioned and turned into a trail. This proposal went out for public comment in January 1998.*

<u>Grayback</u>

There are Coho present in Grayback in the lower reaches below Whiterock, they are occasionally seen up to Mossback. Steelhead occupy the channel all the way to the Fan, Elk, Little junctions, and use lower portions of Whiterock. *The team recommends that the fish passage barrier (culvert) at Windy Creek be changed to a pipe arch to open up habitat. Instream bundles for fish cover are also recommended. Large wood is also considered to be of value in lower Grayback. One team member disagreed; concerned largely about the source of such wood and bridge safety.*

Some local miners have agreed to use their suction dredges to clear the recently deposited silt out the previously excavated coho alcove in the lower floodplain.

Riparian Meadows along lower Grayback: some of these are seeding in and will go back to trees. There are some opportunities to plant trees along the stream side edge.

The headwater drainages of Elk, Fan, Little and Jenny Creeks contain the land with the greatest risk of mass failure in the Grayback watershed. Numerous failures have occurred here in large storm events, January 1997 was no exception.

There is a very high percentage of Whiterock Creek in lands that are considered to be at high risk of mass failure. Limited field reconnaissance in this watershed indicates that much of the basin is occupied by large deposits from ancient failures, these sites are very productive in terms of growing vegetation.

There are MANY stands that are a high priority for treatment in the upper Grayback area. The team reviewed these on a road by road basis as part of our objective in this area was to look for opportunities to reduce road mileage or alter road templates in a way that reduced effects and costs associated with large storm events.

> 4611-988. Most stands have been treated and it is estimated that it will be 20 years until the next commercial opportunity. *The team recommends that this area be carefully reviewed by a silviculturist for opportunities.* This road has a low watershed risk, but a high value for closure/ mitigation due to POC.
>
> 4611-079. Road 988 comes off of this road, so any treatments needed there should be considered in conjunction with this road. There is a large stand, 40020066, located along this road. This is a very high treatment priority. There is one moderate priority stand 40020063 and a low priority stand 40020079. There is a strong need to remove or storm proof this road from a physical science perspective, 70% of the pipes on this road have diversion potential. Some team members felt road closure was very important for POC, others disagreed as the road is blocked for travel during much of the wet season due to snow drifts.
>
> 4611-070. This road traverses ground that includes habitat connections whose land allocation is matrix. This makes treatment here a lower priority from a wildlife perspective as we will not be able to maintain mature and old-growth conditions on these sites over long periods of time. Stand 40010004 is presently available for commercial thin. The remaining stands accessed by this road are of moderate priority. This road is the primary escape route in case of a fire in the Caves N=tl Mon. 95% of the pipes on this road have diversion potential, making it a very high priority from a physical science perspective. *However, because the road is needed, the team recommends storm proofing (diversion protection most likely).*
>
> 4611-063. The majority of the stands along this road are 10-15 years away from commercial treatment. The bottom of stand 40050064 was originally accessed using the 063 road, and the

road may be needed again to treat those acres. *The team recommends that a logging engineer review this site.* This road is a high priority from a physical science standpoint due to a high number (83% of pipes) of potential diversions, past (and present) failures, and a large distances between drainage pipes.

4611-063-970. This spur road accesses the heart of the connectivity in Grayback. There are 3 large stands ready for commercial entry: 40050005, 40010027, & 40010028. These stands are highly dissected by stream channels. *The team recommends field review of these units by an IDT as soon as feasible.*

4611-078. This road accesses stand 40010017 which is a high priority for commercial treatment. Once this treatment is complete, the team sees little reason for this road in terms of forest management for 20 years or so. The risk analysis does not indicate a high potential for failure, but Dave Patton, a long time employee, has seen failures on this road in the past. *The team recommends field review as soon as feasible.*

4611-085. This road had little interest from any team member.

4611-079 out to Williams. There are no vegetation treatments recommended along this stretch of road, aside from planting the deposit portion of the debris avalanche from the January 1, 1997 storm. There are a high number of historic failures on this road. *Storm proofing is recommended as the road is a connector and access matrix and therefore decommissioning did not appear to be an option.*

4611-955. There are no vegetation treatments recommended along this road. *The team recommends that this road be field reviewed for possible hydrologic and stability concerns.*

4611-019. Stand 40050039 is a high priority for treatment, stands 40050034, 40050032, 40050035 are moderate priority for treatment, and stands 40050127 and 40050079 should be considered for potential for pine restoration. If all of these stands are treated shortly, then the road could be heavily storm proofed. Decommissioning was not seriously considered as the road accesses privately owned timber land. POC would benefit from road closure or other mitigations.

4613-015. There are several stands who would benefit (moderate priority) from a pre-commercial treatment. There would then be a 30 year period where the road was not needed for forest management and could be heavily storm proofed. Decommissioning was not discussed as the road does not rate as a high risk to watershed resources. The stream crossing pipes on this road are covered with very little fill (flat ground at crossing). This may be a good opportunity to pull pipes so that during the 30 year hiatus we could reduce maintenance costs. It would be relatively inexpensive to put pipes back in when needed.

4613. There are 3 high priority stands along this road; 40050341, 40050069, 40050051. Stand 40050116 is of moderate priority.

4613-953. Stand 4005022 is of moderate priority. This road traverses private ground.

4611. This main road accesses much of the basin, including private land. The team discussed the potential for decommissioning. There was strong support for decommissioning due to location of the road in the riparian zone. The realities of decommissioning such a large, heavily invested and heavily used road, however, precluded this recommendation from being made in any formal way. There was no consensus on decommissioning. There are existing funds collected through KV (timber sale) to storm proof this road.

Little Grayback

There are coho in the lower reaches of Little Grayback and steelhead up further.

There are few acres in Little Grayback that pose a risk of mass failure.

There are two stands in the habitat connector that goes up Lake Creek, 40050043 and 40050019, these need to be field reviewed, but appear to be high priority through this analysis.

There were no Forest Service road segments reviewed in this watershed for this analysis. The BLM is contemplating, pending permittee contact, obliteration of 0.5 miles of road and upgrade of approximately 1.5 miles in this watershed.

Bear

Coho are present along Lower Bear Creek, this area has been field identified as very critical. *There is a diversion ditch that has no screen that the team recommends the local watershed council consider aiding the landowner in design and installation.*

There were no stands identified for treatment in this watershed due to incompatibilities between FS and BLM data.

The BLM is contemplating, pending permittee contact, obliteration of approximately 3.5 miles of road in Bear Creek.

ECOMMENDATIONS TO PRIVATE LANDS

The team did not systematically review the existing situation on private lands. Local experience of team members, however resulted in the following list of critical considerations as society looks for opportunities to improve watershed conditions on privately-held lands.

