Appendix A: Documentation of data used in the Ecosystem Diagnosis and Treatment Model (EDT) for the Grande Ronde Basin.

SUMMARY

This report summarizes the values used in the Ecosystem Diagnosis and Treament Model (EDT) for Grande Ronde Basin. In this project we rated over 500 reaches with 46 environmental attributes per reach for current conditions and another 45 for historical conditions. Over 45,000 ratings were assigned and empirical observations within these reaches were not available for all of these ratings. In fact less than 20% of these ratings are from empirical data. However there was a high quality source of local knowledge. The ODFW, and USFS biologists who participated in the ratings individually have worked in the subbasin for 20 to 30 years and have had the opportunity develop extensive personal knowledge and experience on subbasin conditions. In addition we developed an overlay of the GIS reach layer on digital orthophotographs which allowed viewing of the exact location and conditions of each reach while discussing appropriate reach ratings. To develop the remaining data we used expansion of empirical observations, derived information, expert opinion, and hypothetical information. For example, if a stream width measurement existed for a reach and the reach upstream and downstream had similar characteristics then we used the expansion of empirical information from the middle reach to estimate widths in the downstream and upstream reaches.

HYDROLOGIC REGIME – NATURAL

Definition: The natural flow regime within the reach of interest. Flow regime typically refers to the seasonal pattern of flow over a year; here it is inferred by identification of flow sources. This applies to an unregulated river or to the pre-regulation state of a regulated river.

Rationale: These watersheds originate in the Blue Mountains and Wallowa Mountains. The maximum elevation is over 7,000 ft. These elevations are consistent with rain-on-snow transitional watersheds. These watersheds were given an EDT rating of two (2) for the historic and current conditions.

Level of Proof: Empirical observations were used to estimate the ratings for this attribute and the level of proof is thoroughly established.

HYDROLOGIC REGIME – REGULATED

Definition: The change in the natural hydrograph caused by the operation of flow regulation facilities (e.g., hydroelectric, flood storage, domestic water supply, recreation, or irrigation supply) in a watershed. Definition does not take into account daily flow fluctuations (See Flow-Intra-daily variation attribute).

Rationale: These watersheds do not have artificial flow regulation. These watersheds were given an EDT rating of 0 for the historical and current conditions.

Level of Proof: Empirical observations were used to estimate the ratings for this attribute and the level of proof is thoroughly established.

FLOW - CHANGE IN INTERANNUAL VARIABILITY IN HIGH FLOWS

Definition: The extent of relative change in average peak annual discharge compared to an undisturbed watershed of comparable size, geology, orientation, topography, and geography (or as would have existed in the pristine state). Evidence of change in peak flow can be empirical where sufficiently long data series exists, can be based on indicator metrics (such as TQmean, see Konrad [2000]), or inferred from patterns corresponding to watershed development. Relative change in peak annual discharge here is based on changes in the peak annual flow expected on average once every two years (Q2yr).

Rationale: By definition the template conditions for this attribute are rated as a value of two because this describes this attribute rating for watersheds in pristine conditions. The current condition was also rated as two (2) because no direct measures of inter annual high flow variation were not available for most basins. Local technical experts felt there was not enough evidence of changes in peak flow to alter the rating.

Level of Proof: Empirical observations were used to estimate the historical ratings for this attribute and the level of proof is thoroughly established. The current ratings for this attribute and the level of proof has a weight of evidence in support but not fully conclusive.

FLOW - CHANGES IN INTERANNUAL VARIABILITY IN LOW FLOWS

Definition: The extent of relative change in average daily flow during the normal low flow period compared to an undisturbed watershed of comparable size, geology, and flow regime (or as would have existed in the pristine state). Evidence of change in low flow can be empirically-based where sufficiently long data series exists, or known through flow regulation practices, or inferred from patterns corresponding to watershed development. Note: low flows are not systematically reduced in relation to watershed development, even in urban streams (Konrad 2000). Factors affecting low flow are often not obvious in many watersheds, except in clear cases of flow diversion and regulation.

Rationale: By definition the template conditions for this attribute are rated as a value of two because this describes this attribute rating for watersheds in pristine conditions.

In the Grande Ronde water withdrawals reduce summer flow and in the Prarie Creek system water transfers result in an increase in summer flows. A total of 38 reaches were identified as having impacted summer low flows due to water diversions. The amount of diversion and change in low flow was estimated using stream gauge records and local knowledge. The Table below summarizes the reaches with changes in low flow and the EDT ratings they were assigned.

No. Reaches	Reach Name(s)	Template	Current
6	Catherine Cr-1, 2, 3, 4, 5, 6	2	3.8
1	Catherine Cr-7	2	3
1	Clark Cr-5	2	3.5
10	Grande Ronde- 26, 27, 28, 29, 30, 31, 33, 34A, 35B, 36	2	3.5
1	Hurricane Cr-2	2	2.5

1	Indian Cr-1	2	3.8
1	Indian Cr-2	2	3.5
1	Ladd Cr-1	2	3.8
1	Ladd Cr-2	2	3.5
1	Little Cr-1	2	3.8
1	Little Cr-2	2	3.5
3	Lostine-4, 5, 6	2	2.5
2	Mill Cr-1, 2 (Catherine)	2	3.5
4	Prairie Cr-1, Hayes Fork, Prairie Cr-2, OK Gulch Fork	2	1*
2	Wallowa-17, 19	2	2.5
2	Willow Cr-1, 2	2	3.5

*Increase in low flow due to interbasin water transfer

Level of Proof: Empirical observations were used to estimate the historical ratings for this attribute and the level of proof is thoroughly established. Derived information was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive.

FLOW – INTRA DAILY (DIEL) VARIATION

Definition: Average diel variation in flow level during a season or month. This attribute is informative for rivers with hydroelectric projects or in heavily urbanized drainages where storm runoff causes rapid changes in flow.

Rationale: By definition the template conditions for this attribute are rated as a value of 0 because this describes this attribute rating for watersheds in pristine conditions. This attribute was given an EDT rating of 0 for the current conditions due to the lack of storm water runoff and hydroelectric development. There are no major metropolitan areas in these watersheds with large areas of impervious surfaces.

Level of Proof: Empirical observations were used to estimate the historical ratings for this attribute and the level of proof is thoroughly established. Derived information was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive.

FLOW –INTRA ANNUAL FLOW PATTERN

Definition: The average extent of intra-annual flow variation during the wet season -- a measure of a stream's "flashiness" during storm runoff. Flashiness is correlated with % total impervious area and road density, but is attenuated as drainage area increases. Evidence for change can be empirically derived using flow data (e.g., using the metric TQmean, see Konrad [2000]), or inferred from patterns corresponding to watershed development.

Rationale: By definition the template conditions for this attribute are rated as a value of 2 because this describes this attribute rating for watersheds in pristine conditions. Similar to high flows, monthly and seasonal flow patterns have been affected by land use practices in these watershed. Since there was no data for this attribute and there is disagreement among technical

experts about evidence of changes in the basin, it was the rating for current and template condition remain the same.

Level of Proof: Empirical observations were used to estimate the historical ratings for this attribute and the level of proof is thoroughly established. Expert opinion was used to estimate the current ratings for this attribute.

CHANNEL LENGTH

Definition: Length of the primary channel contained within the stream reach -- Note: this attribute will not be given by a category but rather will be a point estimate. Length of channel is given for the main channel only--multiple channels do not add length.

Rationale: The current length of each reach was calculated from GIS layers provided by TOAST. It has been documented that changes in stream length have occurred in the Grande Ronde largely due to channel straightening efforts. Template Lengths were calculated by multiplying by a fixed factor based on the reach gradient and confinement. The table below summarizes reaches where length was adjusted and the adjustment factor.

Wallowa-08,9, 10, 11, 13, 14, 15, 16, 17, 18, 19, 20, 22	**1.6**
Grande Ronde-34A, 34B, 35A, 35B, 36, 48	**1.6**
Joseph Cr-1, 5, 6	**1.4**
Wallowa-04, 12	**1.4**
Grande Ronde-42, 43, 45	**1.4**
Cottonwood Cr-1, 2 (Joseph), Joseph Cr-4, Cougar Cr (Joseph), Elk Cr-1 & 2 (Joseph), Little Elk Cr	**1.1**
Horse Cr	**1.1**
Swamp Cr-2	**1.1**
Sumac Cr	**1.1**
Crow Cr-1, 2	**1.1**
Chesnimnus Cr-1, 2, 3, 4, 5, 6, 7, 8, 9, NF, Butte Cr (Chesnimnus), Peavine Cr-1, 2, 3 & EF & WF (Chesnimnus), Alder Cr-1 (Chesnimnus), Alder Cr-2 (Chesnimnus)	**1.1**
McCarty Gulch, Telephone Gulch Cr, Pine Cr-1, Poison Cr, Summit Cr, TNT Gulch, Vance Draw, Doe Cr	**1.1**
Devils Run Cr-1 Devils Run Cr-2 Devils Run Cr-3	**1.1**
Buford Cr-1, Courtney Cr-1, Tope Cr, McCubbin Cr, Wildcat Cr-1, Wallupa Cr, Grossman Cr-3	**1.1**
Grande Ronde-37, 38, 39, 40, 41	**1.1**

Level of Proof: Derived information (GIS) was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive especially for historical length.

CHANNEL WIDTH – MONTH MINIMUM WIDTH

Definition: Average width of the wetted channel. If the stream is braided or contains multiple channels, then the width would represent the sum of the wetted widths along a transect that extends across all channels.

Rationale: Maximum and minimum channel width was calculated using the Environmental Attribute Guidelines from Mobrand Biometrics. The equation used can be applied to streams on the east side of the Cascade crest using an equation given in Johnson et al. (1988) as follows:

$$Width = a*CFS^{b}$$

Where a = 4.5789 and b = 0.5660

The flow (CFS) for each reach was calculated by first determining the number of square miles in the basin that drained into each reach and the number of square miles that drained to each gage. Each reach was then correlated to its appropriate gage in the basin as follows:

$$Reach\ Ratio = \frac{reach\ size\ (sq.\ miles)}{gage\ size\ (sq.\ miles)}$$

The reach ratio was then raised to the .9 power (Kjelstrom and Moffatt, 1981). The cfs for each reach for each month was then calculated as follows:

$$CFS=(Reach\ Ratio)^{0.9} * average\ monthly\ flow$$

Average monthly flow was obtained from USGS and State of Oregon gaging stations in the basin. Only gaging stations with a minimum of 10 years of historical record were used.

Where appropriate, reaches were modified based on actual measured data from the Oregon Department of Fish and Wildlife. These initial values were then reviewed by subbasin mangers and adjusted based on their personal experience, in general the calculated values significantly underestimated the channel width. As an additional check the assigned widths were compared to the widths assigned during the previous EDT analysis. Where there was a significant difference this was checked with local biologists and the values adjusted based on their recommendations.

We generally assigned the calculated values for current conditions. Template conditions were adjusted according to the table below:

Gradient Class	Confinement Class	Width Multiplier
<1	0	**1.6**
1-2%	0	1.4
2-4%	0	1.2
4-6%	0	1.1
<1	1	1.08
1-2%	1	1.06
2-4%	1	1.04
4-6%	1	1.02
<1	2	1.06
1-2%	2	1.04
2-4%	2	1.02

4-6%	2	1.01
7-10%	2	1.005
<1	3	1.01
1-2%	3	1.01
2-4%	3	1.01
4-6%	3	1.01
7-10%	3	1.01
10+%	3	1.01
<1	4	1.01
1-2%	4	1.0
2-4%	4	1
4-6%	4	1
7-10%	4	1
10+%	4	1

Where significant irrigation withdrawals potentially impacted minimum widths the calculated widths were decreased c by % indicated for irrigation withdrawals as follows

ReachName	Reach ID	Is Reach Dewaterd in Summer due to Irrigation (Y if yes)
Catherine Cr-4	376	**y 75**
Grande Ronde-28	312	**y 50**
Grande Ronde-29	314	**y 50**
Grande Ronde-30	318	**y 50**
Grande Ronde-31	322	**y 50**
Clark Cr-5	338	**y 50**
Grande Ronde-33	351	**y 50**
Grande Ronde-34	366	**y 50**
Mill Cr-2 (Catherine)	369	**y 50**
Grande Ronde-35	397	**y 50**
Grande Ronde-36	398	**y 50**
Indian Cr-1	340	**y 75**
Catherine Cr-1	367	**y 75**
Catherine Cr-2	370	**y 75**
Ladd Cr-1	371	**y 75**
Catherine Cr-3	373	**y 75**
Little Cr-1	374	**y 75**
Catherine Cr-5	379	**y 75**
Catherine Cr-6	380	**y 75**
Grande Ronde-26	292	**y 50**
Grande Ronde-27	294	**y 50**
Indian Cr-2	342	**y 50**
Willow Cr-1	352	**y 50**
Willow Cr-2	354	**y 50**
Mill Cr-1 (Catherine)	368	**y 50**
Ladd Cr-2	372	**y 50**
Little Cr-2	375	**y 50**
Catherine Cr-7	381	**y 25**

Level of Proof: A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive. For historical information we expanded empirical observations and used expert opinion and the level of proof has theoretical support with some evidence from experiments or observations.

Kjelstrom, L.C. and R.L. Moffatt, 1981, USGS *A Method of Estimating Flood-Frequency Parameters for Streams in Idaho.*

CHANNEL WIDTH – MONTH MAXIMUM WIDTH

Definition: Average width of the wetted channel during peak flow month (average monthly conditions). If the stream is braided or contains multiple channels, then the width would represent the sum of the wetted widths along a transect that extends across all channels. Note: Categories are not to be used for calculation of wetted surface area; categories here are used to designate relative stream size.

Rationale: See above for discussion of calculation of monthly widths and validation of assigned values. Changes between Template and Current widths were calculated using the adjustment factor listed above. No adjustments were made for diversions.

Level of Proof: A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but is not fully conclusive. For historical information, we expanded empirical observations and used expert opinion and the level of proof has theoretical support with some evidence from experiments or observations.

GRADIENT

Definition: Average gradient of the main channel of the reach over its entire length. Note: Categorical levels are shown here but values are required to be input as point estimates for each reach.

Rationale: The average gradient for each stream reach (expressed as % gradient) was calculated using TOAST provided GIS layers to provide the beginning elevation, ending elevation, and length for each EDT reach. And by dividing the change in reach elevation by the reach length and multiplying by 100.

Level of Proof: Derived information (GIS) was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive especially for historical gradient.

CONFINEMENT – NATURAL

Definition: The extent that the valley floodplain of the reach is confined by natural features. It is determined as the ratio between the width of the valley floodplain and the bankful channel width. Note: this attribute addresses the natural (pristine) state of valley confinement only.

Rationale: Confinement ratings were estimated by GIS technician by projecting the GIS reach layer over digital orthophotographs. The width of the river and widths of the valley walls were measured at least three times over a reach and the rating was automatically calculated and assigned based on the measurements.

Level of Proof: Derived information (GIS) was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive.

CONFINEMENT – HYDRO-MODIFICATIONS

Definition: The extent that man-made structures within or adjacent to the stream channel constrict flow (as at bridges) or restrict flow access to the stream's floodplain (due to streamside roads, revetments, diking or levees) or the extent that the channel has been ditched or channelized, or has undergone significant streambed degradation due to channel incision/entrenchment (associated with the process called "headcutting"). Flow access to the floodplain can be partially or wholly cutoff due to channel incision. Note: Setback levees are to be treated differently than narrow-channel or riverfront levees--consider the extent of the setback and its effect on flow and bed dynamics and micro-habitat features along the stream margin in reach to arrive at rating conclusion. Reference condition for this attribute is the natural, undeveloped state.

Rationale: In the historic condition (prior to manmade structures and activity) reaches were fully connected to the floodplain. By definition the template conditions for this attribute are rated as a value of 0 because this describes this attribute rating for watersheds in pristine conditions.

Most hydro-modification consists of roads in the floodplain and diking. EDT ratings. were assigned by local based on computer projection of the GIS reach layer over digital orthophotographs. The rating was assigned based on the degree of hydromodification visable in the photographs and local knowledge of specific reach conditions..

Level of Proof: A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive.

HABITAT TYPE

Definition: *Backwater pools* is the percentage of the wetted channel surface area comprising backwater pools. *Beaver ponds* is the percentage of the wetted channel surface area comprising beaver ponds. Note: these are pools located in the main or side channels, not part of off-channel habitat. *Primary pools* is the percentage of the wetted channel surface area comprising pools, excluding beaver ponds. *Pool tailouts* are the percentage of the wetted channel surface area comprising pool tailouts.

Large cobble/boulder riffles is the percentage of the wetted channel surface area comprising large cobble/boulder riffles. *Small cobble/gravel riffles* is the percentage of the wetted channel

surface area comprising small cobble/gravel riffles. Particle sizes of substrate modified from Platts et al. (1983) based on information in Gordon et al. (1992): gravel (0.2 to 2.9 inch diameter), small cobble (2.9 to 5 inch diameter), large cobble (5 to 11.9 inch diameter), boulder (>11.9 inch diameter).

Glides is the percentage of the wetted channel surface area comprising glides. Note: There is a general lack of consensus regarding the definition of glides (Hawkins et al. 1993), despite a commonly held view that it remains important to recognize a habitat type that is intermediate between pool and riffle. The definition applied here is from the ODFW habitat survey manual (Moore et al. 1997): an area with generally uniform depth and flow with no surface turbulence, generally in reaches of <1% gradient. Glides may have some small scour areas but are distinguished from pools by their overall homogeneity and lack of structure. They are generally deeper than riffles with few major flow obstructions and low habitat complexity.

Rationale: A variety of reaches in the Grande Ronde and tributaries were surveyed by the USFS and ODFW. Habitat type composition was measured during these surveys. Ratings for non-surveyed reaches were inferred by applying data from representative reach surveys with similar habitat, gradient and confinement.

USFS habitat surveys primarily followed USFS stream survey protocols, which delineate between riffles and slow water but not pools and glides. Glide habitat is the most difficult habitat to identify, therefore was estimated but not surveyed. ODFW survey methodology did not appear to work for glides.

Habitat simplification typically results from timber harvest, grazing and other land uses. These activities have decreased the number and quality of pools. Reduction in wood and hydromodifications are primary causes for reduction in primary pools. Historic habitat type composition was estimated by assuming primary pool habitat has been reduced by 50% on average. Stable historical flows and abundant large woody debris maintained higher levels of spawning gravel than the current condition. Due to increases in primary pools and spawning riffles/tailouts, glides were assumed to be less abundant in the template condition. These values were adjusted to account for the gradient and confinement of the reaches.

In general, we assumed for historical conditions that the percentage of pools was twice the current percentage. We assumed that tail-outs represent 15% of pool habitat. In addition we assumed that primary pool capacity is capped at 45%, with a minimum of 20%. Maximum spawning riffles were capped at 20% and glides were approximately 10%.

Where we had no survey data on habitat types for we assumed a relationship between nearby reaches with the same gradient and confinement.

Level of Proof: A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute. Stream surveys allowed accurate classification of fast water (riffles) and slow water (pools and glides) habitat. However, there was likely inconsistency in distinguishing pools from glides. The level of proof for current ratings has a strong weight of evidence in support but not fully conclusive. For

historical information we expanded empirical observations and used expert opinion and the level of proof has theoretical support with some evidence from experiments or observations.

HABITAT TYPES – OFF-CHANNEL HABITAT FACTOR

Definition: A multiplier used to estimate the amount of off-channel habitat based on the wetted surface area of the all combined in-channel habitat.

Rationale: When rivers are unconfined they tend to meander across their floodplains forming wetlands, marshes, and ponds. These are considered off-channel habitat. Confined and moderately confined reaches typically have little or no off-channel habitat. Off-channel habitat increases in unconfined reaches. Historic Side channel ratings were assigned by gradient and confinement class as follows:

Historic Side Channel Rating	Confinement Class	Grad Class
30	0	<1%
25	0	1-2%
20	0	2-4%
15	0	4-6%
25	1	<1%
0	1	10+%
20	1	1-2%
20	1	2-4%
15	1	4-6%
15	2	<1%
15	2	1-2%
10	2	2-4%
10	2	4-6%
5	2	7-10%
5	3	<1%
0	3	10+%
10	3	1-2%
10	3	2-4%
8	3	4-6%
5	3	7-10%
5	4	<1%
0	4	10+%
7	4	1-2%
10	4	2-4%
5	4	4-6%
5	4	7-10%

Where survey data was available ratings were expanded into reaches with similar gradient and confinement ratings. Expert opinion was used to rate reaches with no data. In general Template Condition was rated lower than historic except for wilderness reaches in the Wenaha and Minam watersheds where ratings were the same.

Level of Proof: A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive. For historical information we expanded empirical observations and used expert opinion and the level of proof has theoretical support with some evidence from experiments or observations.

OBSTRUCTIONS TO FISH MIGRATION

Definition: Obstructions to fish passage by physical barriers (not dewatered channels or hindrances to migration caused by pollutants or lack of oxygen).

Rationale: No comprehensive survey of barriers was available for the Grande Ronde. Various agencies (ie. Forest Service, ODFW and others) have surveyed barriers but the information has not been compiled or even consistently collected. Existing barriers were identified through consultation with local biologists. EDT requires that obstructions be rated for species, life stages, effectiveness, and percentage of passage effectiveness. In many cases the fish distribution stopped at natural barriers (usually waterfalls). In some cases where fish occurred above barriers (ie. collection facilities) passage was assumed to be 100% for the species and all life stages. Since steelhead and chinook salmon are generally mainstem and large tributary spawners, barrier effects on these species were minimal. However the Nez Perce Tribe has conducted an inventory of passage barriers which is recommended for evaluation of barriers beyond the EDT analysis.

Level of Proof: A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive.

WATER WITHDRAWALS

Definition: The number and relative size of water withdrawals in the stream reach.

Rationale: No water withdrawals occurred in the pristine condition. Water withdrawals were significant in some portions of the subbasin. A total of 85 reaches with some type of withdrawal were identified. The impacted reaches are distributed in the subbasin watersheds as follows:

Subbasin Watershed	Count of reaches impacted by withdrawals
Catherine	5
GR	22
Indian	3
Joesph	12
LGR	3
Lookingglass	1
Wallowa	29
Willow	10
Grand Total	85

EDT Ratings were assigned to the impacted reaches based on observations of local biologists. The ratings were assigned as follows:

Reach Name	# of Reaches	Watershed	EDT Current Rating
Pyles Canyon-1	1	Catherine	1
Little Cr-2	1	Catherine	3
Little Cr-1, Mill Cr-1 (Catherine), Mill Cr-2 (Catherine)	3	Catherine	4
Bear Cr-1 (1st GR), Cougar Cr (GR), Grande Ronde-01, 02, 03, 04, 05, 06	8	GR	0.5
Bear CR EF (1st GR), Cottonwood Cr-1 (GR), Grande Ronde-10, 11, 12, 14, 31, 33, 34A, 34B	10	GR	1
Grande Ronde-35_A, 35B, 36, 37	4	GR	2
Indian Cr-1, 2, Shaw Cr.	3	Indian	1
Joseph Cr-2	1	Joesph	0.5
Butte Cr (Chesnimnus), Chesnimnus Cr-1, Cottonwood Cr-1 (Joseph), Elk Cr-1, 2 (Joseph), Joseph Cr-1, 5, 6, Crow Cr-2, Gooseberry Cr, Swamp Cr-2	11	Joesph	1
Grouse Cr- 1, Menatchee Cr	2	LGR	0.5
Grossman Cr-3	1	LGR	1
Lookingglass Cr-2	1	Lookingglass	1
Bear Cr-1, 2 (Wallowa), Deer Cr-2 (Wallowa), Hurricane Cr-2, Little Hurricane Cr, Spring Cr-1, 3 (Wallowa), Wallowa- 09, 10, 22, Little Bear Cr-4, Lostine-1, 5, Prairie Cr-1, 2, 3	16	Wallowa	1
Hurricane Cr-1, Trout Cr (Wallowa), Wallowa-08, 11, 12, 17, 21, Whiskey Cr-1 (Wallowa), Lostine-3, 4, Prairie Cr-4	11	Wallowa	2
Hurricane Cr-4, Wallowa-19	2	Wallowa	3
Coon Cr, Dry Cr-1, 2 (Willow), End Cr, Finley Cr, Mill Cr (Willow), Willow Cr-3, 4	8	Willow	1
Willow Cr-1, 2	2	Willow	2

Level of Proof: A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive.

BED SCOUR

Definition: Average depth of bed scour in salmonid spawning areas (i.e., in pool-tailouts and small cobble-gravel riffles) during the annual peak flow event over approximately a 10-year period. The range of annual scour depth over the period could vary substantially. Particle sizes of substrate modified from Platts et al. (1983) based on information in Gordon et al. (1992): gravel (0.2 to 2.9 inch diameter), small cobble (2.9 to 5 inch diameter), large cobble (5 to 11.9 inch diameter), boulder (>11.9 inch diameter).

Rationale: No bed scour data is available for these basins. Technical experts in the basin were uncomfortable estimating ratings so the template and current conditions were all given a rating on 0.

Level of Proof: This variable was set to a default of 0 because expert opinion was uncomfortable assigning values to this variable.

ICING

Definition: Average extent (magnitude and frequency) of icing events over a 10-year period. Icing events can have severe effects on the biota and the physical structure of the stream in the short-term. It is recognized that icing events can under some conditions have long-term beneficial effects to habitat structure.

Rationale: These watersheds are rain on snow/ transitional. Anchor ice and icing events do occur. EDT ratings were assigned to reaches based on the observations of local ODFW and Forest Service Biologists. For most reaches the historical and current condition were given the same rating. In some cases changes between template and current conditions were thought to occur due to changes in channel morphology, flow of other conditions. These reaches are the assigned EDT ratings are summarized below:

Reach Name	Watershed	# of Reaches	Template	Current
Chesnimnus Cr-8	Joseph	1	2	3
Meadow Cr-1, 2, 3, 4, 5, 6, 7, 8 (2nd GR)	GR	8	1	3
Waucup Cr	Upper GR	1	1	3
Chesnimnus Cr-4, 5, 6, Peavine Cr-1, 2, 3 (Chesnimnus)	Joseph	6	1	2
Pine Cr-1, 2, Alder Cr-1,2, Trib (Chesnimnus), Vance Draw	Joseph	6	1	2
First Cr, Second Cr, Third Cr, Melton Cr.	Weneha	4	1	2
Courtney Cr-1, 2, Buck Cr-2 (GR), Tope Cr, Mud Cr - 3, Sled Cr - 2, Tepee Cr, McCubbin Cr, Wildcat Cr-1, Wallupa Cr	Lower GR Trib	10	1	2
Grande Ronde-16, 17, 18, 19, 20, 21, 22, 23, 24	GR	9	1	2
Howard Cr, Fisher Cr, Deer Cr-2, 3 (Wallowa), Sage Cr-2, Water Canyon, Dry Cr-3, 4 (Wallowa), Rock Cr-2 (Wallowa), Bear Cr-1, 2 (Wallowa), Little Bear Cr - 1, 2, 4, Whiskey Cr MF, NF-1, NF 2 (Wallowa), Straight Whiskey Cr	Wallowa	18	1	2
Clark Cr-1	mid GR	1	1	2
Grande Ronde-37, 38, 39, 41, 41, 42, 43, 44, 45, 46	GR	10	1	2
Joseph Cr-1, 2, Cottonwood Cr-1 (Joseph)	Joseph	3	1	1.5
Shumaker Cr, Deer Cr (GR), Buford Cr-1, Rattlesnake Cr-1, Rattlesnake Cr-3, Rattlesnake Cr W Branch, Rattlesnake Cr-4, Cottonwood Cr-1, 3 (GR)	Lower GR Trib	9	1	1.5
Grande Ronde-7, 8, 9, 10, 11	GR	5	1	1.5
Bear CR EF (1st GR), Bear CR WF (1st GR), Grouse Cr- 3, 5, 7	Lower GR Trib	5	1	1.5
Wenaha-2, Crooked Cr-2, 3, 4	Weneha	4	1	1.5
Duncan Canyon, Rysdam Canyon, Medicine Cr	Mid GR Trib	3	0	1
Phillips Cr-3, Clark Cr NF, Clark Cr-2, Clark Cr MF	Phillips	4	0	1
Grande Ronde-35_A, 35B, 36	GR	3	0	1

Level of Proof: Professional observations were used to estimate the ratings for this attribute and the level of proof is not thoroughly established.

RIPARIAN

Definition: A measure of riparian function that has been altered within the reach.

Rationale: By definition the template conditions for this attribute are rated as a value of zero because this describes this attribute rating for watersheds in pristine conditions. Riparian zones

with mature conifers are rated at 1.0. Riparian with saplings and deciduous trees are rated as 1.5 due to lack of shade and bank stability. Riparian zones with brush and few trees would be rated as 2. For an EDT rating to exceed 2 residential developments or roads need to be in the riparian zone. Therefore, for current conditions, as long as the riparian area has trees it should have a score of two or better. Most current vegetated riparian zones with no hydro-confinement should be rated as a 1 to 1.5. When hydro-confinement exists rating from rules on hydro-confinement were used to increase the riparian rating. Ratings also increased based on lack of vegetation.

EDT ratings. were assigned by local based on computer projection of the GIS reach layer over digital orthophotographs. The rating was assigned based on the condition and types of riparian vegetation and hydromodification visible in the photographs and local knowledge of specific reach conditions..

Level of Proof: A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive.

WOOD

Definition: The amount of wood (large woody debris or LWD) within the reach. Dimensions of what constitutes LWD are defined here as pieces >0.1 m diameter and >2 m in length. Note: channel widths here refer to average wetted width during the high flow month (< bank full), consistent with the metric used to define high flow channel width.

Rationale: LWD density was calculated from the ODFW and USFS surveys, however there was difficulty extrapolating the surveyed values to EDT values because LWD was defined slightly different. Current condition rating based on survey data all came out extremely low (=4.0) using the strict definition in the EDT documentation. Based on discussion with L. Lestelle of Mobrand Biometrics about what ratings would be appropriate based on his local knowledge and a review of the survey numbers a decision was made to base the ratings entirely on professional opinion.

Template Ratings were generally scaled to position in the watershed (larger mainstem reaches would not be expected to hold all but the largest wood), habitat type (forested areas would be expected to have higher levels of lwd than lower elevation sage, meadow areas), gradient and confinement. The template ratings were assigned as follows:

Reach Name	Template
Grande Ronde-1 to 47	3.5
Applegate Canyon, Bailey Cr, Bear Cr (2nd GR), Bear Cr (4th GR), Bear CR EF (1st GR), Bear Cr Trib (4th GR), Bear CR WF (1st GR), Bear Cr-1 (1st GR), Beaver Cr-1 (GR), Bishop Cr, Buck Cr-1 (GR), Buford Cr-1, 2, Cabin Cr-1, NF, SF, Catherine Cr-1 to 5, Little Catherine Cr, Milk Cr-1, 2 (Catherine), Coon Cr, Cottonwood Cr-1, 2 (Joseph), Courtney Cr-1, Deer Cr (GR), Dry Cr-1 (Willow), Duncan Canyon, End Cr, Fir Cr, Fisher Cr, Gordon Cr-1, 2, Grossman Cr-1,2, EF, Hayes Fork, Howard Cr, Jarboe Cr, Jordan Cr, Grande Ronde-48, Hurricane Cr-1 to 4, Little Hurricane Cr, Joseph Cr-1 to 3, Ladd Cr-1, 2, Lewis Branch, Little Courtney Cr, Little Cr-1, 2, Lookingglass Cr-1 to 4, Little Lookingglass Cr-1, 2, Marley Cr, McCoy Cr-1, 2, Mclntyre Cr, Medicine Cr, Mottet Cr, Mud Cr-1, OK Gulch Fork, Meadow Cr-1 to 6 (2nd GR), Phillips Cr-1, 2, Wallowa-1to 4, 13 to 22, Spring Cr-1 to 3 (Wallowa), Trout Cr (Wallowa), Prairie Cr-1 to 4, Warm Springs Cr, Wildcat Cr-1, Smith Cr, Rysdam Canyon, Pyles Canyon-1, 2, Willow Cr-1 to 5, Mill Cr (Willow)	3
Courtney Cr-2 to 4, Bobcat Cr, Shamrock Cr, Burnt Cr, Buck Cr-2 (GR), Rock Cr-1, 2, 3 (GR), Sheep Cr (GR	2.5

Rock), Little Rock Cr, Whiskey Cr-1, 2 (GR), Little Whiskey Cr, Syrup Cr	
Horse Cr, Peavine Cr (Joseph), Chesnimnus Cr-1,2,3,4, NF Gooseberry Cr, Butte Cr (Chesnimnus), Pine Cr-1, 2, Alder Cr-1, 2, Trib (Chesnimnus), Salmon Cr-1, 2, Dry Salmon	2.0
Wenaha-1 , Mud Cr-2, 3, 7 Tope Cr, Evans Cr, McCubbin Cr, Wallupa Cr, Wildcat Cr-2, Ward Canyon, Sickfoot Cr, Deep Cr , Grossman Cr-3, Elbow Cr, Bear Cr (3rd GR), Alder Cr (GR), Meadow Cr (1st GR), Clear Cr (1st GR), Sheep Cr-1, 2 (1st GR), Minam-1 to 4, Squaw Cr (Minam), Wallowa-5 to 8, 10, 11 Fountain Canyon, Water Canyon, Rock Cr-1 (Wallowa), Dry Cr-1 to 4 (Wallowa), Reagin Gulch, Rock Cr-2 (Wallowa), Bear Cr-1, 2, 3, 4 (Wallowa), Little Bear Cr-1 to 4, Doc Cr, Whiskey Cr-1, 2, MF, NF-1, NF2 (Wallowa), Straight Whiskey Cr, Lostine-1 to 6, Parsnip Cr, Hurricane Cr-6, Buzzard Cr, Lookingglass Cr-5 to 7, Little Lookingglass Cr-3, 4, Little Lookingglass Trib, Eagle Cr, Summer Cr, Little Phillips Cr, Phillips Cr-3, Phillips Cr EF-1, Pedro Cr, Phillips Cr EF-2, Phillips Cr-4, Clark Cr-1 to 5, NF, MF Indian Cr-1, 2, Shaw Cr, Finley Cr, Dry Cr-2 (Willow), Catherine Cr-6 to 9, Five Points Cr-1, 2, 3, MF, Pelican Cr-1, Dry Cr-1 (Five Points), Calfornia Gulch, Dry Cr-2 (Five Points), Pelican Cr-2, Fiddlers Hell, Mt Emily, Rock Cr EF (GR), Rock Cr-4 (GR), Spring Cr-1 (GR), Spring Cr SF (GR), Spring Cr-2 (GR), Hoodoo Cr, Beaver Cr-2 (GR), Dark Canyon, McCoy Cr-3, Burnt Corral Cr-1,2,3, EF, Sullivan Gulch, Battle Cr, Bear Cr (Meadow), Meadow Cr-7, 8, 9 (2nd GR), Peet Cr, Waucup Cr	2.0
McAlister Cr, Mud Cr-4, 5, 6, Sled Cr-1, 2, Tepee Cr, Goat Cr, Bear Cr-5 (Wallowa), Lostine-7, 8, Scout Cr, Catherine Cr SF-1, 2, Collins Cr, Sand Pass Cr, Buck Cr (Catherine), Catherine Cr MF	1.5
Broady Cr-1, 2, WF, Cottonwood Cr-3 (Joseph), Swamp Cr-1, 2, Joseph Cr-4, 5, 6, Cougar Cr (Joseph,) Sumac Cr, Crow Cr-1, Elk Cr-1, 2 (Joseph), Little Elk Cr, Crow Cr-2, Peavine Cr-1, 2, 3, EF, WF (Chesnimnus), McCarty Gulch Telephone Gulch Cr, Chesnimnus Cr-5 to 9, SF, Doe Cr Billy Cr, Devils Run Cr-1, 2, 3, 4, Vance Draw, Shumaker Cr, Rattlesnake Cr-1 to 4, Rattlesnake Cr W Branch, Cougar Cr (GR), Grouse Cr 1 to 7, Gunderson Cr	1.0
Minam-5, 6, Deer Cr-2, 3 (Wallowa), Wallowa-9, 12, Little Indian Cr, Catherine Cr NF-1, 2, 3, Fly Cr-1, 2, 3, 4, Little Fly Cr-1, 2, Squaw Cr (Fly), Umapine Cr, Sheep Cr-1 (2nd GR), Dry Cr (2nd GR Sheep), Chicken Cr W, Limber Jim Cr-1, 2, 3, 4, 5, SF, NF, Marion Cr, Meadowbrook Cr, Clear Cr-1, 2, 3 (2nd GR), Clear Cr Trib-1 (2nd GR), Clear Cr Trib Trib (2nd GR), Clear Cr Trib-2 (2nd GR), Little Clear Cr	1.0
Grande Ronde EF, Tanner Gulch	1.0
Indian Cr-3 to 6, NF, Camp Ck, EF, Lookout Cr, Grande Ronde-49 to 53	0.5
Cottonwood Cr-1, 3 (GR), Menatchee Cr, Crooked Cr-1 to 4, First Cr, Melton Cr, Second Cr, Third Cr, Wenaha-2, 3, 4, 5, 6, NF, Weller Cr, Butte Cr-1, 2 (Wenaha), Rock Cr (Wenaha), Slick Ear Cr, Beaver Cr (Wenaha), Wenaha SF-1, 2, 3, Jaussaud Cr, Milk Cr (Wenaha), Cougar Cr (Minam), Trout Cr (Minam), Murphy Cr, Little Minam Cr-1, Little Minam Cr-3, 4, 5, Boulder Cr, Dobbin Cr, Minam-7, 8, 9 Minam N-1, 3, Elk Cr-1 (Minam), Elk Cr EF (Minam), Elk Cr-2 (Minam), Chicken Cr-1, Chicken Cr-2, Indiana Cr, Sheep Cr-2, 3, 4. E (2nd GR), Sheep Cr Trib (2nd GR)	0.0

Current ratings were developed by local ODFW biologists based on professional experience. As the ratings were developed the digital orthophotos were consulted to verify reach location and current riparian conditions.

Level of Proof: A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive. For historical information, expanded empirical observations were used to estimate the ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive.