Pine-Oak Savanna. Much of the valley flat was historically dominated by this fire-dependant plant association. These plants are easily out-competed by vegetation that is more effective at gaining access to limited summer-time moisture (firs, cedar, brush). Restoration of these species on appropriate sites is desired.

Slow Water Habitats. The low gradient reaches of Sucker (below Grayback) offer unique habitat for fish and other aquatic organisms. Most critical are those channels that offer slow moving water during periods of high flow, these locations often offer cool, complex habitat during low flow also. Preservation and expansion of this habitat component in Sucker Creek is crucial.

Riparian Forests. The riparian forests of Sucker Creek have not been systematically inventoried. A more thorough understanding of their extent and character would aid in management of this outstanding resource. It is likely that due to fire exclusion, opportunities exist to treat these stands in order to ensure their long term health and productivity.

Port Orford Cedar is an important and unique species in our riparian forests. The area downstream of Grayback Creek is infested with the root rot disease that attacks this species. POC sanitation and other techniques may preserve individual trees.

Non-native Vegetation. There are locations where aggressively growing non-native vegetation is out-competing native trees and other vegetation on the valley flat. Control of this non-native vegetation, including noxious weeds, is recommended.

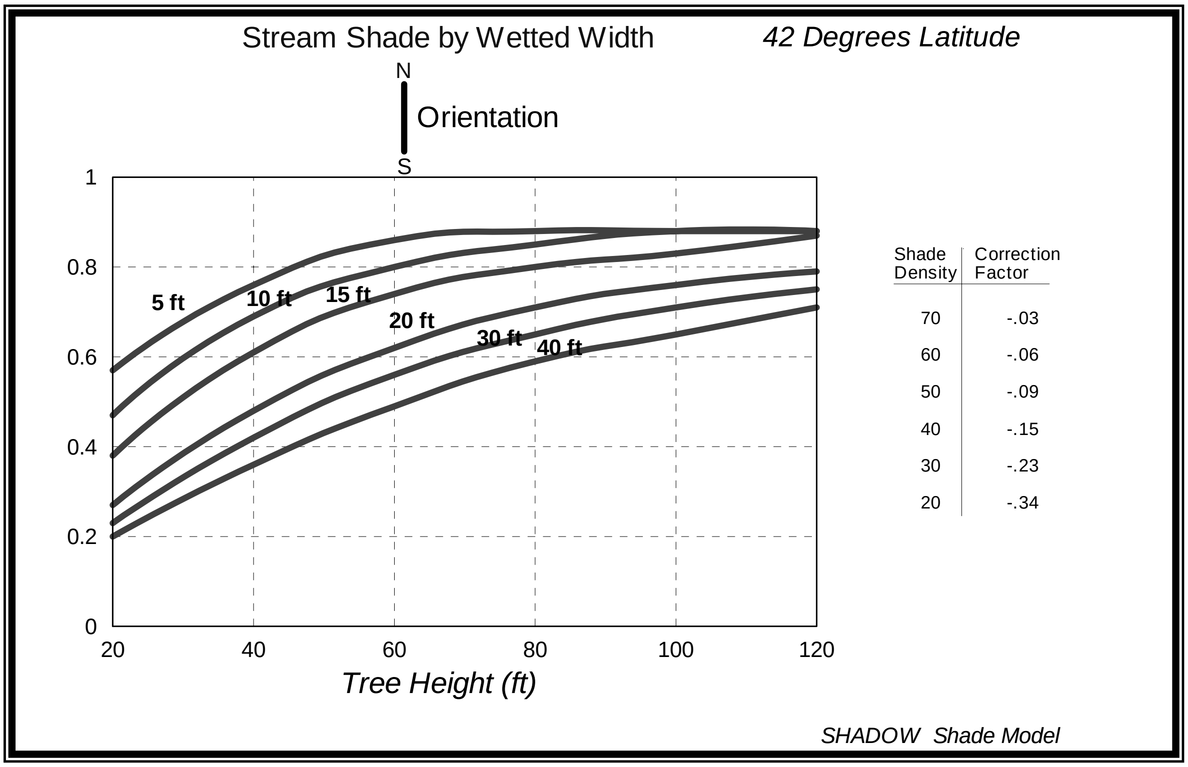
Roads. Diversion of natural stream courses by privately or county-owned roads is believed to occur throughout the watershed. Correction of these problems such that channels are in equilibrium with the historic water balance is desirable.

Erosion of fine-grained sediments and subsequent delivery to channels is believed to occur throughout the watershed. Road drainage improvement such that this erosion is minimized is desirable.

Mining. Mining along the floodplain of Sucker Creek above Grayback could potentially be conducted in a manner that disturbed small portions at any given time. The feasibility of this approach would have to be decided in concert with the mine operator and the Division of Geology and Minerals Industry.

APPENDIX B

Shade Estimation


Stream Shade by Wetted Width
42 Degrees Latitude
N
Orientation
S
5 ft
10 ft
15 ft
20 ft
30 ft
40 ft
1
0.8
0.6
0.4
0.2
0
20
40
60
80
100
120
Tree Height (ft)
Shade Density
Correction Factor
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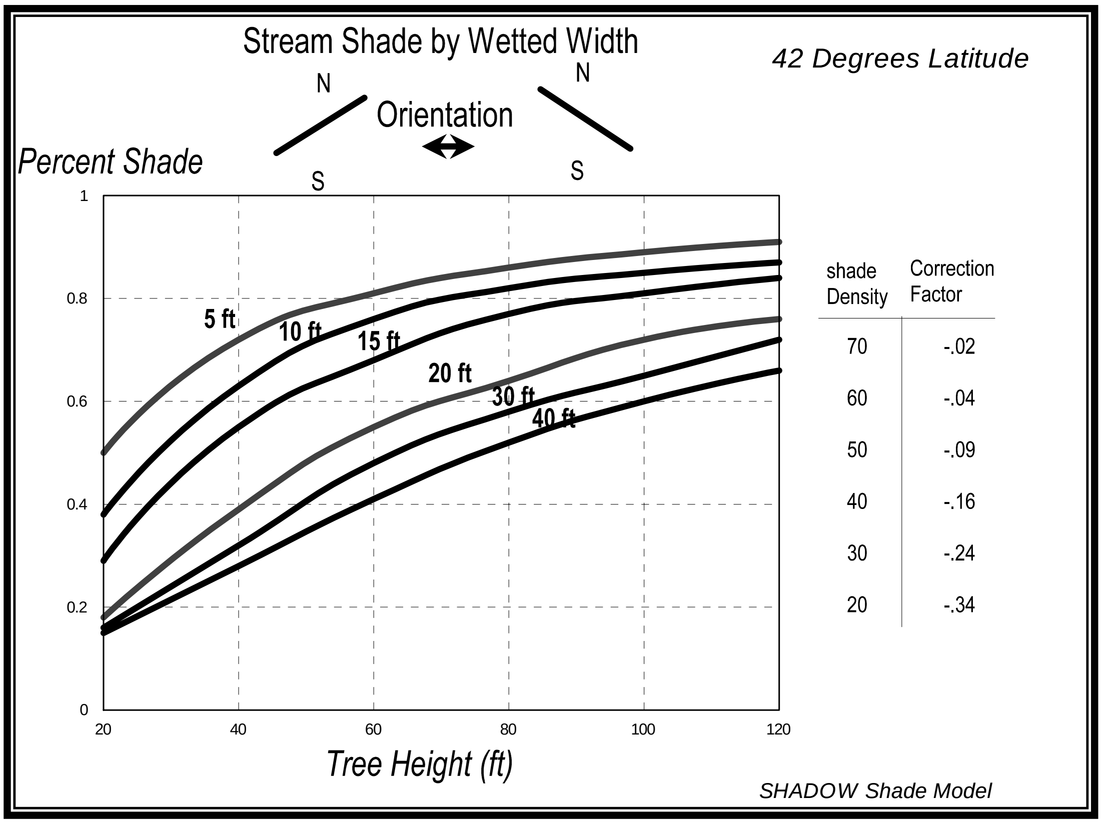
60 -.06
50 -.09
40 -.15
30 -.23
20 -.34
SHADOW Shade Model