FINE SEDIMENT (INTRAGRAVEL)

Definition: Percentage of fine sediment within salmonid spawning substrates, located in pool-tailouts, glides, and small cobble-gravel riffles. Definition of "fine sediment" here depends on the particle size of primary concern in the watershed of interest. In areas where sand size particles are not of major interest, as they are in the Idaho Batholith, the effect of fine sediment on egg to fry survival is primarily associated with particles <1mm (e.g., as measured by particles <0.85 mm). Sand size particles (e.g., <6 mm) can be the principal concern when excessive accumulations occur in the upper stratum of the stream bed (Kondolf 2000).

Rationale: In the template (pristine) condition, watersheds were assumed to have been 6%-11% fines and were given an EDT rating of 1. Higher gradient reaches or reaches with low current fine sediments were rated lower based on expert observations.

To rate fine sediments for the current condition, we had substratre ratings from 69 sites collected from USFS/ODFW Habitat Surveys. As an initial cut reaches with fines and/ or sand as a dominant or subdominant substrate were rated and then extrapolated to nearby reaches with similar gradient and confinement. This information was reviewed and adjusted based on local expert opinions.

Level of Proof: A combination of derived information and expert opinion was used to estimate the current and historical ratings for this attribute and the level of proof has theoretical support with some evidence from experiments or observations

EMBEDDEDNESS

Definition: The extent that larger cobbles or gravel are surrounded by or covered by fine sediment, such as sands, silts, and clays. Embeddedness is determined by examining the extent (as an average %) that cobble and gravel particles on the substrate surface are buried by fine sediments. This attribute only applies to riffle and tailout habitat units and only where cobble or gravel substrates occur.

Rationale: In the template (pristine) condition, it was assumed most reaches had > 10 and < 25 % covered by fine sediment and were given an EDT rating of 1. Higher gradient reaches or reaches with low current embeddness were rated lower based on expert observations.

To rate embeddedness for the current condition, we had 49 embeddness measurements from USFS/ODFW Habitat Surveys. As an initial cut the measured valued were rated and then extrapolated to nearby reaches with similar gradient and confinement. This information was reviewed and adjusted based on local expert opinions.

Level of Proof: A combination of derived information and expert opinion was used to estimate the current and historical ratings for this attribute and the level of proof has theoretical support with some evidence from experiments or observations.

TURBIDITY (SUSPENDED SEDIMENT)

Definition: The severity of suspended sediment (SS) episodes within the stream reach. (Note: this attribute, which was originally called turbidity and still retains that name for continuity, is more correctly thought of as SS, which affects turbidity.) SS is sometimes characterized using turbidity but is more accurately described through suspended solids, hence the latter is to be used in rating this attribute. Turbidity is an optical property of water where suspended, including very fine particles such as clays and colloids, and some dissolved materials cause light to be scattered; it is expressed typically in nephelometric turbidity units (NTU). Suspended solids represents the actual measure of mineral and organic particles transported in the water column, either expressed as total suspended solids (TSS) or suspended sediment concentration (SSC)—both as mg/l.

Rationale: Suspended sediment levels in the template (pristine) condition were assumed to be at low levels, even during high flow events. An EDT rating of "0" was assigned to all reaches except for some portions of Joseph Creek and tributaries to the lower Grande Ronde where geology is conducive to production of suspended sediments. .

For current conditions suspended sediment levels were estimated based on expert opinion and observation. Typically where there are heavily roaded areas or high impact grazing or agricultural activities the reaches were gives a rating of 1.0. Prairie Creek was rated as 2.0 due to eroding banks from increased water in the channel.

Level of Proof: A combination of derived information and expert opinion was used to estimate the current and historical ratings for this attribute and the level of proof has theoretical support with some evidence from experiments or observations

TEMPERATURE – DAILY MAXIMUM (BY MONTH)

Definition: Maximum water temperatures within the stream reach during a month.

Rationale: The table below summarizes data from ODFW and USFS which was used to establish ratings. It was assumed temperatures recorded were near average. Where data was not available data from the nearest location was used as a basis for estimating a rating which was then verified with local experts..

Historical riparian conditions along most stream reaches consisted of forest of complex wetland meadow systems. Currently most riparian areas in the lower portions of the subbasin have been straightened and the vegetation highly modified. Therefore, on average historical maximum temperatures were rated as lower than current temperatures.

Location	dates	year	Notes
Middle Crooked Mainflow Temps	6/26-9/22	1994	thermograph located approx. 1/2 mile below mouth of First Creek
Lower Elk Creek	7/8-8/29	1994	
Lower Cottonwood Mainflow Temps	6/21-9/21	1994	location approx 200 m above mouth
Joseph Creek Temperature (C)	6/21-8/29	1994	
jomaxmw - comparison file		1994	
Lower Crow Creek Temperature (C)	7/8-8/20	1994	
Lower Joseph Mainflow Temperatures	6/21-9/21	1994	thermograph located at approx river mile 5
Middle Cottonwood Mainflow Temps	6/21-9/21	1994	location approx 100m above mouth of Horse Creek
Middle Crooked Mainflow Temps	6/26-9/22	1994	thermograph located approx. 1/2 mile below mouth of First Creek
Middle Joseph Canyon Air Temperatures	6/17-9/23	1994	location on river floodplain at approx river mile 28
Middle Joseph Barb-Wire Riffle Cold Seep	7/12-9/23	1994	
Upper 1/3 Pool Cold Seep	6/13-8/23	1994	
Middle Joseph Mainflow Temperatures	6/17-9/4	1994	thermograph located at approx river mile 28
North Pine Creek Air Temps	7/1-9/24	1994	
Upper Chesnimnus Cr. Temperature (C)	7/13-8/29	1994	

Upper Crow Cr. Temperatures (C)	7/9-8/29	1994	
Broady Creek Mainflow Temperatures	6/22-8/12	1994	location approx 1.5 miles below confluence West Fork Broady Creek
First Creek Daily Temperatures	6/26-9/22	1994	thermograph located approx 1/2 mile upstream of mouth
Lower Crooked Air Temperatures	6/25-9/22	1994	thermograph located near mouth of Crooked Creek on floodplain
Broady Seep Temperatures	6/22-9/18	1994	Seep emerging on old-growth conifer forested floodplain, on right bank approx 1.5 miles below confluence West Fork Broady Creek
Upper Joseph Creek Temperatures	6/22-9/21	1994	location at approx river mile 41
Crooked Creek @ mouth	11/7 -9/30	2001-02	
Crooked Creek @ mouth	10/23 -10/29	2002-03	
Wenaha River Blw Wilderness Bdry / Crooked Cr	10/22 - 10/30	2002-03	
Butte Creek @ Mouth	10/25-9/01	2002-03	
Jarboe Creek@ Fs Bdry	6/2 - 10/27	2003	
Sheep Creek @ Mouth @ Grande Ronde	6/2 - 10/24	2003	Exposed to Air or very low water levels from 7-17 through end of season. Temperatures for June 2 through July 7th 2003 7 day max~ 63, but doesn't represent season's average.
Lookingglass Creek Above Springs	6/2 - 10/27	2003	
Lookingglass Creek Above Eagle Creek	6/2 - 10/27	2003	
Mottet Creek @ Fs Bdry	6/2 - 10/27	2003	
Lookingglass Creek Above Springs	6/6-9/26	2002	
Lookingglass Creek Above Eagle Creek	6/9 - 10/31	2002	
Sheep Creek @ Mouth / @ Grande Ronde River	6/4 - 10/31	2002	
Jarboe Creek @ Fs Bdry	6/6 - 9/26	2002	
Mottet Creek @ Fs Bdry	6/4 - 10/31	2002	
Jarboe Creek / Upper / 6413 Rd	5/29 -9/18	2001	
Jarboe Creek Below East Fork	6/1 - 9/18	2001	
Jarboe Creek Above East Fork	5/29 - 9/18	2001	
Jarboe Creek / Lower / Above Rd 62	5/29 - 9/18	2001	
Jarboe Creek @ FS Bdry	5/3 -8/23	2001	
Lookingglass Creek Above Eagle Creek	5/14 - 10/31	2001	
Mottet Creek @ FS Bdry	5/14 - 10/31	2001	
Lookingglass Creek @ FS Bdry	5/14 - 10/31	2001	
Little Lookingglass Creek @ FS Bdry	5/14 - 10/31	2001	

Level of Proof: A combination of derived information and expert opinion was used to estimate the historical ratings for this attribute and the level of proof has theoretical support with some evidence from experiments or observations. A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive.

TEMPERATURE – DAILY MINIMUM (BY MONTH)

Definition: Minimum water temperatures within the stream reach during a month.

Rationale: The only temperature data for a full year was available from the Wenaha watershed collected by the USFS, this data was collected for a single year 11/2001 to 10/2002 . This data

was used to create the shaping pattern for the entire subbasin (see below for pattern information). Current and Template ratings were assigned using expert opinion based on observations of icing and knowledge of local conditions. Stream reaches in wilderness areas were rated the same for Current and Template conditions. In reaches where channel modification or riparian modification has occurred experts assumed winter temperatures would be slightly warmer.

Level of Proof: Professional judgment was used to estimate the ratings for this attribute and the level of proof is based on weight of evidence.

TEMPERATURE – SPATIAL VARIATION

Definition: The extent of water temperature variation within the reach as influenced by inputs of groundwater.

Rationale: We could not find any data on the current or historical conditions for ground water input. In the current condition, groundwater input in low gradient, unconfined to moderately confined reaches low in the watershed has likely been reduced by current land use practices. Expert opinion was used to estimate the current and historical ratings for this attribute based on local biologists experience and observations on where groundwater inputs currently occur and their knowledge of channel changes and activities.

Level of Proof: Expert opinion was used to estimate the current and historical ratings for this attribute and the level of proof has theoretical support with some evidence from experiments or observations.

ALKALINITY

Definition: Alkalinity, or acid neutralizing capacity (ANC), measured as milliequivalents per liter or mg/l of either HCO3 or CaCO3.

Rationale: Alkalinity was estimated from historical ODEQ data provided by TOAST. Alkalinity values for the entire subbasin ranged from a low of 22 to a high of 125mg/l. All reaches were given a rating of 3.0. Alkalinity in the historic condition was given the same value as the current condition.

Level of Proof: A combination of derived information and expert opinion was used to estimate the current and historical ratings for this attribute and the level of proof has theoretical support with some evidence from experiments or observations.

DISSOLVED OXYGEN

Definition: Average dissolved oxygen within the water column for the specified time interval.

Rationale: Dissolved oxygen in the template (historic) condition was assumed to be unimpaired. ODEQ water quality data indicated DO conditions generally exceeded 8 mg/l. DO levels less than 8mg/l have been recorded in later summer mostly in reaches with known elevated temperatures. Based on this data 347 reaches were identified with known summer high

temperatures and these reaches were assigned an EDT rating of 1.0. The reaches and EDt ratings are summarized below.

Reach Names	# of Reaches	Watershed	Tem-plate	Current
Joseph Cr-1,2,3,4,5,6	6	Joseph	0	1
Broady Cr 1, 2, WF, Butte Cr (Chesnimnus), Chesnimnus Cr-1, 2, 3, 4, 5, 6, 7, 8, 9, nf, sf, Cottonwood Cr-1, 2, 3 (Joseph), Cougar Cr (Joseph), Crow Cr-1, 2, Davis, Elk Cr-1 (Joseph), Elk Cr-2 (Joseph), Little Elk Cr, McCarty Gulch, Gooseberry Cr, Horse Cr	28	Joseph	0	1
Peavine Cr (Joseph), Peavine Cr-1, 2, 3 (Chesnimnus), Peavine Cr EF (Chesnimnus), Peavine Cr WF (Chesnimnus), Sumac Cr, Swamp Cr-1, 2, Telephone Gulch Cr, Alder Cr-1, 2, Trib (Chesnimnus), Pine Cr-1	14	Joseph	0	1
Salmon Cr-1, 2, Dry Salmon, Pine Cr-2, Billy Cr, Devils Run Cr-1, 2, 3, 4, Poison Cr, Summit Cr, TNT Gulch, Vance Draw	14	Joseph	0	1
Grande Ronde-2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	11	Lower GR	0	1
Shumaker Cr, Deer Cr (GR), Buford Cr-1, Applegate Canyon, Buford Cr-2, Rattlesnake Cr-1, Rattlesnake Cr-3, Rattlesnake Cr W Branch, Rattlesnake Cr-4, Cottonwood Cr-1 (GR), Cottonwood Cr-3 (GR), Bear Cr-1 (1st GR), Bear CR EF (1st GR), Bear CR WF (1st GR), Cougar Cr (GR), Menatchee Cr, Grouse Cr- 1, 3, 5, 7, Bear Cr (2nd GR)	20	Lower GR Tribs	0	1
Wenaha-1	1	Wenaha	0	1
Courtney Cr-1, 2, 3, 4, Little Courtney Cr, Bobcat Cr, Shamrock Cr, Mud Cr-1, 2, 3, 4, 5, 6, 7, Buck Cr-1, 2 (GR), Burnt Cr, Tope Cr, McAlister Cr, Sled Cr-1, 2, Evans Cr, Tepee Cr, McCubbin Cr	24	Lower GR Tribs	0	1
Grande Ronde-14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25	12	Lower GR	0	1
Wildcat Cr-1, 2, Wallupa Cr, Bishop Cr, Ward Canyon, Sickfoot Cr, Grossman Cr-1, 2, 3, EF, Deep Cr, Elbow Cr, Bear Cr (3rd GR), Alder Cr (GR), Meadow Cr (1st GR), Clear Cr (1st GR), Sheep Cr-1, 2 (1st GR)	18	Lower GR Tribs	0	1
Wallowa-1, 2, 3, 5, 6, 7, 8, 10, 12, 13, 14, 15, 16, 17, 19, 21, 22	18	Wallowa	0	1
Howard Cr, Fisher Cr, Minam-1, Deer Cr-2, 3 (Wallowa), Sage Cr-2, Fountain Canyon, Water Canyon, Rock Cr-1, 2 (Wallowa), Dry Cr-1, 3, 4 (Wallowa), Reagin Gulch, Bear Cr-1, 2 (Wallowa), Little Bear Cr-1, Whiskey Cr-1, 2, SF, MF, NF (Wallowa), Straight Whiskey Cr, Whiskey Cr NF-2 (Wallowa)	24	Wallowa	0	1
Lostine-1, Parsnip Cr, Spring Cr-1, 3 (Wallowa), Trout Cr (Wallowa)	5	Wallowa	0	1
Hurricane Cr-1, 2, 4, 6, Little Hurricane Cr, Prairie Cr-1, 2, 3, 4, Hayes Fork, OK Gulch Fork	11	Wallowa	0	1
Grande Ronde-26, 27, 29, 30, 31, 32, 33, 34A, 34B, 35B, 36, 37	12	Mid GR	0	1
Lookingglass Cr-1	1	Lookingglass	0	1
Duncan Canyon, Jarboe Cr, Rysdam Canyon, Cabin Cr-1, SF, NF, Gordon Cr-1, 2, Pedro Cr Medicine Cr, Phillips Cr-1, 2, 3, 4, EF-1, 2, Little Phillips Cr, Bailey Cr, Clark Cr-1, 2, 3, 4,5 , NF, MF, Willow Cr-1, 2, 3, 4,5 , Mill Cr (Willow), End Cr, Coon Cr, Dry Cr-1, 2 (Willow), Smith Cr, Fir Cr, Lewis Branch	38	Mid GR Trib	0	1
Indian Cr-1, 2, 3, ,4, 5, 6, EF, NF, Shaw Cr, Little Indian Cr	10	Mid GR Trib	0	1
Catherine Cr-1, 2, 3, 4	4	Catherine	0	1
Mill Cr-1, 2 (Catherine), Ladd Cr-1, 2, Little Cr-1, 2,	6	Catherine	0	1
Grande Ronde-38, 39, 40, 41, 42, 43, 44 , 45, 46	9	Upper GR	0	1
Pyles Canyon-1, Five Points Cr-1, 2, 3, MF, Pelican Cr-1, 2, Dry Cr-1, 2 (Five Points), Calfornia Gulch, Fiddlers Hell, Mt Emily, Rock Cr-1, 2, 3, 4, EF (GR), Sheep Cr (GR Rock), Little Rock Cr	19	Upper GR Trib	0	1
Whiskey Cr-1, 2 (GR), Little Whiskey Cr, Spring Cr-1, 2, SF (GR), Jordan Cr, Bear Cr (4th GR), Bear Cr Trib (4th GR), Beaver Cr-1, 2 (GR), Hoodoo Cr, Meadow Cr-1, 2 , 3 , 4, 5, 6, 7, 8, 9 (2nd GR), Dark Canyon, McCoy Cr-1, 2, 3, Mclntyre Cr, Syrup Cr, Marley Cr, Burnt Corral Cr-1, 2, 3, EF, Su llivan Gulch, Battle Cr, Bear Cr (Meadow), Peet Cr, Waucup Cr, Warm Springs Cr, Fly Cr-1	39	Upper GR Trib	0	1
Grande Ronde-1	1	Lower GR	1	1
Crooked Cr-1	1	Wenaha	1	1
First Cr	1	Wenaha	1	1

Level of Proof: A combination of derived information and expert opinion was used to estimate the current and historical ratings for this attribute and the level of proof has theoretical support with some evidence from experiments or observations.

METALS – IN WATER COLUMN

Definition: The extent of dissolved heavy metals within the water column.

Rationale: Historically (template condition), toxic chemicals and metals in the water column and/or sediment were assumed to be non-existent or at background levels. Current levels are unknown and were assumed to be the same as the template condition.

Level of Proof: Expert opinion was used to estimate the current and historical ratings for this attribute and the level of proof is speculative with little empirical support because, of the lack of data.

METALS/POLLUTANTS – IN SEDIMENTS/SOILS

Definition: The extent of heavy metals and miscellaneous toxic pollutants within the stream sediments and/or soils adjacent to the stream channel.

Rationale: Historically (template condition), toxic chemicals and metals in the water column and/or sediment were assumed to be non-existent or at background levels. Current levels are unknown and were assumed to be the same as the template condition.

Level of Proof: Expert opinion was used to estimate the current and historical ratings for this attribute and the level of proof is speculative with little empirical support because of the lack of data.

MISCELLANEOUS TOXIC POLLUTANTS – WATER COLUMN

Definition: The extent of miscellaneous toxic pollutants (other than heavy metals) within the water column.

Rationale: Historically (template condition), toxic chemicals and metals in the water column and/or sediment were assumed to be non-existent or at background levels. Current levels are unknown and were assumed to be the same as the template condition.

Level of Proof: Expert opinion was used to estimate the current and historical ratings for this attribute and the level of proof is speculative with little empirical support because of the lack of data.

NUTRIENT ENRICHMENT

Definition: The extent of nutrient enrichment (most often by either nitrogen or phosphorous or both) from anthropogenic activities. Nitrogen and phosphorous are the primary macro-nutrients that enrich streams and cause build ups of algae. These conditions, in addition to leading to other

adverse conditions, such as low DO can be indicative of conditions that are unhealthy for salmonids.

Rationale: Actual data for this attribute is limited. Historically nutrient enrichment did not occur because watersheds were in the "pristine" state so the Template condition was rated as 0 for all reaches. To determine the amount of nutrient enrichment in various reaches the following factors were examined: fertilizing by timber companies, reaches downstream from hatcheries, agriculture effects, septic tanks, and storm water run-off.

Based of professional opinion the following reaches were rated as follows:

Reach Name	Template	Current
Catherine Cr-1 to 5	0.0	2.5
Grande Ronde-30, 31, 32, 33, 34, 35, 36	0.0	2.0
Crooked Cr-1, Medicine Cr, Indian Cr-1, Willow Cr-1, 2, Mill Cr-1 (Catherine), Little Cr-1, Pyles Canyon-1	0.0	2.0
Grande Ronde-1, 2, 3, 5, 6, 7, 8, 9, 10	0.0	1.0
Swamp Cr-1, 2, Davis Cr, Joseph Cr-5, 6, Sumac Cr, Crow Cr-1, 2, Elk Cr-1, 2 (Joseph), Chesnimnus Cr-1 to 9, Butte Cr (Chesnimnus), Vance Draw, Chesnimnus Cr NF	0.0	1.0
Shumaker Cr, Rattlesnake Cr-1, Cottonwood Cr-1 (GR) Bear Cr-1 (1st GR), Bear CR EF (1st GR), Cougar Cr (GR), Menatchee Cr, Grouse Cr- 1, Wenaha-1, Tope Cr	0.0	1.0
Minam-1, 2, 3, 4, 7, Squaw Cr (Minam), Gunderson Cr, Cougar Cr (Minam)	0.0	1.0
Rock Cr-1 (Wallowa), Dry Cr-1 (Wallowa), Whiskey Cr-1 (Wallowa), Spring Cr-1 (Wallowa), Spring Cr-3 (Wallowa), Trout Cr (Wallowa), Hurricane Cr-1	0.0	1.0
Wallowa-13, 14, 15, 16, 17, 19, Prairie Cr-1, 2, 3, Hayes Fork	0.0	1.0
Grande Ronde-26 to 29	0.0	1.0
Lookingglass Cr-1, Lookingglass Cr-2, Rysdam Canyon, Cabin Cr-1, Gordon Cr-1, Phillips Cr-1, Clark Cr-1, Shaw Cr, Indian Cr-2, Mill Cr (Willow) End Cr, Willow Cr-3, 4, Coon Cr, Willow Cr-4, Smith Cr, Fir Cr, Lewis Branch, Ladd Cr-1 , 2, Little Cr-2, Pyles Canyon-2, Catherine Cr-6, 7, 8, Little Catherine Cr, Milk Cr-1, 2 (Catherine)	0.0	1.0

Level of Proof: Expert opinion was used to estimate the current ratings for this attribute and the level of proof is speculative with little empirical support because the lack of data.

Biological Community

FISH COMMUNITY RICHNESS

Definition: Measure of the richness of the fish community (no. of fish taxa, i.e., species).
Rationale: Historical fish community richness was estimated from the current distribution of native fish in these watersheds.

Current fish community richness was estimated from direct observation (stream surveys and electro-shocking), personal communications with professional fish biologists/hatchery personnel familiar with these areas, and local knowledge.

Level of Proof: A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive. For historical

information, empirical observations were used to estimate the ratings for this attribute and the level of proof is thoroughly established.

FISH SPECIES INTRODUCTIONS

Definition: Measure of the richness of the fish community (no. of fish taxa). Taxa here refers to species.

Rationale: By definition the template conditions for this attribute are rated as a value of 0 because this describes this attribute rating for watersheds in pristine conditions. There are 15 introduced species in the Grande Ronde subbasin many of these are warmwater species which occur in the mainstem. Fish introductions was estimated from personal communications with professional fish biologists familiar with the area.

Level of Proof: A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive. For historical information, empirical observations were used to estimate the ratings for this attribute and the level of proof is thoroughly established.

HATCHERY FISH OUTPLANTS

Definition: The magnitude of hatchery fish outplants made into the drainage over the past 10 years. Note: Enter specific hatchery release numbers if the data input tool allows. "Drainage" here is defined loosely as being approximately the size that encompasses the spawning distribution of recognized populations in the watershed.

Rationale: By definition the template conditions for this attribute are rated as a value of 0 because this describes this attribute rating for watersheds in pristine conditions. In the historic condition (prior to 1850 and European settlement), there were no hatcheries or hatchery outplants.

Hatchery releases of chinook, and, steelhead were estimated by local professionals familiar with hatchery and release operations. The table below summaries EDT ratings for reaches where hatchery releases have occurred within the subbasin watersheds.

Reach Name	Watershed	Template	Current
Wallowa-1 to 22	Wallowa	0.0	4.0
Bear Cr-1,2,3,4,5 (Wallowa), Deer Cr-2,3 (Wallowa), Doc Cr, Dry Cr-1,3,4 (Wallowa), Fisher Cr, Fountain Canyon, Goat Cr, Hayes Fork, Howard Cr, Little Bear Cr-1,2,4, OK Gulch Fork, Parsnip Cr	Wallowa	0.0	4.0
Hurricane Cr-1, 2, 4, 6, Little Hurricane Cr	Wallowa	0.0	4.0
Prairie Cr-1,2,3,4	Wallowa	0.0	4.0
Reagin Gulch, Rock Cr-1, 2 (Wallowa), Sage Cr-2, Spring Cr-1,3 (Wallowa), Trout Cr (Wallowa), Water Canyon	Wallowa	0.0	4.0
Whiskey Cr-1, 2, SF, NF-1, NF-2, MF (Wallowa), Straight Whiskey Cr	Wallowa	0.0	4.0

Minam-1,2,3,4,5,6,7,8,9, N-1, N-3	Minam	0.0	1.0
Elk Cr-1,2,EF (Minam), Cougar Cr (Minam), Trout Cr (Minam), Gunderson Cr, Murphy Cr, Squaw Cr (Minam), Little Minam Cr-1	Minam	0.0	1.0
Lostine-1, 3, 4, 5, 6, 7, 8, Lake Cr	Lostine	0.0	4.0
Lookingglass Cr-1,2,3	Lookingglass	0.0	2.0
Lookingglass Cr-4, 5	Lookingglass	0.0	1.0
Grande Ronde-37,38,39,40,41,42,43,44,49,50	GR	0.0	2.0
Grande Ronde-4, 10, 11, 12, 13, 14, 15, 16, 17, 18	GR	0.0	4.0
Grande Ronde-48	GR	0.0	1.0
Grande Ronde-6	GR	0.0	2.0
Sheep Cr-3 (2nd GR)	GR	0.0	1.0
Catherine Cr NF-1, NF-2, SF-1	Catherine	0.0	1.0
Catherine Cr-1,2,3,4,5	Catherine	0.0	2.0
Catherine Cr-6, 7, 8, 9	Catherine	0.0	4.0

Level of Proof: For current and historical information, and professional judgment were used to estimate the ratings for this attribute.

FISH PATHOGENS

Definition: The presence of pathogenic organisms (relative abundance and species present) having potential for affecting survival of stream fishes.

Rationale: For this attribute the release of hatchery salmonids is a surrogate for pathogens. In the historic condition there were no hatcheries or hatchery outplants and we assumed an EDT rating of zero. Whirling disease has been detected in portions of the subbasin – but there has been no widespread evidence of this impacting populations. EDT ratings were assigned as follows:

- Joseph Creek, Lower Grande Ronde (mainstem & tribs), main Wallowa (except Minam) were assigned a rating of 3.
- Lookingglass +2
- Catherine Creek reaches were rated 2 or 1 depending on hatchery releases
- All Upper Grande Ronde Reaches were rated 1 because of stocking history.

Level of Proof: A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive.

HARASSMENT

Definition: The relative extent of poaching and/or harassment of fish within the stream reach.

Rationale: In the historic condition (prior to 1850 and European settlement), harassment levels were assumed to be low. By definition the template conditions for this attribute are rated as a value of 0 because this describes this attribute rating for watersheds in pristine conditions.

Topographic maps and digital orthophotos were examined to identify the proximity of stream reaches to population centers, and to estimate access via roads, bridges, gates, boat launches, etc. EDT ratings of 3.0 was given to reaches with road/boat access and high recreational use (i.e. Lower Grande Ronde reaches, upper Wallowa near Wallowa Lake); 2 was given to reaches with multiple access points (or road parallels reach) through public lands or unrestricted access through private lands (i.e.mid Grande Ronde, lower Wallowa); 1 was given to reaches with 1 or more access points behind a locked gate or 1 or more access points but limited due to private lands; 0 was given to reaches with no roads and that are far from population centers.

Level of Proof: There is no statistical formula used to estimate harassment. Therefore, expert opinion was used to estimate the current ratings for this attribute and the level of proof has theoretical support with some evidence from experiments or observations.

PREDATION RISK

Definition: Level of predation risk on fish species due to presence of top level carnivores or unusual concentrations of other fish eating species. This is a classification of per-capita predation risk, in terms of the likelihood, magnitude and frequency of exposure to potential predators (assuming other habitat factors are constant).

Rationale: By definition the template conditions for this attribute are rated as a value of 2 because this describes this attribute rating for watersheds in pristine conditions.

There were 54 reaches identified where native predator fish populations have been depressed. These are generally reaches which historically supported Bull trout these reaches were assigned an EDT rating of 1. In all other reaches, we assumed current predation levels were the same as the template.

Level of Proof: There is no statistical formula used to estimate predation risk. A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive.

SALMON CARCASSES

Definition: Relative abundance of anadromous salmonid carcasses within watershed that can serve as nutrient sources for juvenile salmonid production and other organisms. Relative abundance is expressed here as the density of salmon carcasses within subdrainages (or areas) of the watershed, such as the lower mainstem vs. the upper mainstem, or in mainstem areas vs. major tributary drainages.

Rationale: Historic carcass abundance was estimated based on the distribution of anadromous fish in the watershed.

- Reaches with historic fall chinook (spawning) were given a rating of 3.2
- Mainstem reaches with chinook and coho, were given a rating of 2.
- Reaches with chinook were given a rating of 3.6 or 3.7 depending on historic return information

- Catherine Creek reaches with spring chinook and steelehead were rated 3.8
- Upper Grande Ronde reaches with spring chinook were rated 3.9
- Reaches with coho, steelhead and bull trout were given a rating of 2.5
- Lookingglass creek spawning reaches with spring chinook, steelhead were rated 3.4
- Reaches with sockeye were given a rating of 0.8
- Reaches with bull trout and/ or steelhead were given a rating of 4, since these fish do not die after spawning.

An estimate of the current number of salmon carcasses per mile was derived from natural spawn escapement estimates for salmonids in each basin, EDT reach length data, and fish distribution data. Using potential fish distribution, EDT reach lengths were summed to develop the total number of miles of available habitat for each species. The natural spawn escapement estimate was divided by the corresponding number of miles of habitat to generate the average number of carcasses per mile for each species. These values were summed according to the species present within each reach to develop the total number of carcasses per mile within the reach.

Level of Proof: A combination of empirical observations, expansion of empirical observations, and expert opinion was used to estimate the current ratings for this attribute and the level of proof has a strong weight of evidence in support but not fully conclusive

BENTHOS DIVERSITY AND PRODUCTION

Definition: Measure of the diversity and production of the benthic macroinvertebrate community. Three types of measures are given (choose one): a simple EPT count, Benthic Index of Biological Integrity (B-IBI)—a multimetric approach (Karr and Chu 1999), or a multivariate approach using the BORIS (Benthic evaluation of ORegon RIverS) model (Canale 1999). B-IBI rating definitions from Morley (2000) as modified from Karr et al. (1986). BORIS score definitions based on ODEQ protocols, after Barbour et al. (1994).

Rationale: Direct measures of benthos diversity were only available for a small portion of the upper Grande Ronde and Wenaha watersheds. We assigned an EDT rating of "0" and assumed that in the historic condition macroinvertebrate populations were healthy, diverse, and productive and in the natural/pristine state.

Using the spot data that was available and nutrient enrichment levels and mean August temperatures EDT ratings were generated. For the reaches where nutrient enhancement was minimal and average August water temperatures fell between 12 and 20 deg. C producing an EDT rating of "0", this was usually in the wilderness watershed (Wenaha and Minam) as well as the upper Grande Ronde.

Shaping Pattern Keys

Attribute	Default Shaping Pattern
Bed Scour (BdScour)	FlowMax
Dissolved oxygen (DisOxy)	TempMax
Flow High (FlwHigh)	FlowMax
Flow Low (FlwLow)	FlowMin
Flow Intra-annual (FlwIntraAnn) -- "flow flashiness"	FlowMax
Icing (Icing)	TempMin
Nutrient Enrichment (NutEnrch)	TempMax
Predation Risk (PredRisk)	*TempMax*
Temperature Maximum (TempMx)	TempMax
Temperature Minimum (TempMn)	TempMin
Turbidity (Turb) -- deleterious affects of suspended sediments	*FlowMax*
Width Max (WidthMx)	Flow
Width Min (WidthMn)	Flow
Withdrawals (Wdrwl),	FlowMin

Low Flow Multipliers - FLOWMIN

Gage #	Gage Name	Reach #'s	Jan	Feb	March	April	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.
13318500	Grande Ronde nr Hilgard, OR	427--461	0.616	0.281	0	0	0	0	0.705	0.987	1	0.955	0.8	0.505
13318800	Grande Ronde at Hilgard, OR	420-426,462-509	0.102	0.08	0	0	0	0	0.739	0.985	1	0.985	0.851	0.523
13319000	Grande Ronde at La Grande	399-419	0.175	0	0	0	0	0	0.784	1	0.993	0.923	0.801	0.43
13320000	Catherine Creek	382-397	0.824	0.689	0.219	0	0	0	0.313	0.923	1	0.964	0.886	0.83
13323500	Grande Ronde nr Elgin	351-381,398	0.533	0.189	0	0	0	0	0.291	0.965	1	0.942	0.797	0.558
13323600	Indian Creek	345-350	0.599	0.076	0	0	0	0	0.81	0.988	1	0.987	0.778	0.657
13329770	Wallowa River above Cross Country Canal	259-261,264-274,276,277-286,288-291	1	0.895	0.672	0.384	0	0	0	0.515	0.411	0.699	0.803	0.842
13330050	Lostine River at Caudle Lane	257-258	0.77	0.735	0.72	0.187	0	0	0	0.76	1	0.87	0.69	0.72
13330300	Lostine River at Baker Rd	255-256	0.87	0.838	0.886	0.126	0	0	0	0.908	1	0.819	0.6614	0.757
13330500	Bear Creek	234-243	0.61	0.53	0.36	0	0	0	0	0.92	1	0.93	0.58	0.5
13331450	Wallowa River below Water Canyon	223-233, 244-253,262-263	0.697	0.449	0.19	0	0	0	0	1	0.97	0.887	0.674	0.619
13331500	Minam River	182-213	0.706	0.557	0.387	0	0	0	0	0.835	0.994	1	0.846	0.739
13332000	Wallow River at Minam	214-222	0.906	0.832	0.029	0	0	0	0	0.836	1	0.948	0.674	0.841
13332500	Grande Ronde at Rondowa	292-296, 297-344	0.533	0.189	0	0	0	0	0.291	0.965	1	0.942	0.797	0.558
13333000	Grand Ronde at Troy	101-181	0.382	0	0	0	0	0	0.397	0.966	1	0.951	0.794	0.471
13334000	Grande Ronde nr Zindel WA	1 -100	0.686	0.609	0	0	0	0	0.201	0.971	1	0.915	0.627	0.896

High Flow Mulitipliers - FLOWMAX

Gage #	Gage Name	Reach #'s	Jan	Feb	March	April	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.
13318500	Grande Ronde nr Hilgard, OR	427--461	0	0	0.3	1	0.854	0.235	0	0	0	0	0	0
13318800	Grande Ronde at Hilgard, OR	420-426,462-509	0	0	0.383	0.836	1	0.208	0	0	0	0	0	0
13319000	Grande Ronde at La Grande	399-419	0	0.162	0.362	0.904	1	0.27	0	0	0	0	0	0
13320000	Catherine Creek	382-397	0	0	0	0.162	1	0.617	0	0	0	0	0	0
13323500	Grande Ronde nr Elgin	351-381,398	0	0	0.204	0.637	1	0.739	0	0	0	0	0	0
13323600	Indian Creek	345-350	0	0	0.234	0.836	1	0.117	0	0	0	0	0	0
13329770	Wallowa River above Cross Country Canal	259-261,264-274,276,277-286,288-291	0	0	0	0	0.436	1	0.477	0	0	0	0	0
13330050	Lostine River at Caudle Lane	257-258	0	0	0	0	0.491	1	0.394	0	0	0	0	0
13330300	Lostine River at Baker Rd	255-256	0	0	0	0	0.517	1	0.29	0	0	0	0	0
13330500	Bear Creek	234-243	0	0	0	0.223	0.674	1	0.014	0	0	0	0	0
13331450	Wallowa River below Water Canyon	223-233, 244-253,262-263	0	0	0	0.122	0.674	1	0.17	0	0	0	0	0
13331500	Minam River	182-213	0	0	0	0.077	0.761	1	0.144	0	0	0	0	0
13332000	Wallow River at Minam	214-222	0	0	0	0.302	0.64	1	0.16	0	0	0	0	0
13332500	Grande Ronde at Rondowa	292-296, 297-344	0	0	0.204	0.637	1	0.739	0	0	0	0	0	0
13333000	Grand Ronde at Troy	101-181	0	0.027	0.286	0.762	1	0.602	0	0	0	0	0	0
13334000	Grande Ronde nr Zindel WA	1 -100	0	0	0.763	0.868	0.793	1	0	0	0	0	0	0

Shaping pattern for widths - FLOW

Gage #	Gage Name	Reach #'s	Jan	Feb	March	April	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.
13318500	Grande Ronde nr Hilgard, OR	427--461	0.1359	0.2304	0.5173	1.0000	0.8998	0.4724	0.1106	0.0311	0.0276	0.0403	0.0840	0.1671
13318800	Grande Ronde at Hilgard, OR	420-426,462-509	0.3084	0.3152	0.5930	0.8923	1.0000	0.4773	0.1145	0.0397	0.0351	0.0397	0.0805	0.1803
13319000	Grande Ronde at La Grande	399-419	0.0595	0.1570	0.6422	1.0000	0.6638	0.3015	0.0674	0.0216	0.0222	0.0288	0.0484	0.0621
13320000	Catherine Creek	382-397	0.1095	0.1387	0.2409	0.5839	1.0000	0.7275	0.2204	0.0878	0.0713	0.0791	0.0959	0.1080
13323500	Grande Ronde nr Elgin	351-381,398	0.2975	0.4375	0.5897	0.9388	1.0000	0.5306	0.0931	0.0208	0.0229	0.0463	0.0873	0.2118
13323600	Indian Creek	345-350	0.0434	0.0505	0.0760	0.3403	1.0000	0.6990	0.1582	0.0337	0.0238	0.0287	0.0393	0.0556
13329770	Wallowa River above Cross Country Canal	259-261,264-274,276,277-286,288-291	0.3786	0.3939	0.4264	0.4685	0.7323	1.0000	0.7514	0.4493	0.4646	0.4226	0.4073	0.4015
13330050	Lostine River at Caudle Lane	257-258	0.0828	0.0907	0.0938	0.2103	0.6195	1.0000	0.5465	0.0837	0.0329	0.0605	0.1003	0.0933
13330300	Lostine River at Baker Rd	255-256	0.0939	0.1017	0.0923	0.2397	0.6448	1.0000	0.4807	0.0880	0.0703	0.1053	0.1359	0.1173
13330500	Bear Creek	234-243	0.1417	0.1639	0.2076	0.4606	0.9059	1.0000	0.3155	0.0585	0.0384	0.0547	0.1494	0.1707
13331450	Wallowa River below Water Canyon	223-233, 244-253,262-263	0.2572	0.3099	0.3650	0.4783	0.8065	1.0000	0.5070	0.1929	0.1972	0.2168	0.2621	0.2737
13331500	Minam River	182-213	0.1286	0.1630	0.2024	0.3469	0.8313	1.0000	0.3947	0.0987	0.0619	0.0606	0.0961	0.1209
13332000	Wallow River at Minam	214-222	0.1402	0.1570	0.3390	0.5434	0.7648	1.0000	0.4510	0.1560	0.1191	0.1308	0.1928	0.1550
13332500	Grande Ronde at Rondowa	292-296, 297-344	0.2364	0.3383	0.5183	0.7805	1.0000	0.8425	0.3081	0.1087	0.0984	0.1153	0.1583	0.2290
13333000	Grand Ronde at Troy	101-181	0.0632	0.0603	0.0702	0.2056	0.6510	1.0000	0.4860	0.1094	0.0637	0.0716	0.0816	0.0745
13334000	Grande Ronde nr Zindel WA	1 -100	0.2218	0.2469	0.8686	0.9268	0.8848	1.0000	0.3785	0.1299	0.1208	0.1481	0.2410	0.1542

Temp Min	Jan	Feb	March	April	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.
Wenaha - Crooked Creek @ Mouth	1	0.8	0.7	0.15	0	0	0	0	0	0	0.8	0.88

TempMAX	Jan	Feb	March	April	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.
Wenaha - Crooked Creek @ Mouth	0.00	0.00	0.00	0.00	0.16	0.68	1.00	0.86	0.68	0.19	0.00	0.00

Appendix B: DESCRIPTION OF QUANTITATIVE ACTIONS USED IN MODELING GRANDE RONDE RESTORATION SCENARIOS

STATUS QUO ACTIONS

OVERVIEW

The Status Quo set of actions is divided into four distinct elements: a "restoration element", a "degradation element" a "partial Properly Functioning Condition ("partial PFC")" and an "obstruction removal element."