Stream Shade by Wetted Width
42 Degrees Latitude
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N
Orientation
S
S
Percent Shade
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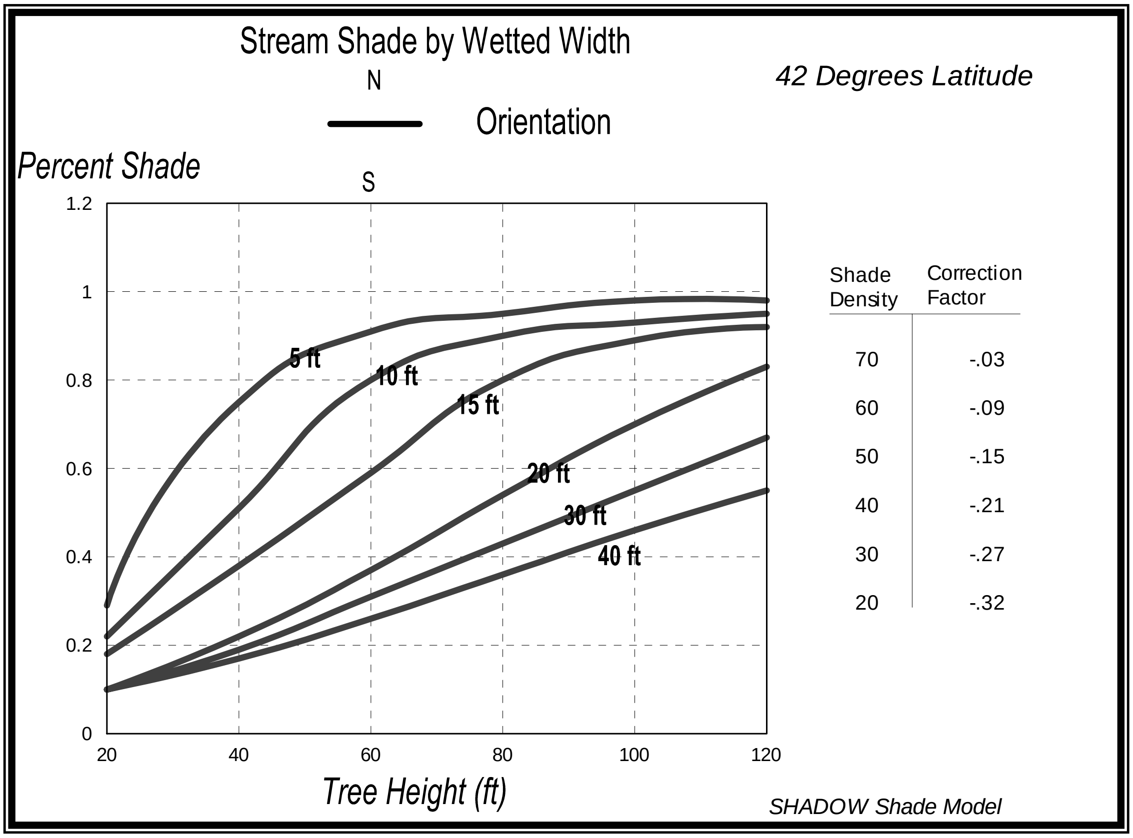
0.8
0.6
0.4
0.2
0
5 ft
10 ft
15 ft
20 ft
30 ft
40 ft
20
40
60
80
100
120
Tree Height (ft)
shade Density
Correction Factor
70 -.02
60 -.04
50 -.09
40 -.16
30 -.24
20 -.34
SHADOW Shade Model


Stream Shade by Wetted Width
N
Orientation
S
42 Degrees Latitude
Percent Shade
1.2
1
0.8
0.6
0.4
0.2
0
20
40
60
80
100
120
Tree Height (ft)
5 ft
10 ft
15 ft
20 ft
30 ft
40 ft
Shade Density
Correction Factor
70 -.03
60 -.09
50 -.15
40 -.21
30 -.27
20 -.32
SHADOW Shade Model

APPENDIX C

Habitat Benchmarks

ODFW: AQUATIC INVENTORY PROJECT: HABITAT BENCHMARKS

TABLE 1

	POOR	GOOD
POOLS		
POOL AREA (%)	<10	>35
POOL FREQUENCY (Channel Widths)	>20	<8
RESIDUAL POOL DEPTH		
LOW GRADIENT-SMALL	<0.2	>0.5
HIGH GRADIENT-LARGE	<0.5	>1.0
RIFFLES		
WIDTH / DEPTH RATIO		
EASTSIDE	>30	<10
WESTSIDE	>30	<15
SILT-SAND-ORGANICS (% AREA)		
NORTHWEST/COLUMBIA	>25	<10
NORTHEAST	>20	<8
CENTRAL/SOUTHEAST	>25	<12
SOUTHWEST	>15	<5
GRAVEL (% AREA)	<15	>35
SHADE (Reach Average, Percent)		
STREAM WIDTH < 12 meters		
WESTSIDE	<70	>75
NORTHEAST	<60	>70
CENTRAL - SOUTHEAST	<40	>50
STREAM WIDTH >12 meters		
WESTSIDE	<55	>60
NORTHEAST	<40	>60
CENTRAL - SOUTHEAST	<30	>40
LARGE WOODY DEBRIS (15cm x 3m minimum piece size)		
PIECES / 100 m STREAM LENGTH	<10	>20
VOLUME / 100 m STREAM LENGTH	<20	>30
"KEY" PIECES (> 50 cm dia. & > ACW long)/100m	<1	>3
RIPARIAN CONIFERS (30m FROM BOTH SIDES CHANNEL)		
NUMBER >20in dbh/1000ft STREAM LENGTH	<150	>300
NUMBER >35in dbh/1000ft STREAM LENGTH	<75	>200

"Good" habitat conditions based on values from surveys of reference areas with known productive capacity for salmonids and from the 65th percentile of values obtained in surveys of late successional forests. "Poor" habitat conditions based on values associated with known problem areas and from the lower 25th percentile of combined data for each region.

APPENDIX D

Road Flood Damage Assessment

ROAD DAMAGE

KEY FINDINGS

Diversions

1. Diversion potential exists at many mid- & upper slope road/stream crossings. Diversion of intermittent or ephemeral streams resulted in some of the most extensive damage features.

2. Diversions greatly increase the effects of road failure sites. Comparison of three watersheds showed that diversions increased sediment delivery an average of 2 to 3 times over sediment that is delivered if the water is not diverted and erodes only the road fill at the crossing.

3. Ditch flow and diversions are often carried long distances where the road surface angle dips toward the cutbank. Some diversions were up to 1400 meters long.

4. Existing treatments aimed at preventing diversions may not be totally effective. One diversion with major effects occurred at a site where the road had a broad-based dip. A debris flow deposited material in the dip, and the flow diverted around it and down the road.

Debris Flows

1. Repair designs should account for future movement of landslides and reactivation of debris dams at many impacted sites.

2. Roads prisms often stop or significantly reduce the size debris flows. Inlet basins are typically completely filled with debris and sediment and the road fill eventually is eroded. Large wood was often captured at road crossings and was not delivered downstream.

Road Design, Maintenance, and Reconstruction Factors

1. Most forest roads have not been adequately storm proofed or armored to prevent severe erosion.

2. Several repairs made immediately after the storm were simple replacements of what failed and did nothing to prevent the likelihood of future failure (i.e. same size culvert, no diversion prevention measures). Many of the damage sites exposed old buried culverts at a lower elevation in the road fill, indicating that the sites had failed in previous storms.

3. There are ephemeral channels on each district that have no drainage structure where they intersect a road. Some of these caused road failures; others contributed to failures at larger stream crossings.

4. Small pieces of wood commonly initiated debris plugging of culverts[1].

1

5. Both number and size of failures increase with lower hillslope position.
6. Relatively few road failures can be attributed to inadequate maintenance. Where maintenance-related failures did occur, they were caused by rusted out pipes or live vegetation blocking culvert inlets or outlets [2].

Stream Channels

1. Road failures greatly increased storm effects on some channels, but left no visible effects on others.

2. Sediment delivery to streams from road damage varied by site from none to 100 percent. The average amount delivered was 75% of the total failed volume.

3. On Gold Beach and Chetco Districts little sediment was delivered directly into fish bearing streams. On the Powers District, 36 percent of sediment was delivered directly into fish bearing streams.

RESULTS & DISCUSSION

FAILURES:

The high flows generated by intense rainfall over a two-day period mobilized in channel sediment and wood, scoured stream banks, and triggered landslides that added more sediment and wood to the flows. As these high flows traveled downstream and encountered road crossings, they either passed through the drainage structure, exceeded the hydraulic capacity, or plugged culverts with sediment and/or woody material. Hydraulic exceedence and culvert plugging resulted in ponding behind the road fill, overtopping and eroding the road fill, saturating the fill and causing it to fail, or diverting of the flow and its transported material along the road. These mechanisms occurred at damage sites singly and in a variety of combinations. The effects of these “failed” crossings were road erosion, greater storm effects to downstream channels, diversion gullies, other damage sites downstream or down road, and landslides.

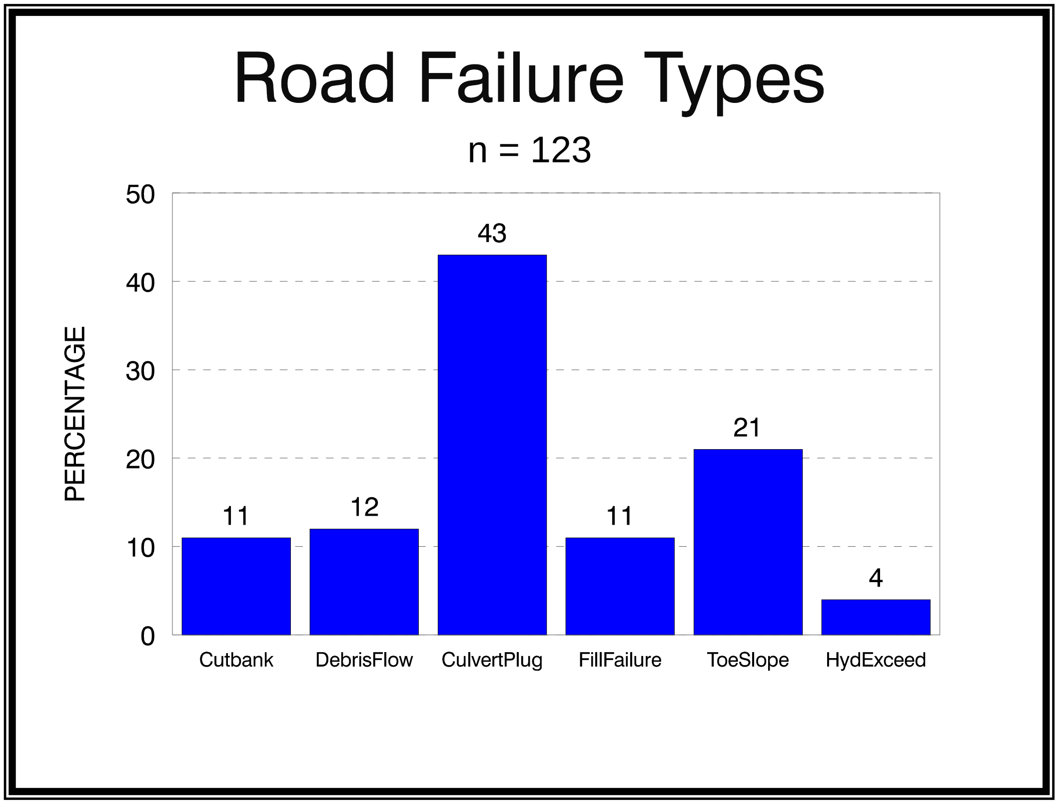
Where roads were constructed along the valley floor of larger streams, the high storm flows undercut the toe of road fills. The intense rainfall also saturated soils in road cutbanks and fills and caused failures that damaged roads.
Causes:
Road damage was typically caused by one of the following:

Cutbank failure
Pipe plugging by debris flow
Pipe plugging by sediment and/or woody debris
Saturated fill failure
Fill failure from stream scour at toe
Hydraulic exceedence

[2] Finding consistent with Region 6 “Pacific Northwest Floods of 1996" conclusions.