The "restoration element" of the status quo scenario was based on discussions with Lyle Kuchenbecker and Cecilia Noyes of the Grande Ronde Model Watershed Project. These individuals were asked to identify projects that had already been implemented but which will require a number of years to mature in terms of benefits to fish habitat and fish production. A perfect example of the type of project they were asked to identify was a riparian fencing project. Obviously, some decades are necessary before a fenced-off riparian corridor can be expected to regenerate itself. Other types of long-maturing restoration projects incorporated in the restoration element included campground closures, road obliterations and closures, floodplain restoration, wet meadow restoration, addition of large woody debris to stream channels, and, as mentioned, various types of riparian restoration actions.

The "partial PFC" element consisted of applying PFC conditions to all reaches under federal management (U.S. Forest Service and Bureau of Land management) except for those already included in a Wilderness Area. Wilderness Areas were excluded because environmental conditions there are already better than are projected under a PFC scenario. Although the PFC scenario is defined in detail in Appendix 1 at the bottom of this document, it is appropriate to briefly define this scenario here. In very general terms, PFC conditions are established for each environmental attribute individually, and the values set represent conditions "just good enough" to pose no threat to the long-term viability of a salmonid population. This scenario is termed a "partial PFC" because normally PFC conditions are applied throughout a Subbasin. In this case, however, they were applied only to non-Wilderness reaches under federal management. This restriction of PFC effects is justified by the fact numerous federal land and water management policies already in effect should, over 25 years, result in the attainment of PFC status for federally managed areas.

Because conversations with Union and Wallowa County Planners indicated no meaningful changes in agricultural, industrial or logging-related activities were expected over the next 25 years, the degradation element was assumed to be caused exclusively by urban growth. The population increase expected over the next 25 years was based on information gleaned from the U.S. Census Bureau Quick Facts Internet site (http://quickfacts.census.gov/qfd/) for Union and Wallowa Counties. Adverse urbanization impacts were restricted to stream reaches flowing through cities and towns with a current population of 1,000 or more, and to one or two reaches upstream and downstream of such cities and towns.

Obstructions were not assumed to be made fully passable throughout the subbasin under the Status Quo scenario. Rather, obstructions to fish passage were modeled as being eliminated only

for reaches under federal management. This restriction was made because the Grande Ronde Model Watershed staff did not expect all obstructions to be eliminated, but the elimination of obstructions *is* a standard provision of the PFC scenario, which applies to all federally managed waters.

DEGRADATION ACTIONS

Census Bureau information was used to generate a regression that was used to forecast population growth over the next 25 years (3.6% for Wallowa County and 19.1% for Union County). The data and regression for this forecast is summarized in Table A-1 below.

Table A-1. Data and population growth regressions for Union and Wallowa Counties (data from U.S. Census Bureau).

Wallowa County

YEAR	POPULATION	
1960	7102	
1970	6247	
1980	7273	
1990	6911	
2000	7226	
2003	7082	Absolute increase
2029	7,338	256
		Percent increase
		3.6%

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.362284219
R Square	0.131249855
Adjusted F	-0.085937681
Standard E	393.6398596
Observatio	6

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regressior	1	93640.14	93640.14	0.604316	0.480349
Residual	4	619809.4	154952.3		
Total	5	713449.5			

	Coefficients	*tandard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-9019.478195	20573.62	-0.4384	0.683733	-66141.1	48102.16
X Variable	8.061654135	10.37032	0.777378	0.480349	-20.731	36.85434

Union County

YEAR	POPULATION	
1960	18180	
1970	19377	
1980	23921	
1990	23598	
2000	24530	
2003	24561	Absolute increase
2029	29,252	4,691
		Percent increase
		0.190976

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.916817221
R Square	0.840553817
Adjusted F	0.800692272
Standard E	1261.035474
Observatio	6

ANOVA

	df	*SS*	*MS*	*F*	*ignificance F*
Regressior	1	33532505	33532505	21.08683	0.010091
Residual	4	6360842	1590210		
Total	5	39893347			

	Coefficients	*tandard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-280282.3038	65908.11	-4.25262	0.013131	-463273	-97291.7
X Variable	152.5548872	33.22159	4.59204	0.010091	60.31677	244.793

Population growth was assumed to be restricted to the immediate vicinity of existing cities and towns with a population of 1,000 or more. Specifically, growth was assumed to occur between one or two EDT reaches upstream and downstream of these larger urban areas. The precise location of urbanization effects is described in Table A-2.

Some of the 46 environmental attributes used by the EDT model were assumed to be affected by the "full force" of the projected growth increase, some were assumed to be affected by a fraction of projected growth (25 or 50%), and some were assumed to be totally unaffected. Table A-3 describes precisely the attributes that were modeled as being affected by increased development and the degree of degradation assumed to be associated with this increase in development.

Table A-2. Specific reaches assumed to be affected by increased development in Elgin, La Grande/Island City, Cover, Enterprise-Joseph and Wallowa, Oregon.

Reaches	City	Description	Assumed Increase in Population
Grande Ronde-31	Elgin	Gande Ronde, at Gordon Cr confl.	19.0%
Grande Ronde-32	Elgin	Gande Ronde, at Indian Creek confl.	19.0%
Grande Ronde-35_B	La Grande / Island City	GR, upper end of state ditch	19.0%
Grande Ronde-37	La Grande / Island City	GR, at 5 Points Cr confl.	19.0%
Mill Cr-1 (Catherine)	Cove	Mill Cr near Cove	19.0%
Mill Cr-2 (Catherine)	Cove	Mill Cr near Cove	19.0%
Little Cr-1	Union	Little Cr near Union	19.0%
Little Cr-2	Union	Little Cr near Union	19.0%
Pyles Canyon-1	Union	Plyles Canyon Cr near Union	19.0%
Pyles Canyon-2	Union	Plyles Canyon Cr near Union	19.0%
Catherine Cr-5	Union	Catherine Cr at Pyles Canyon Cr confl.	19.0%
Catherine Cr-6	Union	Catherine Cr at State Ditch above Hwy 203	19.0%
Wallowa-14	Enterprise-Joseph	Wallowa River at Trout Cr confl.	3.6%
Wallowa-18	Enterprise-Joseph	Wallowa River at Dorrance Rd Divesion	3.6%
Wallowa-9	Wallowa	Wallowa River at Bear Cr confl.	3.6%
Wallowa-10	Wallowa	Wallowa River at Lostine River confl.	3.6%

The phrase “degree of degradation” in Table A-3 is defined as “the percent to which the existing difference between current and historical environmental conditions *increases* – that is to say, the proportional *worsening* of conditions relative to estimated historical conditions.” The reader is referred to May et al. 1997 for the justification for assuming that the impact to some attributes would be directly proportional to the increase in development, while the impact to others would be 50%, 25% or non-existent.

Table A-3. Environmental attributes modeled as impacted by urban development increases predicted over the next 25 years for Union and Wallowa Counties, Oregon (data from U.S. Census Bureau and May et al. 1997).

Environmental Attributes Affected (for all cities and reaches)	Projected Increase in Development (Union County)	Projected Increase in Development (Wallowa County)	Projected Degree of Degradation (Union County)	Projected Degree of Degradation (Wallowa County)
Benthic Community Richness (food)	19.1%	3.6%	9.6%	1.8%
Man-caused Confinement	19.1%	3.6%	19.1%	3.6%
Embeddedness	19.1%	3.6%	4.8%	0.9%
Hourly Flow Fluctuations	19.1%	3.6%	9.6%	1.8%
Peak Flow Impacts	19.1%	3.6%	4.8%	0.9%
Flashy Flow Impacts	19.1%	3.6%	19.1%	3.6%
Fine Sediment	19.1%	3.6%	4.8%	0.9%
Fish Pathogens	19.1%	3.6%	9.6%	1.8%
Harassment	19.1%	3.6%	19.1%	3.6%
Backwater Pools	19.1%	3.6%	9.6%	1.8%
Beaver Ponds	19.1%	3.6%	19.1%	3.6%
Off-channel Habitat	19.1%	3.6%	19.1%	3.6%
Primary Pools	19.1%	3.6%	9.6%	1.8%
Pool Tail-outs	19.1%	3.6%	9.6%	1.8%
Heavy Metals (soils/sediment)	19.1%	3.6%	19.1%	3.6%
Heavy Metals (dissolved)	19.1%	3.6%	19.1%	3.6%
Miscellaneous Toxic Pollution	19.1%	3.6%	19.1%	3.6%
Nutriewnt Enrichment	19.1%	3.6%	19.1%	3.6%
Riparian Function	19.1%	3.6%	19.1%	3.6%
Spatial Variation in Temperature	19.1%	3.6%	19.1%	3.6%
Turbidity	19.1%	3.6%	4.8%	0.9%
Large Woody Debris	19.1%	3.6%	19.1%	3.6%

RESTORATION ACTIONS

Table A-4 summarizes the impacts that were modeled for long-maturing projects of various types. It must be understood that the values entered in the table are rough approximations, but an attempt was made to be conservative in terms of expected effectiveness as well as to ensure that the relative effectiveness of similar actions were entered appropriately -- e.g., that the benefits ascribed to "riparian planting" were less than the benefits of "riparian fencing *and* planting."

All of the information in Table A-4 (as well as Tables A-5, A-5A and A-6 to follow) was culled from a restoration project dataset generously provided by Cecilia Noyes of the Grande Ronde Model Watershed project. Some of the actions in the original dataset were omitted because, after further reflection, it was determined that they were not "long-maturing"--that their benefits were essentially immediate and had already been included in the description of current environmental conditions. Again, the way the data in Table A-4 was applied was to assume a percent restoration for a specific attribute in a specific reach equal to the *product* of the assumed effectiveness of the action and the ratio of the project footprint length to the length of the Geographic Area in which it was applied.

One additional consideration was applied to the effectiveness assumptions summarized in Table A-4. This consideration deals with the downstream propagation of beneficial effects. Water flows downhill, and a number of environmental attributes are propagated downstream somewhat after the fashion of a dissolved or suspended substance. Clearly flow-related attributes (e.g., peak flow, base flow, flow flashiness) "trickle down" from upper to lower reaches, as do sediment-related attributes and, with site-specific variations, temperature. A simple volumetric approach to modeling beneficial "trickle-down impacts" is possible in which the downstream impact is a simple function of the ratio of the discharge in the source and receiving reaches. Although simple predictions must be (and were) tempered by a host of "other factors" and site-specific considerations, predictions of some sort were needed to realistically assess the benefits of restoration actions.

The actual process employed involved the use of a relationship between wetted width and discharge for streams east of the Cascades (Johnson et al. 1994). This relationship gave width (in feet) as a function of discharge (cfs), but can be re-arranged to give discharge as a function of width. The re-arranged function was:

$$Q = \left(\frac{W}{5.5789}\right)^{\frac{1}{0.566}} \qquad \text{Equation 1}$$

in which Q is mean discharge in cfs, W is mean width in feet and 5.5789 and 0.566 are constants.

Table A-4. Benefits of long-maturing restoration actions as modeled in EDT status Quo Scenario. NOTE: effectiveness is expressed in terms of the product of the assumed percent restoration of historical/normative conditions and the percent of the Geographic Area covered by the footprint of the action.

Task_Name	Riparian Function	Pool Habtat (all types)	Off-Channel Habitat	Fines, Turbidity, Embeddedness	Maximum Temperature	Harassment	LWD	Peak Flow Impacts	Low Flow Impacts	Flashy Flow Impacts	Man-Caused Confinement
close campground(s)	15% rest * % length	5% rest* % length		15% rest * % length	15% rest for width<30*%length, 5% rest for width>30 * % length	90% rest * % length	10% rest* % length				100% rest * % length
obliterate campground(s)	20% rest * % length	5% rest* % length		15% rest * % length	20% rest for width<30*%length, 5% rest for width>30 * % length	90% rest * % length	10% rest* % length				100% rest * % length
floodplain restoration	40% rest * % length	25% rest* % length	100% rest* % length	40% rest* % length	30% rest for width<30*%length, 15% rest for width>30 * % length		15% rest* % length	5% rest* % length	40% rest* % length	10% rest* % length	100% rest * % length
LWD addition	5% rest* % length	40% rest* % length	20% rest* % length	10% rest* % length		50% rest * % length	20% * % length for streams <50 ft, 10% * % length for streams >50 ft wide				
Restore wet meadow	30% rest * % length			drainage specific	drainage specific	drainage specific	drainage specific	drainage specific	drainage specific	drainage specific	drainage specific
Riparian water development	5% rest * % length										
Riparian seeding	10% rest * % length			5% rest * % length	5% rest for width<30*%length						
Riparian planting	12% rest * % length			5% rest * % length	7% rest for width<30*%length						
Riparian seeding and water development	12% rest * % length			12% rest * % length	7% rest for width<30*%length						
Riparian planting & water development	15% rest * % length			15% rest * % length	8% rest for width<30*%length						
Riparian fencing	20% rest * % length	5% rest* % length		20% rest * % length	15% rest for width<30*%length, 5% rest for width>30 * % length		5% rest* % length		20% rest* % length		
Riparian fencing & seeding or Riparian fencing & water development	25% rest * % length	5% rest* % length		20% rest * % length	20% rest for width<30*%length, 5% rest for width>30 * % length		5% rest* % length		25% rest* % length		
Riparian fencing & planting	30% rest * % length	15% rest* % length		25% rest * % length	25% rest for width<30*%length, 10% rest for width>30 * % length		10% rest* % length		30% rest* % length		
Riparian fencing & planting & water development	30% rest * % length	15% rest* % length		30% rest * % length	25% rest for width<30*%length, 10% rest for width>30 * % length		10% rest* % length		30% rest* % length		
road(s) closed or obliterated	Reach-specific estimates from L. Kuchenbecker	Reach-specific estimates from L. Kuchenbecker	Reach-specific estimates from L. Kuchenbecker	Reach-specific estimates from L. Kuchenbecker	Reach-specific estimates from L. Kuchenbecker	Reach-specific estimates from L. Kuchenbecker	Reach-specific estimates from L. Kuchenbecker	Reach-specific estimates from L. Kuchenbecker	Reach-specific estimates from L. Kuchenbecker	Reach-specific estimates from L. Kuchenbecker	Reach-specific estimates from L. Kuchenbecker

Table A-5. Estimated improvement in environmental conditions in Geographic Areas of the Grande Ronde Subbasin attributable to road closures and road obliterations. Estimates for improvement over Current conditions for fines, embeddedness , turbidity, riparian function and temperature provided by L. Kuchenbecker of the Grande Ronde Model Watershed Project. MBI assumed that road-related confinement would be essentially eliminated by road obliteration and essentially unaffected by a simple road closure.

			Improvement After 25 Years			
Geographic Area	Action Type	% Length of Geographic Area benefitted	Percent Improvement in Current Fines, Embeddedness and Turbidity	Percent Improvement in Current Riparian Function Rating	Percent Improvement in Current Temperature Rating	Percent Improvement in Current Anthropogenic Confinement Rating
Lower Indian Cr	road(s) closed	15%	25%	15%	5%	0%
Lower Minam R	road(s) closed	36%	20%	10%	5%	0%
McCoy Cr	road(s) closed	19%	50%	35%	5%	0%
Mid Grnd Rnd R 4	road(s) closed	12%	25%	15%	5%	0%
Phillips Cr	road(s) closed	11%	15%	10%	5%	0%
Rock Cr (Wallowa)	road(s) closed	6%	25%	10%	5%	0%
Upper Lostine R	road(s) closed	46%	25%	15%	5%	0%
Upper Mud Cr	road(s) closed	4%	20%	10%	5%	0%
Lower Grnd Rnd tribs 2	road(s) obliterated	27%	40%	20%	10%	90%
McCoy Cr	road(s) obliterated	65%	50%	35%	15%	90%
Mid Grnd Rnd tribs 4	road(s) obliterated	1%	40%	15%	10%	90%
Phillips Cr	road(s) obliterated	9%	35%	15%	5%	90%
SF Catherine Cr	road(s) obliterated	36%	60%	35%	15%	90%
Sheep Cr (GR)	road(s) obliterated	3%	45%	25%	10%	90%
Upper 5-points Cr	road(s) obliterated	6%	45%	25%	10%	90%
Upper Chesnimnus Cr	road(s) obliterated	3%	45%	25%	10%	90%
Upper Grnd Rnd R 1	road(s) obliterated	5%	45%	25%	10%	90%
Upper Grnd Rnd R 2	road(s) obliterated	3%	45%	25%	10%	90%
Upper Lookglass Cr	road(s) obliterated	21%	40%	20%	5%	90%
Upper Meadow Cr	road(s) obliterated	5%	60%	35%	15%	90%
Upper Mud Cr	road(s) obliterated	1%	40%	20%	10%	90%
Upper Willow Cr	road(s) obliterated	16%	40%	20%	10%	90%

Table A-5A. Assumed benefits of road obliteration and/or closure to nearby stream reaches in the Grande Ronde Subbasin. Effectiveness estimates provided by Grande Ronde Model Watershed Project.