The vast majority of road damage sites were associated with culverts and stream crossings. At sites not associated with culverts, fill failures and cutbank failures were typically caused by saturated ground conditions and removal of toe support by either road construction (cutbanks) or stream scour. The failure types for the study area are shown in Figure 9.

The most common failure type was culvert plugging by sediment and/or woody debris (43%). The other common failure types were fill failure from scour by streams at the toe (21%), plugging by debris flow (12%), fill failure not associated with stream crossings (11%), and cutbank failures (9%).



Only 4% of culvert failures were attributed to hydraulic exceedence. However, hydraulic exceedence may have been the cause of more site failures than reported. Personnel on site during the storm reported that there was no material at the inlet of some culverts that they attempted to unblock with heavy equipment, but the flow was more than the culvert could handle. When they returned to the sites after the storm, material had been deposited on the falling limb of the hydrograph making it appear that sediment had blocked the inlet.

Another observed cause was ephemeral channels that crossed the road with no drainage structure. One ephemeral stream caused a road damage site; in other cases flow from ephemeral channels diverted and contributed to failures at larger stream crossings.

Factors Contributing to Failure:
Culvert plugging by debris, especially sediment, caused the most resource damage of all failure types (see Effects Section). In addition to the volume and size of sediment and woody debris

relative to the size of the stream channel and culvert, culvert plugging appears to be related to a number of design factors.

Examination of 35 of the sites found that 60% of failures by plugging had a significant break in slope between the upstream channel and the culvert and/or inlet basin. The decreased gradient of the pipe/inlet basin appears to induce sediment deposition and eventual plugging.

Pipe inlet configuration (protruding, beveled, etc.) and inlet basin configuration play a significant role in the plugging potential from both wood and sediment. Beveled inlets increase the inlet efficiency of the culvert and reduce the potential for wood to jam at the inlet. Funnel-shaped inlet basins increase the capacity of the culvert to transport flows, sediment, and woody material. A circular basin will create eddies that cause head scour, and align wood across the inlet, trapping sediment and plugging the culvert. Most culverts measured had inlet basins several times the width of the culvert, which would have contributed to their plugging.

Road fill failure from scour at the toe by streams was the most common failure type in watersheds with arterial roads paralleling streams. These type of failures are recurring on low elevation roads along the larger rivers and streams. The encroachment of the fill prism into the river valley eventually leads to erosion during infrequent, large storm events. For the arterial road in Elk River, similar failures were experienced in previous floods of 1955 and 1964.

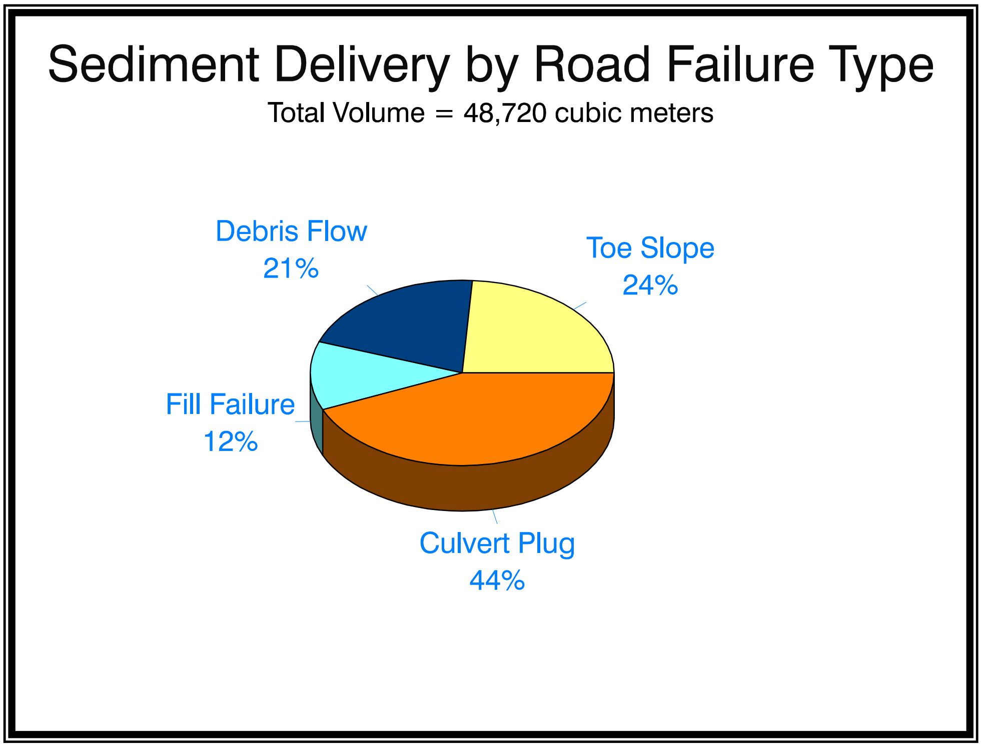
> Road construction on steep slopes within inner gorges creates high cutbanks which tend to become saturated and fail in large storm events or extended wet periods. However, no cutbank failure delivered significant sediment volume to any stream.

Failure Distribution:
At the watershed level, considerable variation occurred in failure causes and effects. A total of 123 sites were evaluated in the Powers, Gold Beach, and Chetco study area. Topographic position of the roads appears to have been a factor in both damage occurrence and extent. Nearly 50% of all failures were located within the lower hillslope position, primarily on roads constructed along major rivers such as the Elk and the South Fork Coquille. Road densities, failure locations, and slope positions will be analyzed in more detail when GIS data is available.

Diversions:
Diversions typically resulted in multiple plugging of ditch relief culverts, ditch scour, and landslides or hillslope gullies at the exit points, substantially increasing sediment delivery. Examination of the data within three of the watersheds showed that diversions increased sediment production an average of 2 to 3 times over the amount produced if the water is not diverted and erodes only the road fill at the crossing. Road crossings that survived debris flows with least damage had paved surfaces and no diversion potential. Paved surfaces minimized the amount of erosion caused by water flowing over the fill after the crossing overtopped. Lack of diversion minimized failure consequences by isolating damage to the fill prism at the stream crossing.

EFFECTS:

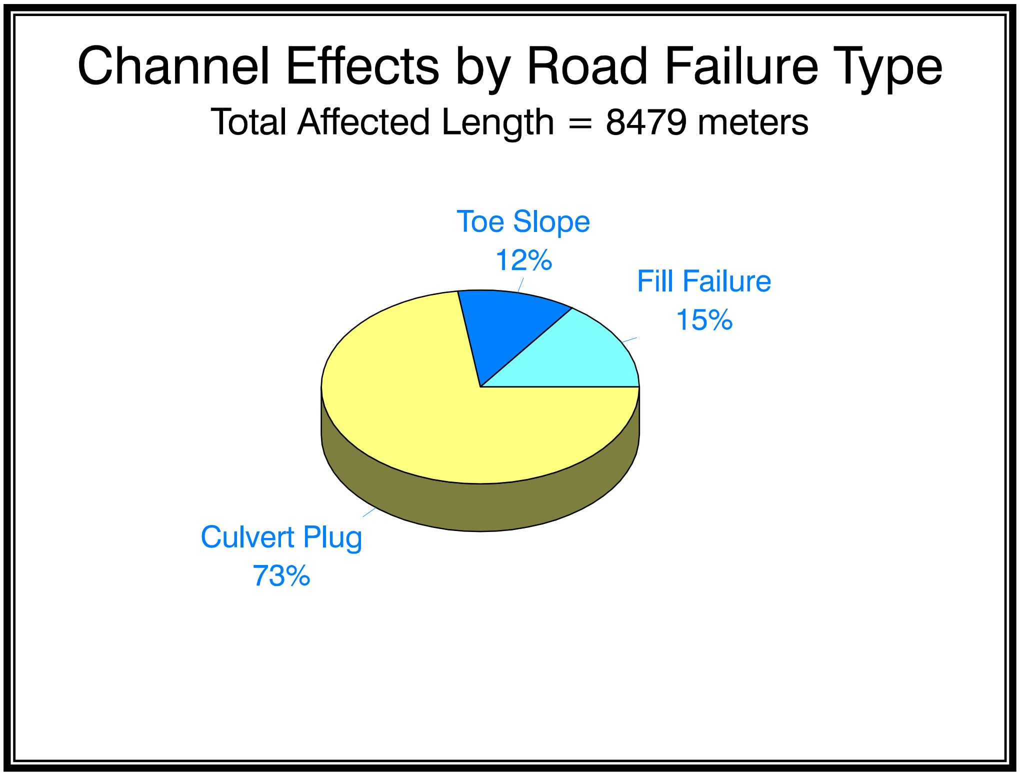
Sediment Delivery:
Road failures within the study area resulted in nearly 50,000 cubic meters of sediment being delivered to stream channels. On the Powers Ranger District, approximately 65 percent was deposited directly into small intermittent or perennial streams while the remaining 35 percent entered directly into high order fish bearing streams. On Gold Beach and Chetco Ranger Districts, little sediment was delivered directly into fish bearing streams.



Effects to Stream Channels:
Most of the sediment delivered to these streams was transported downstream from the point of delivery. Some was deposited behind log jams or wood complexes, some in gravel bars or terraces, some behind downstream road crossings. At all sites assessed, channels were surveyed as far downstream as the effects continued. Road crossing failures in the study area caused damage to nearly 8500 meters of small intermittent and perennial streams immediately below the failures. The stream types recording effects are relatively small, steep, non fish-bearing reaches that typically transport or temporarily store most sediment inputs with eventual deposition at lower gradient reaches in larger channels.

Upper Pistol, Quosatana, and Shasta Costa watersheds, none of the channels showed effects continuing downstream to the next larger flow category (i.e. intermittent to perennial, or perennial to fish-bearing). Undoubtedly, smaller material was transported to larger flow category streams, and some may have been deposited in flatter gradient reaches of these larger streams, and may have affected fish habitat. The storm triggered many natural landslides and inner gorge bank failures that contributed large volumes of sediment to streams. The relative contributions of road-related sediment and naturally generated sediment is unknown.

Damage to stream channels included degradation, aggradation, removal of riparian vegetation, bank scour, and initiation of stream bank slides. Effects varied considerably depending on the failure size, channel gradient, width, streamflow and bed features. As the stream gradient and depth of high water increased, so did the amount of channel degradation. At the same time, the amount of large woody material retained in the channel, either in complexes or scattered pieces, decreased. Figure 11 shows that the majority of channel effects (73%) were the results of plugged culverts. Measured response reaches in higher order fish bearing streams saw decreases in maximum depth and pool volume. See Fish Section.



Cascades:
An initial cause can affect another site, which in turn causes an effect at one or several additional sites, which become causes of effects at further sites. This type of chain reaction is referred to as "cascading effects" or "cascades." The characteristics of sites that experienced a complex series of causes and effects:

- Located within the high storm intensity or snowmelt areas.
- Steep hillslope (quantify after the field surveys are completed)
- More than one road on the hillslope
- Upper road generated debris flow by:
  - Drainage structure failed to pass bedload./wood transported by channel
  - Road cutbank failure
  - Road fill failure in headwall position
- Soils in streambanks and/or road cutbanks susceptible to undercutting by channelized flow

An example of a cascading failure is in the Rock Creek sub-watershed. A small landslide near the ridge entered an intermittent channel and plugged a 600 mm (24 inch) culvert. The stream diverted 60 m down the road, causing a large landslide to fail back into the channel. This landslide initiated a debris flow that destroyed two downstream road crossings, one of which diverted over 500 meters down the road and caused three other road fill failures. A schematic of the failure is shown in Figure 12. Erosional consequences are shown in the following table.

Length of Affected Channel	Delivered Landslide Volume	Delivered Road Erosion	Gully Erosion	Total Erosion **	Estimated Repair Cost
2020 meters	7000 cu.m.	4200 cu.m.	1900 cu.m.	13100 cu.m.	$363,000

** Erosion estimate does not include volume scoured from channel within debris flow track.

RECOMMENDATIONS:

Stream Crossings

1. Install driveable dips to eliminate diversion potential at road/stream crossings. Use ditch dams to further reduce the likelihood of diversions.

2. Upgrade undersized pipes to pass the 100-year recurrence interval discharge along with associated debris while minimizing adverse effects of eventual failure.

3. Reduce the magnitude of potential failures by decreasing fill size where appropriate.

4. Armor down stream fillslopes at crossings, where appropriate, to help prevent fill erosion during road overtopping.

5. Minimize the change in channel width at inlet basins. Narrow inlet approaches tend to align debris; wider basins set up lateral currents and encourage debris plugging.