Reach	% Restoration Fines. Embeddedness, Turbidity	% Restoration Riparian Function	% Restoration of Maximum Temperature	% Restoration Man-Caused Confinement
Alder Cr (GR)	21.23%	5.31%	17.25%	0.00%
Bailey Cr	11.90%	2.36%	1.95%	7.70%
Battle Cr	5.50%	1.62%	1.35%	4.17%
Bear Cr (3rd GR)	21.23%	5.31%	17.25%	0.00%
Bear Cr (4th GR)	0.65%	0.16%	0.30%	0.95%
Bear Cr (Meadow)	5.50%	1.62%	1.35%	4.17%
Bear Cr Trib (4th GR)	0.65%	0.16%	0.30%	0.95%
Beaver Cr-1 (GR)	0.65%	0.16%	0.30%	0.95%
Beaver Cr-2 (GR)	0.65%	0.16%	0.30%	0.95%
Billy Cr	4.08%	0.76%	0.88%	2.72%

Table A-5A. Assumed benefits of road obliteration and/or closure to nearby stream reaches in the Grande Ronde Subbasin. Effectiveness estimates provided by Grande Ronde Model Watershed Project.

Reach	% Restoration Fines. Embeddedness, Turbidity	% Restoration Riparian Function	% Restoration of Maximum Temperature	% Restoration Man-Caused Confinement
Burnt Corral Cr EF	5.50%	1.62%	1.35%	4.17%
Burnt Corral Cr-1	5.50%	1.62%	1.35%	4.17%
Burnt Corral Cr-2	5.50%	1.62%	1.35%	4.17%
Burnt Corral Cr-3	5.50%	1.62%	1.35%	4.17%
Catherine Cr SF-1	50.57%	0.00%	0.00%	0.00%
Catherine Cr SF-2	50.57%	0.00%	0.00%	0.00%
Chesnimnus Cr NF	4.08%	0.76%	0.88%	2.72%
Chesnimnus Cr SF	4.08%	0.76%	0.88%	2.72%
Chesnimnus Cr-5	4.08%	0.76%	0.88%	2.72%
Chesnimnus Cr-6	4.08%	0.76%	0.88%	2.72%
Chesnimnus Cr-7	4.08%	0.76%	0.88%	2.72%
Chesnimnus Cr-8	4.08%	0.76%	0.88%	2.72%
Chesnimnus Cr-9	4.08%	0.76%	0.88%	2.72%
Chicken Cr W	2.36%	0.86%	0.98%	3.10%
Chicken Cr-1	2.36%	0.86%	0.98%	3.10%
Chicken Cr-2	2.36%	0.86%	0.98%	3.10%
Clark Cr MF	11.90%	2.36%	1.95%	7.70%
Clark Cr NF	11.90%	2.36%	1.95%	7.70%
Clark Cr-1	11.90%	2.36%	1.95%	7.70%
Clark Cr-2	11.90%	2.36%	1.95%	7.70%
Clark Cr-3	11.90%	2.36%	1.95%	7.70%
Clark Cr-4	11.90%	2.36%	1.95%	7.70%
Clark Cr-5	11.90%	2.36%	1.95%	7.70%
Clear Cr (1st GR)	21.23%	5.31%	17.25%	0.00%
Collins Cr	50.57%	0.00%	0.00%	0.00%
Dark Canyon	72.97%	29.54%	23.67%	58.85%
Devils Run Cr-1	4.08%	0.76%	0.88%	2.72%
Devils Run Cr-2	4.08%	0.76%	0.88%	2.72%
Devils Run Cr-3	4.08%	0.76%	0.88%	2.72%
Devils Run Cr-4	4.08%	0.76%	0.88%	2.72%
Doe Cr	4.08%	0.76%	0.88%	2.72%
Dry Cr (2nd GR Sheep)	2.36%	0.86%	0.98%	3.10%
Dry Cr-1 (Wallowa)	2.92%	0.58%	0.53%	0.00%
Dry Cr-1 (Willow)	0.00%	3.23%	3.03%	14.53%
Dry Cr-2 (Wallowa)	2.92%	0.58%	0.53%	0.00%
Dry Cr-2 (Willow)	0.00%	3.23%	3.03%	14.53%
Dry Cr-3 (Wallowa)	2.92%	0.58%	0.53%	0.00%
Dry Cr-4 (Wallowa)	2.92%	0.58%	0.53%	0.00%
Eagle Cr	76.44%	4.25%	2.12%	19.11%
Elbow Cr	21.23%	5.31%	17.25%	0.00%
Evans Cr	3.78%	0.63%	0.84%	0.95%

Table A-5A. Assumed benefits of road obliteration and/or closure to nearby stream reaches in the Grande Ronde Subbasin. Effectiveness estimates provided by Grande Ronde Model Watershed Project.

Reach	% Restoration Fines. Embeddedness, Turbidity	% Restoration Riparian Function	% Restoration of Maximum Temperature	% Restoration Man-Caused Confinement
Fiddlers Hell	5.18%	0.00%	0.00%	0.00%
Finley Cr	0.00%	3.23%	3.03%	14.53%
Fir Cr	0.00%	3.23%	3.03%	14.53%
Five Points Cr-2	5.18%	0.00%	0.00%	0.00%
Five Points Cr-3	5.18%	0.00%	0.00%	0.00%
Five Points MF	5.18%	0.00%	0.00%	0.00%
Grande Ronde-38	7.96%	1.84%	0.86%	0.00%
Grande Ronde-39	7.96%	1.84%	0.86%	0.00%
Grande Ronde-40	7.96%	1.84%	0.86%	0.00%
Grande Ronde-41	7.96%	1.84%	0.86%	0.00%
Grande Ronde-42	7.96%	1.84%	0.86%	0.00%
Grande Ronde-43	7.96%	1.84%	0.86%	0.00%
Grande Ronde-44	7.96%	1.84%	0.86%	0.00%
Grande Ronde-45	12.26%	1.36%	0.86%	4.90%
Grande Ronde-46	12.26%	1.36%	0.86%	4.90%
Grande Ronde-47	12.26%	1.36%	0.86%	4.90%
Grande Ronde-48	12.26%	1.36%	0.86%	4.90%
Grande Ronde-49	4.04%	0.84%	0.67%	3.03%
Grande Ronde-50	4.04%	0.84%	0.67%	3.03%
Grande Ronde-51	4.04%	0.84%	0.67%	3.03%
Hoodoo Cr	0.65%	0.16%	0.30%	0.95%
Indian Cr-1	0.00%	2.18%	1.31%	0.00%
Indian Cr-2	0.00%	2.18%	1.31%	0.00%
Indiana Cr	2.36%	0.86%	0.98%	3.10%
Jordan Cr	0.65%	0.16%	0.30%	0.95%
Lewis Branch	0.00%	3.23%	3.03%	14.53%
Little Indian Cr	0.00%	2.18%	1.31%	0.00%
Little Phillips Cr	11.90%	2.36%	1.95%	7.70%
Little Whiskey Cr	0.65%	0.16%	0.30%	0.95%
Lookingglass Cr-5	76.44%	4.25%	2.12%	19.11%
Lookingglass Cr-6	76.44%	4.25%	2.12%	19.11%
Lookingglass Cr-7	76.44%	4.25%	2.12%	19.11%
McAlister Cr	3.78%	0.63%	0.84%	0.95%
McCoy Cr-1	72.97%	29.54%	23.67%	58.85%
McCoy Cr-2	72.97%	29.54%	23.67%	58.85%
McCoy Cr-3	72.97%	29.54%	23.67%	58.85%
McCubbin Cr	3.78%	0.63%	0.84%	0.95%
Mclntyre Cr	72.97%	29.54%	23.67%	58.85%
Meadow Cr (1st GR)	21.23%	5.31%	17.25%	0.00%
Meadow Cr-4 (2nd GR)	5.50%	1.62%	1.35%	4.17%
Meadow Cr-5 (2nd GR)	5.50%	1.62%	1.35%	4.17%

Table A-5A. Assumed benefits of road obliteration and/or closure to nearby stream reaches in the Grande Ronde Subbasin. Effectiveness estimates provided by Grande Ronde Model Watershed Project.

Reach	% Restoration Fines. Embeddedness, Turbidity	% Restoration Riparian Function	% Restoration of Maximum Temperature	% Restoration Man-Caused Confinement
Meadow Cr-6 (2nd GR)	5.50%	1.62%	1.35%	4.17%
Meadow Cr-7 (2nd GR)	5.50%	1.62%	1.35%	4.17%
Meadow Cr-8 (2nd GR)	5.50%	1.62%	1.35%	4.17%
Meadow Cr-9 (2nd GR)	5.50%	1.62%	1.35%	4.17%
Minam-1	10.78%	3.59%	0.00%	0.00%
Minam-2	10.78%	3.59%	0.00%	0.00%
Minam-3	10.78%	3.59%	0.00%	0.00%
Mt Emily	5.18%	0.00%	0.00%	0.00%
Mud Cr-3	3.78%	0.63%	0.84%	0.95%
Mud Cr-4	3.78%	0.63%	0.84%	0.95%
Mud Cr-5	3.78%	0.63%	0.84%	0.95%
Mud Cr-6	3.78%	0.63%	0.84%	0.95%
Mud Cr-7	3.78%	0.63%	0.84%	0.95%
Pedro Cr	11.90%	2.36%	1.95%	7.70%
Peet Cr	5.50%	1.62%	1.35%	4.17%
Phillips Cr EF-1	11.90%	2.36%	1.95%	7.70%
Phillips Cr EF-2	11.90%	2.36%	1.95%	7.70%
Phillips Cr-1	11.90%	2.36%	1.95%	7.70%
Phillips Cr-2	11.90%	2.36%	1.95%	7.70%
Phillips Cr-3	11.90%	2.36%	1.95%	7.70%
Phillips Cr-4	11.90%	2.36%	1.95%	7.70%
Poison Cr	4.08%	0.76%	0.88%	2.72%
Reagin Gulch	2.92%	0.58%	0.53%	0.00%
Rock Cr-1 (Wallowa)	2.92%	0.58%	0.53%	0.00%
Rock Cr-2 (Wallowa)	2.92%	0.58%	0.53%	0.00%
Sand Pass Cr	50.57%	0.00%	0.00%	0.00%
Shaw Cr	0.00%	2.18%	1.31%	0.00%
Sheep Cr E (2nd GR)	2.36%	0.86%	0.98%	3.10%
Sheep Cr Trib (2nd GR)	2.36%	0.86%	0.98%	3.10%
Sheep Cr-1 (1st GR)	21.23%	5.31%	17.25%	0.00%
Sheep Cr-1 (2nd GR)	2.36%	0.86%	0.98%	3.10%
Sheep Cr-2 (1st GR)	21.23%	5.31%	17.25%	0.00%
Sheep Cr-2 (2nd GR)	2.36%	0.86%	0.98%	3.10%
Sheep Cr-3 (2nd GR)	2.36%	0.86%	0.98%	3.10%
Sheep Cr-4 (2nd GR)	2.36%	0.86%	0.98%	3.10%
Sickfoot Cr	21.23%	5.31%	17.25%	0.00%
Sled Cr-1	3.78%	0.63%	0.84%	0.95%
Sled Cr-2	3.78%	0.63%	0.84%	0.95%
Smith Cr	0.00%	3.23%	3.03%	14.53%
Spring Cr SF (GR)	0.65%	0.16%	0.30%	0.95%
Spring Cr-1 (GR)	0.65%	0.16%	0.30%	0.95%

Table A-5A. Assumed benefits of road obliteration and/or closure to nearby stream reaches in the Grande Ronde Subbasin. Effectiveness estimates provided by Grande Ronde Model Watershed Project.

Reach	% Restoration Fines. Embeddedness, Turbidity	% Restoration Riparian Function	% Restoration of Maximum Temperature	% Restoration Man-Caused Confinement
Spring Cr-2 (GR)	0.65%	0.16%	0.30%	0.95%
Sullivan Gulch	5.50%	1.62%	1.35%	4.17%
Summer Cr	76.44%	4.25%	2.12%	19.11%
Summit Cr	4.08%	0.76%	0.88%	2.72%
Syrup Cr	72.97%	29.54%	23.67%	58.85%
Tepee Cr	3.78%	0.63%	0.84%	0.95%
TNT Gulch	4.08%	0.76%	0.88%	2.72%
Tope Cr	2.52%	0.42%	0.56%	0.00%
Vance Draw	4.08%	0.76%	0.88%	2.72%
Ward Canyon	21.23%	5.31%	17.25%	0.00%
Waucup Cr	5.50%	1.62%	1.35%	4.17%
Whiskey Cr-1 (GR)	0.65%	0.16%	0.30%	0.95%
Whiskey Cr-2 (GR)	0.65%	0.16%	0.30%	0.95%
Willow Cr-5	0.00%	3.23%	3.03%	14.53%

Table A-6. Benefits projected for wet meadow restoration and reflected in the Status Quo EDT Scenario.

Reaches	Riparian Function	Off-Channel Habitat	Fines, Turbidity, Embeddedness	Maximum Temperature	Peak Flow Impacts	Low Flow Impacts	Flashy Flow Impacts
Meadow Cr-1 (2nd GR)			26%	35%	26%	35%	26%
Meadow Cr-2 (2nd GR)			30%	40%	30%	40%	30%
McCoy Cr-1	50%	50%	30%	40%	30%	40%	30%
McCoy Cr-2	50%	50%	30%	40%	30%	40%	30%
McCoy Cr-3	50%	50%	30%	40%	30%	40%	30%
Catherine Cr-1			7%	9%	7%	9%	7%
Catherine Cr-2			14%	18%	14%	18%	14%
Ladd Cr-1	50%	50%	30%	40%	30%	40%	30%
Ladd Cr-2	50%	50%	30%	40%	30%	40%	30%

EDT input data includes monthly wetted width estimates for every reach and therefore estimates of mean widths as well. If the application of equation 1 resulted in a regular increase in discharge from the reach upstream of a "targeted" reach to the reach below the targeted reach, then the benefits ascribed to the targeted reach were passed on to the downstream reach as a function of their relative mean discharges:

$$Benefits_{reach\,i+1} = \frac{Q_{reach\,i}}{Q_{reach\,i+1}} * Benefits_{reach\,i} \qquad \textbf{Equation 2}$$

where $Benefits_{reach\ i+1}$ is the percent restoration for the downstream reach, $Benefits_{reach\ i}$ is the percent restoration for the reach upstream, and $Q_{reach\ i}$ and $Q_{reach\ i+1}$ are the estimated mean annual discharges of the upstream and downstream reaches, respectively. If, however, the width-based mean discharge estimate of the downstream reach was *less than or equal to* the discharge of the upstream reach, the benefits were assumed to be transmitted without diminution. For instance, if the percent restoration ascribed to temperature in a reach was 10% and the estimated mean discharge of this reach was 50% of the reach downstream, then a 5% temperature restoration benefit was ascribed to the reach downstream. On the other hand, if the width-based discharge estimate of the downstream reach was less than or equal to the discharge of the upstream reach, the same 10% restoration was assumed to be propagated downstream.

A very significant portion of the restoration actions modeled concerned the obliteration and closure of roads located within riparian corridors or connected to nearby stream reaches by drainage networks. Tables A-5 and A-5A summarize the benefits assumed for these types of actions 25 years from now: Table A-5 in terms of percent improvement *from current conditions* by Geographic Area, and Table A-5A in terms of *percent restoration of historical conditions* by reach.. With the exception of anthropogenic confinement, the data in these tables were provided by Lyle Kuchenbecker of the Grande Ronde Model Watershed Project. Mobrand Biometrics assumed that simple road closure would have a negligible impact on road-related confinement, whereas road obliteration would virtually eliminate confinement caused by roads.

As mentioned, Table A-5 expresses improvements in terms of percent improvement from current conditions. This information had to be transformed to be modeled by EDT because the model deals with restoration of historical or "normative" conditions, not improvements from current conditions. The difference between the two measures is subtle but important. If the current value of an environmental attribute is "C", the historical value of the attribute is "H", and the value after some restoration scenario is "S", then (C – S)/C is the percent improvement relative to current conditions. This differs, often substantially, from the percent restoration of historical/normative conditions. The current departure of an environmental attribute from historical conditions, by the coding convention above, is (C – H). The degree to which this difference is reduced is (C – S). Therefore, the percent restoration (of historical conditions) is (C – S)/(C – H). With two additional elements, it was this transformation that was used to translate the data in Table A-5 to that in Table A-5A. The additional considerations were:

- The percent restoration was reduced by multiplying it by the ratio of the number of stream miles benefited to the total number of stream miles in the Geographic Area; and
- The footprint-size-adjusted percent restoration was applied to every reach in the Geographic Area.

One final element of the way in which restoration actions were coded must be explained – the quantification of wet meadow restoration (Table A-6). This analysis includes two significant wet meadow restoration projects: one targeting the Ladd Creek wetland area and one targeting wetlands associated with McCoy Creek. McCoy Creek flows into Meadow Creek and Ladd Creek and the wetlands in lower Ladd Creek drain into Catherine Creek. Substantial benefits for the lower three reaches of McCoy Creek and the lower two reaches of Ladd Creek were coded into this wet meadow action. Lesser benefits were assumed for Meadow and Catherine Creek, located downstream of project footprints. Specifically, the targeted reaches in Ladd and McCoy

Creek were assumed to benefit in the following manner from wetland restoration: a 50% restoration of riparian condition and off-channel habitat; a 30% restoration of fines, embeddedness and turbidity; a 40% restoration of temperature; a 30% restoration of peak flow and flashy flow impacts; and a 40% restoration of baseflow conditions. These benefits were then extended to either Catherine or Meadow Creek by means of the relative discharge procedure described above.

OBSTRUCTION AND PARTIAL PFC ACTIONS

The obstruction and partial PFC actions are combined here because there are relatively few details to add to what was said in the overview. With regard to Obstructions, there were only four federal reaches currently containing obstructions which were modeled under the Status Quo Scenario as being free of any impediment to passage: Sage Cr-1, Little Bear Cr-3, Hurricane Cr-2 and Hurricane Cr-5.

There are two additional details to describe regarding the partial PFC element of the Status Quo scenario: the specific reaches that were targeted for this action (Forest Service and BLM exclusive of Wilderness Areas) as summarized in Table A-7, and the slight modifications to the standard EDT definition of "PFC" that were used in the Grande Ronde.

Table A-8 summarizes the way PFC conditions were coded for this analysis. A re-coding in terms of "% restoration of historical conditions" was essential for technical reasons. The technical reason for "translating" PFC conditions from the relationships described in Appendix 1 boil down to the fact that the standard definitions can only be used in the EDT model when they are applied to every reach in the subbasin. Reach-specific changes in environmental conditions can only be evaluated in the context of a scenario, and scenarios can only be coded in terms of percent restoration.

One additional fact about the partial PFC action as modeled for the Grande Ronde should be mentioned. The results of applying the "standard PFC definition" to the entire subbasin were compared to the results under the revised, percent-restoration-based PFC definitions for all six spring chinook populations. The results were quite comparable in terms of carrying capacity, with the revised definition producing capacities from 0 to 8% larger than the standard definition. Results were also comparable in terms of productivity, although here the revised estimates ranged from 0 – 30% larger.

Table A-7. Reaches at least 50% within US Forest Service or Bureau of Land management ownership exclusive of reaches within Wilderness Areas. These reaches were assumed to afford modified PFC conditions after 25 years given current federal land and water management policies.