6. Align pipes with the channel (horizontally and gradient).

7. Bevel pipe inlets to conform to the fill slope to transport streamflow and floating debris more efficiently.

8. Consider the potential for future debris flows or high sediment/debris loading when designing new stream crossings.

9. Consider wet fords in place of fill-intensive stream crossings with culverts.

10. Place culverts at all ephemeral channel crossings.

Erosion Control

1. Identify and treat unstable landing and sidecast road fills.

2. Prioritize storm proofing treatments in the upper watershed to reduce the likelihood of cascading failures.

3. Prevent long distance diversions, ditch flow and concentration of water by outsloping, where appropriate.

Location

1. Consider treating stacked road systems to reduced likelihood of cascading failures.

2.Design roads in the lower hillslope position recognizing the potential for more and larger failures.

APPENDIX E

Water Rights Information

SUCKER	GRAYBACK	WATER	USE
STREAM SEGMENT	**USE**	**CFS ALLOTMENT**	**TOTAL**
Sucker Creek to E Fk Illinois	Irrigation Fish/Wi Agriculture Industrial Domestic	48.30 0.18 0.01 16.99 0.04	65.52
Bear Creek to Sucker Creek	Irrigation	1.37	1.37
Green Creek to Bear Creek	Irrigation	0.31	0.31
Nelson Cr to Sucker Cr	Irrigation	0.02	0.02
Unnamed Str to Sucker Cr	Domestic	0.01	0.01
Little Grayback to Sucker Cr	Domestic	0.02	0.02
Unnamed Str to Sucker Cr	Domestic	0.01	0.01
Lake Cr to Sucker Cr	Domestic	0.18	0.18
Grayback Cr to Sucker Cr	Irrigation Industrial	1.12 1.00	2.12
Little Jim Cr to Sucker Cr	Industrial	0.80	0.80
Cave Cr to Sucker Cr	Irrigation Industrial Recreation	0.05 11.50 0.01	11.56
Panther Cr to Lake Cr	Domestic	0.01	0.01
Johnson Cr to Sucker Cr	Industrial	4.00	4.00
Yeager Cr to Sucker Cr	Industrial	2.00	2.00
Mule Cr to Sucker Cr	Industrial Domestic	8.00 0.01	8.01
Unnamed Str to Sucker Cr	Industrial Domestic	7.99 0.01	8.00
Bolan Cr to Sucker Cr	Industrial	8.00	8.00
E Fk Bolan Cr to Bolan Cr	Industrial	2.00	2.00

TOTALS BY USE

Irrigation	Fish/Wild	Agriculture	Industrial	Municipal	Domestic	Recreational
51.17	0.18	0.01	62.28	0.00	0.29	0.01

Total CFS 113.94

APPENDIX F

Memorandum of Understanding

MEMORANDUM OF UNDERSTANDING BETWEEN THE OREGON STATE DEPARTMENT OF ENVIRONMENTAL QUALITY AND THE OREGON STATE DEPARTMENT OF FORESTRY

I. Introduction and Statement of Purpose

A. Introduction

1. The Environmental Quality Commission (EQC) and the Oregon Department of Environmental Quality (DEQ) are responsible for implementing the Federal Clean Water Act in Oregon, ORS 468B.035, including adoption of water quality standards. The DEQ has adopted and the U.S. Environmental Protection Agency (EPA) has approved Oregon's water quality standards and its 1994/1996 303(d) list. DEQ intends to update and resubmit its 303(d) list to EPA in 1998 and subsequent years as required by federal regulations. DEQ is setting priorities for TMDL preparation.

2. Subsection 303(d) of the Federal Clean Water Act (the Act), 33 U.S.C. §1313(d), requires states to identify waters for which effluent limitations or other pollution control requirements required by local, State, or Federal authority are not stringent enough to implement applicable water quality standards, 40 C.F.R. §130.7 (b). These water bodies are referred to as "water quality limited." For each water on the 303(d) list that is not removed from the list by findings of water quality impairment due to natural conditions or best management practice (BMP) effectiveness, the state must establish a total maximum daily load (TMDL) allocation at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. A TMDL is the sum of the individual wasteload allocations for point sources and load allocations for non-point sources and natural background, 40 C.F.R. §130.2(i).

3. TMDLs must be incorporated into the continuing planning process required by Section 303(e) of the Act and the continuing planning process must be included in the state's water quality management plan. Sections 208 and 319 of the Act, 33 U.S.C. §1288 and §1329, require the state to prepare non-point source management plans.

4. ORS 527.765 requires the Oregon Board of Forestry (the Board), in consultation with the EQC, to establish Best Management Practices (BMPs) and other rules applying to forest practices to ensure that to the maximum extent practicable non-point source discharges of pollutants resulting from forest operations do not impair the achievement and maintenance of water quality standards established by the EQC. The Oregon Department of Forestry (ODF) is the Designated Management Agency (DMA) by DEQ for regulation of water quality on nonfederal forestlands. Forest operators conducting operations in accordance with ODF BMPs are considered to be in compliance with Oregon's water quality standards.

5. The Board in consultation and with the participation and support of DEQ, has adopted water protection rules in the form of BMPs for forest operations, including, but not limited to, OAR Chapter 629, Divisions 635-660. These rules are implemented and enforced by ODF and monitored to assure their effectiveness. DEQ participates in the design and implementation of these monitoring efforts. The EQC, DEQ, the Board and ODF determined that pollution control measures required as BMPs under ORS 527.765 will be relied upon to result in achievement of state water quality standards.

6. The EQC, DEQ, the Board, and ODF are all committed to restoring salmon and meeting water quality through the Healthy Streams Partnership and Oregon Plan for Salmon and Watersheds, 1997 Oregon Laws, Ch. 7.

B. Purposes of MOU

The purposes of this memorandum of understanding:

1. To further define the respective roles and responsibilities of the EQC, the DEQ, the Board, and ODF in preventing, controlling and reducing non-point source discharges to achieve and maintain water quality standards;

2. To explain the process for determining whether (a) forest practices contribute to identified water quality problems in listed water quality limited streams; (b) if so, to determine whether existing forest practice rules provide sufficient control to assure that water quality standards will be met so that waters can be removed from the 303(d) list;

3. To describe the process for interagency coordination in revising forest practice rules, if necessary, to assure the achievement of water quality standards; and

4. To encourage the use of voluntary and incentive-based regulatory solutions to achieve and maintain water quality.

II. Forest Practice BMPs and Water Quality Standards

Since ODF is the DMA for water quality management on nonfederal forestlands and ODF's BMP's are designed to protect water quality, ODF and DEQ will jointly demonstrate how the Forest Practices Act (FPA), forest practice rules (including the rule amendment process), and BMP's are adequate protection pursuant to ORS 527.765. This demonstration of the ODF BMP program adequacy will be done at the statewide scale with due consideration to regional and local variation in effects including non-anthropogenic factors that can lead to water quality standard violations.

Water quality impairment related to aquatic weeds, bacteria, chlorophyll a, dissolved oxygen, flow modification, many nutrients, total dissolved gas, or toxics are generally not attributable to forest management practices as regulated by the FPA. However, it is generally accepted that forest management practices have in some cases caused documented changes in temperature, habitat modification, sedimentation, turbidity, and bio-criteria. Therefore, this statewide demonstration of FPA effectiveness in protection of water quality will address these specific parameters and will be conducted in the following order:

a. temperature (draft report target completion date Spring, 1999),
b. sedimentation and turbidity (draft report target completion date Summer, 1999),
c. aquatic habitat modification (draft report target completion date fall 1999),
e. bio-criteria (draft report target completion date end 1999), and
f. other parameters (draft report target completion date spring 2000).

The analyses will be presented in a format compatible with EPA region 10 guidance (pages 4-6, dated November 1995) regarding BMP effectiveness determinations, and will include:

a. "Data analysis of the effectiveness of controls relative to the problem": analyze relevant data and studies on the parameter and known control methods,
b. "Mechanisms requiring implementation of pollution controls": give a clear exposition of the rules/programs that are designed to provide for protection,
c. "Reasonable time frame for attaining water quality standards": discuss expected recovery times which may be long for some parameters because the ecological processes that bring recovery are long-term, and
d. "Monitoring to track implementation and effectiveness of controls": describe the scope and extent the effectiveness and implementation monitoring program and how they tie back to program changes for adaptive management.

In addition, these analyses will address attainment of state anti-degradation policy. These demonstrations will be reviewed by peers and other interested parties prior to final release. While analysis is being conducted and unless or until changes are made in accordance with ORS 527.765, the FPA and implementing rules will constitute the water quality BMP program for forestlands. These sufficiency analyses will be designed to provide background information and techniques for watershed based assessments of BMP effectiveness and water quality assessments for watersheds with forest and mixed land uses.

III. ODF and DEQ coordination for listed waterbodies (i.e., 303(d) list)

A. Waterbody Specific Coordination

The following coordination will occur between ODF and DEQ regarding the TMDL process and water quality management plans:

(a) For basins where agreement is reached that water quality impairment is not attributable to forest management practices (Figure 1), the forest practice rules will constitute the water quality compliance mechanism for forest management practices on nonfederal forestland. ODF will not participate in the development of the TMDL or water quality management plan except as requested to assist DEQ as ODF budgeted resources permit. If the basin associated with a listed waterbody is entirely or almost entirely on federal land or non-forestland ODF will have little or no involvement (Figure 1).

(b) For basins where water quality impairment is attributed to the long-term legacy of historic forest management and/or other practices, but ODF and DEQ jointly agree that the forest practice BMP's are now adequately regulating forest management activities and not adding to further degradation of water quality, the forest practice rules will be designated in the water quality management plan as the mechanism to achieve water quality compliance for forest operations. ODF will participate with the other DMAs in developing the water quality management plan as necessary.

(c) For basins where water quality impairment may be attributable to forest management practices and ODF and DEQ cannot agree that the current BMPs are adequately regulating forest management activities (Figure 1), the current forest practice rules will be designated in the water quality management plan as the mechanism to achieve water quality compliance for forest operations. However, ODF will design and implement a specific monitoring program as part of the basin plan to document the adequacy of the best management practices. The schedule and scope of the monitoring program will be jointly agreed to by DEQ and ODF. During the interim, while monitoring is being conducted, the current rules will constitute the water quality compliance mechanism. If the monitoring results indicate that changes in practices are needed in a basin, the DEQ and the Board will use OAR 629-635-120 to create watershed specific protection rules or use other existing authority to ensure that forest management activities do not impair water quality.

(d) For basins where both ODF and DEQ agree that there are water quality impairments due to forest management activities even with FPA rules and BMP's, the DEQ and the BOF will use OAR 629-635-120 to create watershed specific protection rules or use other existing authority to ensure that forest management activities do not impair water quality.

In deciding between conditions (a)-(d) above, the statewide rule sufficiency analysis (described in II) will be critical in determining which situation exists. If the practices and impairments are found by DEQ and ODF to be regional or statewide in nature the BOF will create or modify statewide or regional rules or design other effective measures to address the impairment.

B. Removal or Reclassification of Waterbodies

DEQ will propose removal of waterbodies (Figure 1) on the 303(d) list when:

(a) additional data indicates that the waterbody is not in violation,

(b) water quality parameters are found to be in violation for reasons other than human activities,

(c) TMDL's, or water quality management plans or their equivalents, have been established in compliance with the Clean Water Act §303, or

(d) the FPA, forest practice rules and BMP's are found to be adequate for a given water quality parameter in a given basin via the statewide demonstration or watershed based demonstration (see section II above) and all land affecting the listed waterbody is deemed forestland that is regulated under the FPA. Forest basins that have water quality impairment due to legacy conditions that will not be corrected by the current BMPs alone, remain listed with their present status until voluntary or incentive based actions are implemented that are intended to restore watershed conditions such that water quality standards can be met.

IV. Voluntary and Incentive-Based Approaches

DEQ and ODF will work jointly with landowners and watershed councils, as resources permit, to use innovative approaches to resolving water quality problems. DEQ and ODF will use other pollution control requirements when appropriate to restore watershed conditions such that water quality standards can be met in waterbodies listed under Section 303(d) of the Clean Water Act. These pollution programs include but are not limited to the following:

1. Oregon Laws 1997, ch. 553, The Green Permits Act,;

2. Oregon Laws 1995, ch. 413, The Forest Stewardship Act,;

3. Oregon Laws 1997, ch. 7, Healthy Streams Partnership and the Oregon Plan for Salmon and Watersheds;

4. DEQ's Environmental Management Systems Incentives Project;

5. Habitat Conservation Plans adopted and approved under the Endangered Species Act;

6. Project XL agreements with the EPA; and

7. Pollution Prevention Partnership agreements with the EPA.

Some of these alternative approaches will become critical and complementary to the forest practices program when attempting to restore water quality in streams with significant legacy conditions caused by past actions such as channel simplification from splash damming and stream cleaning.

V. Other key coordination points for DEQ and ODF

There are two other issues that will require special coordination between DEQ and ODF These coordination issues regard:

1. Outstanding Resource Water designations and management measures, and
2. Coordination between the two agencies when there is a land use conversion.

Both agencies agree to open discussion on how to coordinate on these issues but they are separate issues that are not covered by this particular MOU.

VI. Signatures

Signed: James E. Brown
James E. Brown, State Forester
Oregon Department of Forestry

Date: 4/16/98

Signed: Langdon Marsh
Langdon Marsh, Director
Oregon Department of Environmental Quality

Date: 4-17-98