Reach Name	% Ownership	Description
Horse Cr	50% BLM	Mouth to Chaffer Canyon
Broady Cr-1	50% FS	Mouth to West Fork
Broady Cr WF	100% FS	Mouth to below 4200 ft level
Broady Cr-2	100% FS	West Fork to 3800 ft level
Cottonwood Cr-3 (Joseph)	50% FS	Broady Cr to 4800 ft level just above Howard cut off Trail
Peavine Cr (Joseph)	100% FS	Mouth to 4000 ft level
Joseph Cr-3	50% FS	Peavine Cr to Swamp Cr
Swamp Cr-1	100% FS	Mouth to Davis Cr
Davis Cr	100% FS	Mouth to above 4200 ft level
Swamp Cr-2	75% FS	Davis Cr to Arkansas Hollow
Joseph Cr-4	100% FS	Swamp Cr to Cougar Cr
Cougar Cr (Joseph)	100% FS	Mouth to 3600 ft level
Joseph Cr-5	50% FS	Cougar Cr to Sumac Cr
Sumac Cr	50% FS	Mouth to above 3600 ft level at Fork
Little Elk Cr	100% FS	Mouth to first Trib in SE corner of section 33
Elk Cr-2 (Joseph)	75% FS	Little Elk Cr to Fork between 4400 ft 4300 ft level
Crow Cr-2	50% FS	Elk Cr to Trib below 4100 ft level
Peavine Cr-1 (Chesnimnus)	100% FS	Mouth to McCarty Gulch
McCarty Gulch	100% FS	Mouth to 4 Wheel Drive Rd at 4080 ft level
Peavine Cr-2 (Chesnimnus)	100% FS	McCarty Gulch to Telephone Gulch
Telephone Gulch Cr	100% FS	Mouth to trib at 4010 ft level
Peavine Cr-3 (Chesnimnus)	100% FS	Telephone Gulch to EF and WF confluence
Peavine Cr EF (Chesnimnus)	100% FS	Mouth to above 4600 ft level
Peavine Cr WF (Chesnimnus)	100% FS	Mouth to above 4500 ft level
Doe Cr	100% FS	Mouth to 1/4 mile upstream
Chesnimnus Cr-6	100% FS	Doe Cr to Billy Cr
Billy Cr	100% FS	Mouth to Forks below 4600 ft level
Chesnimnus Cr-7	100% FS	Billy Cr to Devils Run
Devils Run Cr-1	100% FS	Mouth to Poison Cr
Poison Cr	100% FS	Mouth to Bear Paw Spring
Devils Run Cr-2	100% FS	Poison Cr to Summit Cr
Summit Cr	100% FS	Mouth to 1st road crossing on the SF at 5200 ft level
Devils Run Cr-3	100% FS	Summit Cr to TNT Gulch
TNT Gulch	100% FS	Mouth to 4600 ft level
Devils Run Cr-4	100% FS	TNT Gulch to fork below 4800 ft level
Chesnimnus Cr-8	100% FS	Devils Run to Vance Draw
Vance Draw	100% FS	Mouth to 2nd Trib in SW corner of section 21
Chesnimnus Cr-9	100% FS	Vance Draw to NF/SF confluence

Table A-7. Reaches at least 50% within US Forest Service or Bureau of Land management ownership exclusive of reaches within Wilderness Areas. These reaches were assumed to afford modified PFC conditions after 25 years given current federal land and water management policies.

Reach Name	% Ownership	Description
Chesnimnus Cr NF	100% FS	Mouth to 1st Rsv in Thomas Meadow
Chesnimnus Cr SF	100% FS	Mouth to fork at 4600 below ft level
Wenaha-1	50% FS	Mouth to Crooked Cr
Bobcat Cr	100% FS	Mouth to forks below Forest Boundary
Shamrock Cr	75% FS	Mouth to forks below 3200 ft level
Burnt Cr	100% FS	Mouth to Burnt Spring at 4600 ft level
Buck Cr-2 (GR)	100% FS	Burnt Cr to 4600 ft level
Mud Cr-2	75% FS	Buck Cr to Tope Cr
Tope Cr	50% FS	Mouth to headwaters in SE corner of section 20
Mud Cr-3	100% FS	Tope Cr to McAlister
McAlister Cr	100% FS	Mouth to forks above Road 3021
Mud Cr-4	100% FS	McAlister Cr to Sled Cr
Sled Cr-1	100% FS	Mouth to Evans Cr
Evans Cr	100% FS	Mouth to headwaters, at road crossing just below springs
Sled Cr-2	100% FS	Evans Cr to road crossing just below springs
Mud Cr-5	100% FS	Sled Cr to Tepee Cr
Tepee Cr	100% FS	Mouth to Fork below Road Crossing at 4360 ft level
Mud Cr-6	100% FS	Tepee Cr to McCubbin Cr
McCubbin Cr	100% FS	Mouth to 4500 ft level
Mud Cr-7	50% FS	McCubin Cr to Road Crossing below 4600 ft level
Wildcat Cr-2	100% FS	Wallupa Cr to yellow Jacket Spring Trib
Grande Ronde-17	50% BLM	Ward Canyon to Sickfoot Cr
Sickfoot Cr	50% BLM	Mouth to 3400 ft level
Grande Ronde-18	100% BLM	Sickfoot Cr to Grossman Cr
Grande Ronde-19	100% FS	Grossman Cr to Elbow Cr
Elbow Cr	100% FS	Mouth to 3600 ft level
Grande Ronde-20	100% FS	Elbow Cr to Bear Cr
Bear Cr (3rd GR)	100% FS	Mouth to 3400 ft level
Grande Ronde-21	100% FS	Bear Cr to Alder Cr
Alder Cr (GR)	100% FS	Mouth to 2400 ft level
Grande Ronde-22	100% FS	Alder Cr to Meadow Cr
Meadow Cr (1st GR)	100% FS	Mouth to 2400 ft level
Grande Ronde-23	100% FS	Meadow Cr to Clear Cr
Clear Cr (1st GR)	100% FS	Mouth to forks at 2600 ft level
Grande Ronde-24	100% FS	Clear Cr to Sheep Cr
Sheep Cr-1 (1st GR)	100% FS	Mouth to Falls at 2600 ft level
Sheep Cr-2 (1st GR)	100% FS	Falls at 2600 ft level to Road below Kettleson Meadow Rd 6231
Deer Cr-2 (Wallowa)	100% FS	Big Canyon AAC/Mouth to Sage Cr
Sage Cr-1	100% FS	Culvert at mouth

Table A-7. Reaches at least 50% within US Forest Service or Bureau of Land management ownership exclusive of reaches within Wilderness Areas. These reaches were assumed to afford modified PFC conditions after 25 years given current federal land and water management policies.

Reach Name	% Ownership	Description
Sage Cr-2	100% FS	Culvert to Trib near Borrow Pit
Deer Cr-3 (Wallowa)	100% FS	Sage Cr to Fork Just North of Wilderness Boundary
Little Bear Cr-1	50% FS	Mouth to Fork below Big Flat Road
Little Bear Cr-2	100% FS	Fork below Big Flat Rd to Ditch
Little Bear Cr-3	100% FS	Diversion for Allen Canyon Ditch
Little Bear Cr-4	100% FS	Diversion for Allen Canyon Ditch obstr to Just below 6000 ft level
Bear Cr-3 (Wallowa)	100% FS	Little Bear to Doc Cr
Doc Cr	100% FS	Mouth to 4800 ft level
Bear Cr-4 (Wallowa)	100% FS	Doc Cr to Goat Cr
Lostine-7	100% FS	Six Mile Bridge to Lake Cr
Lake Cr	100% FS	Mouth to Hunter Falls
Lostine-8	100% FS	Lake Cr to Forks / Falls just below 5800 ft level
Hurricane Cr-3	100% FS	Dam at 4500 ft level
Hurricane Cr-4	100% FS	Dam at 4500 ft level to Fall / Cascade at 4600 ft level
Hurricane Cr-5	100% FS	Fall / Cascade at 4600 ft level
Hurricane Cr-6	100% FS	Fall / Cascade at 4600 ft level to Slick Rock Falls just below Slick Rock Cr
Mottet Cr	75% FS	Mouth to Jubilee Lake
Little Lookingglass Cr-2	50% FS	Mottet Cr to Buzzard Cr
Buzzard Cr	100% FS	Mouth to road crossing in NE corner of section 9
Little Lookingglass Cr-3	100% FS	Buzzard Cr to Unnamed Trib just above 4000 ft level
Little Lookingglass Trib	100% FS	Mouth to road crossing in NE corner of section 11
Little Lookingglass Cr-4	100% FS	Unnamed Trib just above 4000 ft level to road crossing near section line 2/11
Eagle Cr	100% FS	Mouth to 3300 ft level
Lookingglass Cr-6	100% FS	Eagle Cr to Summer Cr
Summer Cr	100% FS	Mouth to Swamp Cr
Lookingglass Cr-7	100% FS	Summer Cr to Falls at 4500 ft level
Little Phillips Cr	50% FS	Mouth to 4400 ft level
Phillips Cr-3	100% FS	Bailey Cr to Phillips Cr EF
Phillips Cr EF-1	100% FS	Mouth to Pedro Cr
Pedro Cr	100% FS	Mouth to headwaters at 4780 ft level
Phillips Cr EF-2	100% FS	Pedro Cr to 4400 ft level
Phillips Cr-4	100% FS	Phillips Cr EF to 4200 ft level
Clark Cr-5	50% FS	Falls at 4300 ft level to headwaters in SE corner of section 6
Indian Cr-4	100% FS	Indian Cr NF to Camp Cr
Camp Cr	100% FS	Mouth to 5200 ft level
Indian Cr-5	100% FS	Camp Cr to Indian Cr EF
Indian Cr EF	100% FS	Mouth to Trail Crossing in Sec 32

Table A-7. Reaches at least 50% within US Forest Service or Bureau of Land management ownership exclusive of reaches within Wilderness Areas. These reaches were assumed to afford modified PFC conditions after 25 years given current federal land and water management policies.

Reach Name	% Ownership	Description
Indian Cr-6	100% FS	Indian Cr EF to 5800 ft level
Finley Cr	100% FS	Mouth to 3800 ft level
Dry Cr-2 (Willow)	100% FS	Finley Cr to forks at section line18/19
Scout Cr	100% FS	Mouth to 3800 ft level
Catherine Cr SF-1	100% FS	Mouth to Sand Pass Cr/Collins Cr
Collins Cr	100% FS	Mouth to 5800 ft level
Sand Pass Cr	100% FS	Mouth to 5400 ft level
Catherine Cr SF-2	100% FS	Sand Pass Cr /Collins Cr to 6100 ft level
Catherine Cr NF-1	100% FS	Mouth to Buck Cr
Buck Cr (Catherine)	100% FS	Mouth to 4300 ft level
Catherine Cr NF-2	100% FS	Buck Cr to Middle Fork
Catherine Cr MF	100% FS	Mouth to 4700 ft level
Catherine Cr NF-3	100% FS	Middle Fork to the Falls at 6000 ft level
Five Points Cr-1	50% FS	Mouth to Pelican Cr
Pelican Cr-1	100% FS	Mouth to Dry Cr
Dry Cr-1 (Five Points)	100% FS	Mouth to California Gulch
California Gulch	100% FS	Mouth to Pond at 3920 ft level
Dry Cr-2 (Five Points)	100% FS	California Gulch to headwaters Near Kamela
Pelican Cr-2	100% FS	Dry Cr to 3500 ft level
Five Points Cr-2	100% FS	Pelican Cr to Fiddlers Hell
Fiddlers Hell	100% FS	Mouth to 3900 ft level
Five Points Cr-3	100% FS	Fiddlers Hell to Middle Fork / Mt Emily
Mt Emily	100% FS	Mouth to 5200 ft level
Five Points MF	100% FS	Mouth at Mt Emily to 4900 ft level
Rock Cr EF (GR)	50% FS	Mouth to headwaters at 5750 ft level
Rock Cr-4 (GR)	50% FS	EF Rock Cr to 4900 ft level
Spring Cr-1 (GR)	100% FS	Mouth to Spring Cr SF
Spring Cr SF (GR)	100% FS	Mouth to 3500 ft level
Spring Cr-2 (GR)	100% FS	Spring Cr SF to forks just below 3900 ft level
Grande Ronde-42	75% FS	Jordan Cr to Bear Cr
Grande Ronde-43	50% FS	Bear Cr to Beaver Cr
Hoodoo Cr	100% FS	Mouth to Falls at 4900 ft level
Beaver Cr-2 (GR)	100% FS	Hoodoo Cr to Dam at Lake
Grande Ronde-44	100% FS	Beaver Cr to Meadow Cr
Dark Canyon	75% FS	Mouth to above Spring Cr Rd 21 at 4180 ft level
Mclntyre Cr	50% FS	Mouth to Rd 21
McCoy Cr-3	75% FS	Syrup Cr to Ensign Cr
Burnt Corral Cr-1	100% FS	Mouth to Sullivan Gulch
Sullivan Gulch	100% FS	Mouth to headwaters in SE corner of section 27
Burnt Corral Cr-2	100% FS	Sullivan Gulch to Burnt Corral Cr EF

Table A-7. Reaches at least 50% within US Forest Service or Bureau of Land management ownership exclusive of reaches within Wilderness Areas. These reaches were assumed to afford modified PFC conditions after 25 years given current federal land and water management policies.

Reach Name	% Ownership	Description
Burnt Corral Cr EF	100% FS	Mouth to 4700 ft level
Burnt Corral Cr-3	100% FS	Burnt Corral Cr EF to 4600 ft level
Battle Cr	100% FS	Mouth to Rd 2120
Bear Cr (Meadow)	100% FS	Mouth to 4500 ft level
Meadow Cr-7 (2nd GR)	100% FS	Bear Cr to Peet Cr
Peet Cr	100% FS	Mouth to 4200 ft level
Meadow Cr-8 (2nd GR)	100% FS	Peet Cr to Waucup Cr
Waucup Cr	100% FS	Mouth to 4300 ft level
Meadow Cr-9 (2nd GR)	100% FS	Waucup Cr to 4300 ft level
Grande Ronde-45	100% FS	Meadow Cr to Warm Spr Cr
Warm Springs Cr	100% FS	Mouth to 1 mile upstream
Fly Cr-1	100% FS	Mouth to Little Fly
Lookout Cr	100% FS	Mouth to 4900 ft level
Little Fly Cr-2	75% FS	Lookout Cr to 5100 ft level
Squaw Cr (Fly)	100% FS	Mouth to 4800 ft level
Fly Cr-3	100% FS	Squaw Cr to Umapine Cr
Umapine Cr	100% FS	Mouth to 5000 ft level
Fly Cr-4	100% FS	Umapine Cr to 4650 ft level
Grande Ronde-47	75% FS	Fly Creek to Sheep Cr
Chicken Cr W	100% FS	Mouth to 4650 ft level
Chicken Cr-2	100% FS	West Chicken Cr to Indiana Cr (ending Chicken Cr here)
Sheep Cr-3 (2nd GR)	75% FS	Unamed Trib (trib from the S in section 33) to East Sheep Cr
Sheep Cr E (2nd GR)	100% FS	Mouth to 5800 ft level
Sheep Cr-4 (2nd GR)	100% FS	East Sheep Cr to 4750 ft level
Limber Jim Cr-1	100% FS	Mouth to Limber Jim Cr SF
Duncan Canyon	100% FS	Mouth to 4400 ft level
Limber Jim Cr-2	100% FS	Limber Jim Cr SF to Limber Jim NF
Lookingglass Cr-2	100% FS	Mouth to 4500 ft level
Jarboe Cr	100% FS	Limber Jim Cr NF to Natural Lava Block at the 4900 ft level
Lookingglass Cr-5	100% FS	Natural Lava Block at the 4900 ft level to Marion Cr
Lookingglass Cr-6	100% FS	Mouth to headwaters at 5900 ft level
Lookingglass Cr-7	100% FS	Marion Cr to headwaters at 5700 ft level
Mottet Cr	75% FS	Mouth to 4900 ft level
Grande Ronde-50	75% FS	Meadowbrook Cr to Clear Cr
Clear Cr-1 (2nd GR)	100% FS	Mouth to Little Clear Cr
Little Clear Cr	100% FS	Mouth to 5100 ft level
Clear Cr-2 (2nd GR)	100% FS	Little Clear Cr to Unnamed Trib at 5700 ft level
Clear Cr Trib-1 (2nd GR)	100% FS	Mouth at 5700 ft level to Unnamed Trib at 6200 ft level

Table A-7. Reaches at least 50% within US Forest Service or Bureau of Land management ownership exclusive of reaches within Wilderness Areas. These reaches were assumed to afford modified PFC conditions after 25 years given current federal land and water management policies.

Reach Name	% Ownership	Description
Clear Cr Trib-2 (2nd GR)	100% FS	Mouth at 6200 ft level to headwaters at 6800 ft level
Clear Cr Trib (2nd GR)	100% FS	Unnamed Trib at 6200 ft level to headwaters at 6800 ft level
Clear Cr-3 (2nd GR)	100% FS	Unnamed Trib at 5700 ft level to headwaters at 6900 ft level
Grande Ronde-51	100% FS	Clear Cr to Grande Ronde EF
Grande Ronde EF	100% FS	Mouth to Falls Just below Little Meadow Cr
Grande Ronde-52	100% FS	Grande Ronde EF to Tanner Gulch
Rysdam Canyon	100% FS	Mouth to 5500 ft level
Grande Ronde-53	100% FS	Tanner Gulch to 5500 ft level

Table A-8. Operational definition of "PFC" conditions for environmental attributes in the Grande Ronde Subbasin defined in terms of percent restoration of Historical/normative conditions.

Environmental Attribute	PFC value in terms of percent restoration of Historical/normative conditions
Channel Length	100%
Channel Width: minimum	100%
Channel Width: maximum	100%
Gradient	100%
Heavy Metals & Other Toxicants	100%
Alkalinity	100%
Anthropogenic Confinement	50%
Irrigation Withdrawals	50%
Icing	50%
Nutrient Enrichment	50%
Dissolved Oxygen	50%
Fish Community Richness	50%
Fish Pathogens	50%
Harassment/Poaching	50%
Exotic Fish Introductions	50%
Predation Risk	50%
Benthic Production	50%
Peak Flow	40%
Base Flow	40%
Flow Flashiness	40%
Diel Flow Fluctuation	40%
Pools (all types)	40%
Bed Scour	40%
Embeddedness, Fines & Turbidity	40%
Temperature	40%
Hatchery Fish Outplants	40%
Riparian Function	35%
Woody Debris	10%
Salmon Carcasses	5%

NEW, SHORT-TERM RESTORATION ACTIONS

The Status Quo scenario (long-maturing restoration actions, degradation actions, obstructions and partial PFC) was combined with a series of newly proposed watershed-specific restoration actions to create the complete, short-term restoration scenario. The new, watershed-specific restoration actions were defined in a series of workshops hosted by MBI in November of 2004. Assuming the reader is familiar with the deliberations that occurred during these workshops, it is necessary at this point to note only three points:

1. The benefits estimated for sediment, temperature and flow-related variables were extended downstream of the reach of application, using the relative-discharge-based "trickle-down" procedure previously described.
2. The high end of the range identified in the work sessions defined the values that were actually modeled.
3. The zipped Excel Workbook named "New Watershed-specific Grande Ronde Restoration Actions.xls" contain the actions that were incorporated in the final "complete restoration package" production estimates.

REFERENCES

Johnson, C.G. Jr., R.R. Clausnitzer, P.J. Mehringer, and C.D. Oliver. 1994. Biotic and abiotic processes of eastside ecosystems: the effects of management on plant and community ecology, and on stand and landscape vegetation dynamics. General Technical Report PNW-GTR-322; USDA Forest Service, Pacific Northwest Region, Portland, OR.

May, C. W., R. R. Horner, J. R. Karr, B. W. Mar, and E. B. Welch. 1997. Effects of urbanization on small streams in the Puget Sound lowland ecoregion. Watershed Protection Techniques 2(4): 483-494.

APPENDIX B-1: DEFINITION OF PROPERLY FUNCTIONING CONDITIONS, AS APPLIED IN THE GRANDE RONDE SUBBASIN EDT ANALYSIS

Properly functioning conditions (PFC) is a concept created originally by the Bureau of Land Management (BLM) to assess the natural habitat-forming processes of riparian and wetland areas (Pritchard et al. 1993). When these processes are working properly, it can be assumed that environmental conditions are suitable to support productive populations of native anadromous and resident fish species. The notion of Properly Functioning Conditions for salmonid systems has also been advanced by the National Marine Fisheries Service (1996) in connection with recovery of species listed under the Endangered Species Act.

The PFC concept has been translated into a set of EDT Level 2 attribute ratings—ratings that define a PFC environmental condition relevant to anadromous salmonids within Pacific Northwest streams.

PFC does not imply pristine or template conditions. There are many examples of healthy populations occupying degraded habitat (Hanford Reach Chinook, for example). With this in mind, PFC ratings were applied to all reaches regardless of current habitat rating (e.g., if riparian function is 100% for the current condition, the PFC condition would still apply the 70% functional rating). Also, PFC is not intended to imply a standard against which all streams are compared. PFC cannot be "better" than historic conditions for a stream reach (e.g., if percent fine sediment in historic reconstruction was 15%, the PFC rating for sediment must be greater than or equal to 15%).

Properly Functioning habitat conditions outlined by the National Marine Fisheries Service (1996) were used to help define the EDT PFC Level 2 ratings. The NMFS document includes a Matrix of Pathways and Indicators (MPI) that relates closely to EDT attributes. An inter-agency team organized by the WDFW and the NWIFC and facilitated by MBI was responsible for translating the NMFS definitions into EDT Level 2 attributes. EDT attribute ratings and their relationship to the NMFS definition of PFC are presented in Table A-1. The MPI addressed only a subset of the attributes used in EDT.

Table A-1 also includes those attributes that were not defined by NMFS but were assigned a PFC rating by the inter-agency technical team. Guidance for these attributes was an understanding of the intent of the NMFS definition of properly functioning, gleaned largely from attributes described in the MPI.

Table A-1. Correspondence of Properly Functioning Condition as designated by NMFS (1996) and fully functional as used in the recovery target analysis (EDT).

Attribute	NMFS (1996) Properly Functioning	Representation of PFC in EDT Level 2 Environmental Attribute
Hydrologic Characteristics		
1) Annual Variation in High Flow	a) Change in Peak/Base Flow: Watershed hydrograph indicates peak flow, base flow, and flow timing characteristics comparable to an undisturbed watershed of similar size, geology, and geography	Consistent with undisturbed watershed of similar size, geology, and geography (Rating 2).
2) Annual Variation in Low Flow		Consistent with undisturbed watershed of similar size, geology, and geography (Rating 2).
3) Diel Variation in Flow		Consistent with natural runoff pattern or hydro project following WDFW ramping rate criteria (Rating 1).
4) Intra-Annual Variation in High Flow	b) Increase in Drainage Network: Zero or minimum increases in drainage network density due to roads.	Consistent with undisturbed watershed of similar size, geology, and geography (Rating 2).
5) Natural Hydrologic Regime	Not described	Attribute describes basic geomorphology and hydrology of basin
6) Regulated Hydrologic Regime	Not described	Flow not modified by hydro project (Rating 0)
Stream Corridor Structure		
7) Channel Length	Not described	EDT analysis assumed historic (template) channel length, gradient and widths; this assumption consistent with assumptions for channel hydromodifications (none)
8) Gradient		
9) Channel Minimum Width		
10) Channel Maximum Width		
11) Hydromodifications	Off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession	Stream channel is fully connected to the floodplain although very minor structures may exist that do not result in flow restriction or constriction (Rating 0).
12) Natural Channel Confinement	Not described; attribute describes basic geomorphology of reach	No difference historic and current ratings in EDT
13) Habitat Types	a) Pool Frequency: Width 5' 184 pools/mile Width 10' 96 pools/mile Width 15' 70 pools/mile Width 20' 56 pools/mile Width 50' 26 pools/mile Width 75' 23 pools/mile Width 100' 18 pools/mile b) Pool Quality: Pools > 1 meter depth (holding pools) with good cover and cool water, minor reduction of pool volume by fine sediment	Assumed to be consistent with 80% of historic (template) pool frequency; EDT criteria developed to acknowledge reach-specific differences in pool frequency.
14) Habitat Type – Off Channel	Backwaters with cover, and low-energy off-channel areas (ponds, oxbows, etc.)	Assumed full connection of historic (template) off-channel habitats.
15) Migration Obstructions	Any man-made barriers present in watershed allow upstream and downstream fish passage at all flows	Obstructions removed or designed to allow full passage of juveniles and adults (Rating 0)

Table A-1. Correspondence of Properly Functioning Condition as designated by NMFS (1996) and fully functional as used in the recovery target analysis (EDT).

Attribute	NMFS (1996) Properly Functioning	Representation of PFC in EDT Level 2 Environmental Attribute
16) Water withdrawals	Not described	Very minor withdrawals (entrainment probability considered to be very low) (Rating 0)
17) Bed Scour	Although not described, bank stability - >90% of banks not actively eroding - implies a stable stream bed.	Average depth of scour >2 cm and < 10 cm (Rating 1)
18) Icing	Not described	Riparian function is high, assumed no degradation of channel stability due to icing – assume historic (template) condition
19) Riparian Function	The riparian reserve system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds, and buffers include known refugia for sensitive aquatic species (>80% intact); and/or grazing impacts; percent similarity of riparian vegetation to the potential natural community composition > 50%.	> 70%-90% of functional attributes present (overbank flows, vegetated streambanks, groundwater interactions typically present) (modeled 70% - Rating 1.6).
20) Wood Debris	>80 pieces/mile (diameter > 2"; length > 50') and adequate sources of woody debris recruitment in riparian areas.	Complex array of large wood pieces but fewer cross channel bars and fewer pieces of sound large wood due to reduced recruitment; influences of large wood and jams are a prevalent influence on channel morphology where channel gradient and flow allow such influences. (Rating 1).
21) Embeddedness	Dominant substrate is cobble or gravel, or embeddedness < 20%	>10% and <25% covered by fine sediment (Rating 1)
22) Fine Sediment (< 0.85 mm) and Turbidity	Fines: < 12%, turbidity low	Fines: 6%-11% (modeled 11% fines - Rating 1.5). Turbidity low, infrequent episodes, short duration, low concentrations (<50 mg/l) (Rating 0.5)
Water Quality		
23) Alkalinity and Dissolved Oxygen	Not described	Assumed historic (template) conditions
24) Pollutants (Metals, misc. pollutants)	Low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303d designated reaches	No toxicity expected due to dissolved heavy metals to salmonids under prolonged exposure (1 month exposure assumed) (Rating 0.5).
25) Nutrient enrichment		Very small amount suspected through land use activities (Rating 1.5)
26) Temperature – Daily Maximum	10-14 C	10-16 C on warmest day (Rating 1)
27) Temperature – Daily Minimum	Not described	Assumed historic (template) conditions
28) Temperature – Spatial Variation	Not described	Assumed historic (template) conditions

Table A-1. Correspondence of Properly Functioning Condition as designated by NMFS (1996) and fully functional as used in the recovery target analysis (EDT).

Attribute	NMFS (1996) Properly Functioning	Representation of PFC in EDT Level 2 Environmental Attribute
Biological Community		
29) Biological community (benthic community richness, introduced species, predator risk, and fish community richness)	Not Described	Assumed historic (template) conditions
30) Fish Pathogens	Not Described	a) No fish stocking within last decade; or b) no sockeye population in basin; or c) no viral epizootics in kokanee populations at the subbasin level (Rating 1).
31) Salmon Carcasses	Not Described	Very abundant -- an average number of carcasses per total miles of main channel habitat >400 and < 800 (Rating 1.5).
32) Hatchery Outplants	Not Described	No more than two instances of fish releases in the past decade in the drainage (Rating 1.5).

The composition of habitat types (pool, riffle, glide, etc) was not clearly defined in the MPI for PFC. The MPI provided pool frequency by channel width (number of pools per mile). However, this description did not adequately consider differences in gradient and channel confinement between stream reaches. Furthermore, the pristine composition of habitat types is not consistent with the overall PFC definition. Simply applying the template assumptions to PFC is not appropriate.

The EDT definition of habitat types under PFC assumes 80% of the template or 80% of current (whatever is greater) pool type habitat (primary pools, backwater pools and pool tailouts, and beaver ponds) within the reach. The composition of non-pool habitat (riffles and glides) is calculated, using the template composition of these habitat types for the reach. This assumes that the template characterization for riffle and glide habitat (largely based on an assessment of channel gradient and confinement for the reach) would correctly represent the natural composition (i.e., derived through natural habitat-forming processes) for these habitat types.

REFERENCES

National Marine Fisheries Service (NMFS). 1996. Making ESA determinations of effect for individual or grouped actions at the watershed scale. Environmental and Technical Services Division, Habitat Conservation Branch, Portland, Oregon

Pritchard, D., H. Barrett, J. Cagney, R. Clark, J. Fogg, K. Gebhardt, P. Hansen, B. Mitchell, and D. Tippy. 1993. Riparian area management: process for assessing proper functioning condition. TR 1737-9. Bureau of Land Management, BLM/SC/ST-93/003+1737, Service Center, Co. 60 pp.

Appendix C: DESCRIPTION OF HYPOTHESIS FOR EDT PHYSICAL AND BIOLOGICAL EFFECTS USED IN MODELING GRANDE RONDE RESTORATION SCENARIOS

Table B-1. Add large wood (>10 cm. diameter) to a small stream.

Small Streams		Stream order	Gradient
East Side		1-3	Moderate-High
Physical Effects	**EDT Attribute**	**Dispersal Downstream**	**Lag time to biological effect**
1. Increases Wood Structure	WdDeb	Low	None
2. Creates Habitat Types			
a. Increase backwater pools	HbBckPls	Low	Low
b. Increase primary pools	HbPls	Low	Low
c. Increase pool tailouts	HbPlTails	Low	Low
d. Reduce sml and lrg cobble riffles	HbSmlCbl & HbLrgCbl	Low	Low
3. Modifies channel structure			
a. Trap fine sediment in pools	FnSedi	Low	Low
b. Reduce bed scour	BdScour	Low	Low
Biological Effects			
1. Provides cover			
a. Reduce predation	PredRisk	Low	None
2. Retains carcasses	SalmCarcass	Low	None
3. Increases food			
a. Provide substrate for benthos	BenComRch	Low	Low

Table B-2. Add large wood (>10 cm. diameter) to a medium stream.

Medium Streams East Side		Stream order 4, 5	Gradient Moderate
Physical Effects	EDT Attribute	Dispersal Downstream	Lag time to biological effect
1. Increases Wood Structure	WdDeb	Low	None
2. Creates Habitat Types			
a. Increase backwater pools	HbBckPls	Low	Low
b. Increase primary pools	HbPls	Low	Low
c. Increase pool tailouts	HbPlTails	Low	Low
d. Reduce glides	HbGlide	Low	Low
e. Reduce sml and lrg cobble riffles	HbSmlCbl & HbLrgCbl	Low	Low
3. Modifies channel structure			
a. Increase low flow channel width	MinWidth	Low	Low
b. Trap fine sediment in pools	FnSedi	Low	Low
c. Reduce Bed Scour	BdScour	Low	Low
Biological Effects			
1. Provides cover			
a. Reduce predation	PredRisk	Low	None
2. Retains carcasses	SalmCarcass	Low	None
3. Increases food			
a. Provide substrate for benthos	BenComRch	Low	Low

Table B-3. Add large wood (>10 cm. diameter) to a large stream.

Large Streams East Side		Stream order 6	Gradient Low
Physical Effects	EDT Attribute	Dispersal Downstream	Lag time to biological effect
1. Increases Wood Structure	WdDeb	Low	None
2. Creates Habitat Types			
a. Increase backwater pools	HbBckPls	Low	Low
b. Reduce glides	HbGlide	Low	Low
c. Reduce sml and lrg cobble riffles	HbSmlCbl & HbLrgCbl	Low	Low
3. Modifys channel structure			
a. Trap fine sediment in pools	FnSedi	Low	Low
Biological Effects			
1. Provides cover			
a. Reduce predation	PredRisk	Low	None
2. Retains carcasses	SalmCarcass	Low	None
3. Increases food			
a. Provide substrate for benthos	BenComRch	Low	Low

Table B-4. Restore riparian function to a medium stream.

Medium Streams East Side		Stream order 4, 5	Gradient Moderate
Physical Effects	EDT Attribute	Dispersal Downstream	Lag time to biological effect
1. Increases Riparian Function	RipFunc	Moderate	Long
2. Increases habitat structure			
a. Increase backwater pools	HbBckPls	Low	moderate
b. Increase primary pools	HbPls	Low	moderate
c. Increase pool tailouts	HbPlTails	Low	moderate
d. Reduce glides	HbGlide	Low	moderate
e. Reduce sml and lrg cobble riffles	HbSmlCbl & HbLrgCbl	Low	moderate
3. Increases large wood	WdDeb	low	moderate
4. Increases shading			
a. Decreases summer water temperature	TempMax	Moderate	Long
Biological Effects			
1. Provides cover			
a. Reduces predation	PredRisk	Low	Moderate
2. Increases leaf drop			
a. Increases benthic food supply	BenComRch	Moderate	Moderate

Table B-5. Improve water quality in a medium stream.

Medium Streams		Stream order 4, 5	Gradient Moderate
Physical Effects	EDT Attribute	Dispersal Downstream	Lag time to biological effect
1. Reduces pollutant levels			
a. Reduces metals in water	MetWatCol	High	None
b. Reduces metals in sediment	MetSedSls	High	None
c. Reduces on metal pollutants	MscToxWat	High	None
d. Reduces nutrient enrichment	NutEnrch	High	
Biological Effects			
1. Increases food			
a. Enhances benthos production	BenComRch	High	Low

Table B-6. Augment base flow in a small stream.

Small Streams East Side		Stream order 1-3	Gradient Moderate-High
Physical Effects	EDT Attribute	Dispersal Downstream	Lag time to biological effect
1. Restores a portion of base flow	FlwLow	High	None
2. Decreases summer water temperature	TmpMonMx	High	None
3. Increases minimum channel width	WidthMn	High	None
4. Moderates low dissolved O2	DisOxy	High	None
Biological Effects			
1. Increases food			
a. Enhances benthos production	BenComRch	High	Low

Table B-7. Augment base flow in a medium stream.

Medium Streams East Side		Stream order 4, 5	Gradient Moderate
Physical Effects	EDT Attribute	Dispersal Downstream	Lag time to biological effect
1. Restores a portion of base flow	FlwLow	High	None
2. Decreases summer water temperature	TmpMonMx	High	None
3. Increases minimum channel width	WidthMn	High	None
4. Moderates low dissolved O2	DisOxy	High	None
Biological Effects			
1. Increases food			
a. Enhances benthos production	BenComRch	High	Low

Table B-8. Augment base flow in a large stream.

Large Streams East Side		Stream order 6	Gradient Low
Physical Effects	EDT Attribute	Dispersal Downstream	Lag time to biological effect
1. Restores a portion of base flow	FlwLow	High	None
2. Decreases summer water temperature	TmpMonMx	High	None
3. Increases minimum channel width	WidthMn	High	None
4. Moderates low dissolved O2	DisOxy	High	None
Biological Effects			
1. Increases food			
a. Enhances benthos production	BenComRch	High	Low

Table B-9. Restore channel form and reconnect side and off-channels areas in a small stream.

Small Streams		Stream order	Gradient
East Side		1-3	Moderate-High
Physical Effects	**EDT Attribute**	**Dispersal Downstream**	**Lag time to biological effect**
1. Reduces hydroconfinement of channel	ConfineHydro	None	Immediate
2. Improves condition of riparian			
a. Increases Riparian Function	RipFunc	None	>50 years
b. Increases large wood	WdDeb	Low	>50 years
3. Traps fine sediment			
a. Reduces fine sediment in riffles	FnSedi	Low	<10 years
b. Reduces gravel embeddedness	Emb	Low	<10 years
4. Improves channel form			
a. Increases channel length	ChLength	None	Low
b. Reduces gradient	Grad	None	Low
c. Reduces bed scour	BdScour		Low
5. Restores Off-Channel Habitat	HbOfChFctr	None	Immediate
Biological Effects			
1. Increases food			
a. Provide increased area for benthos	BenComRch	Low	Immediate

Table B-10. Restore channel form and reconnect side and off-channels areas in a medium stream.

Medium Streams East Side		Stream order 4, 5	Gradient Moderate
Physical Effects	EDT Attribute	Dispersal Downstream	Lag time to biological effect
1. Reduces hydroconfinement of channel	ConfineHydro	None	Immediate
2. Improves condition of riparian			
a. Increases Riparian Function	RipFunc	None	>50 years
b. Increases large wood	WdDeb	Low	>50 years
3. Traps fine sediment			
a. Reduces fine sediment in riffles	FnSedi	Low	<10 years
b. Reduces gravel embeddedness	Emb	Low	<10 years
4. Improves channel form			
a. Increases channel length	ChLength	None	Low
b. Reduces gradient	Grad	None	Low
c. Reduces bed scour	BdScour		Low
5. Restores Off-Channel Habitat	HbOfChFctr	None	Immediate
Biological Effects			
1. Increases food			
a. Provide increased area for benthos	BenComRch	Low	Immediate

Table B-11. Restore channel form and reconnect side and off-channels areas in a large stream.

Large Streams		Stream order	Gradient
East Side		6	Low
Physical Effects	**EDT Attribute**	**Dispersal Downstream**	**Lag time to biological effect**
1. Reduces hydroconfinement of channel	ConfineHydro	None	Immediate
2. Improves condition of riparian			
a. Increases Riparian Function	RipFunc	None	>50 years
b. Increases large wood	WdDeb	Low	>50 years
3. Traps fine sediment			
a. Reduces fine sediment in riffles	FnSedi	Low	<10 years
b. Reduces gravel embeddedness	Emb	Low	<10 years
4. Improves channel form			
a. Increases channel length	ChLength	None	Low
b. Reduces gradient	Grad	None	Low
c. Reduces bed scour	BdScour		Low
5. Restores Off-Channel Habitat	HbOfChFctr	None	Immediate
Biological Effects			
1. Increases food			
a. Provide increased area for benthos	BenComRch	Low	Immediate