This auxiliary metadata for Clusters and Integrity - Subbasin is an excerpt from Chapter 4 (Ecosystem Integrity: Ecological Integrity and Socioeconomic Resiliency) in: Quigley, Thomas M.; Haynes, Richard W.; Graham, Russell T., tech eds. 1996. Integrated scientific assessment for ecosystem management in the interior Columbia basin and portions of the Klamath and Great Basins. Gen. Tech. Rep. PNW-GTR-382. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 303 p.

FOREST AND RANGELAND CLUSTERS

Each of the 164 subbasins in the Basin is unique. The challenge is to identify meaningful similarities among subbasins, while preserving these unique characteristics. We organized subbasins within clusters based on common ecological themes that highlight the similarities of subbasins grouped within clusters, while acknowledging substantive differences among the subbasins. These clusters reflect recurring patterns that emerged from the analyses. Clusters represent a simplified synthesis of common management history, resultant conditions, management needs, opportunities, and potential conflicts across large and complex landscapes.

Two sets of clusters emerged: six forestland and six rangeland groupings or clusters. The primary characteristics for the clusters are shown in tables 1 and 2. These clusters or groupings are a representation of the current ecological conditions for the Basin. As change occurs, the groupings would be expected to also change. The clusters can be useful to land managers as they make decisions about priorities, emphases, and where management activities might occur across the landscape in order to achieve specific goals and attain desired future conditions.

A brief description of each cluster in terms of its current characteristics and conditions is presented in the following paragraphs. Table 3 provides a quick highlight of the primary characteristics of each cluster, the primary risks to current ecological integrity, and primary opportunities to address ecological integrity.

Forest Cluster 1: High integrity cold- and moist-forest--These subbasins contain the greatest proportion of high forest, aquatic, and hydrologic integrity of all clusters. Subbasins in this cluster are dominated by wilderness and roadless areas and contain cold and moist/cold forests that are the least altered by management. Subbasins in this cluster are predominantly high elevation subbasins where forest structure and composition have been simplified by fire exclusion, and there has been little alteration from timber harvest. Late-seral structure has declined in all three (montane, lower montane, and subalpine) elevation settings. Early-seral and mid-seral structure has increased. Mean changes in fire severity and frequency are the lowest for this cluster. Where important changes have occurred, mixed-severity fire regimes have tended toward lethal regimes and fire frequency has generally declined as a result of effective fire suppression. Relatively limited road access in cold and moist forests of this cluster suggests that forest habitats provide a relatively high degree of security for a variety of species vulnerable to human exploitation and/or disturbance (such as, the Rocky Mountain gray wolf, grizzly bear, wolverine, lynx, moose, and elk). Hydrologic integrity of these subbasins is the highest of any forestland in the Basin. Connectivity among subwatersheds supporting native fish strongholds is good and strongholds for multiple species often exist in subwatersheds throughout these subbasins. Fish populations and communities associated with these subbasins are likely the most resilient in the Basin, are able to withstand large-scale disturbance events, and will likely persist without any human intervention.

Forest Cluster 2: Moderate and high-integrity forest--Subbasins in this cluster represent a mix of moderate to high forest, hydrologic, and aquatic integrity. In general the forestland contains semi-wild and moderately-roaded areas. Landscape vegetation patterns and disturbances are more highly altered in lower- and mid-montane settings, which coincide with higher road densities. Late- and early-seral structure has declined in most elevation settings with compensating increases in mid-seral, resulting in more homogeneous forest structure. Subbasins in this cluster provide relatively secure habitats for vertebrates vulnerable to human disturbance. The tendency in dry forests has been to move from non-lethal, to mixed and lethal fire severities with declining fire frequencies. The tendency in moist forest groups has been to move from mixed to lethal fire severity with reduced fire frequency. Aquatic population strongholds are generally associated with headwaters and unroaded portions of the subbasins. These subbasins have good connectivity via unimpeded river corridors. Subbasins within this cluster are ideal for restoration because relatively small investments could secure relatively large, diverse and functional systems.

Forest Cluster 3: Moderate and low-integrity forest--Forests in these subbasins are generally rated as low in integrity with the highest mean departures in fire frequency and severity. The subbasins have moderate road densities. Areas of late- and early-seral structures have declined most significantly with compensating increases in mid-seral structures with the net result being more homogeneous forest structure. Vertebrates vulnerable to human disturbance have limited secure habitat. Risks are highest for those species relying on late- or early-seral forest structure and those species using small non-forest openings or canopy gaps. The aquatic ecosystems may be highly productive and resilient in the face of disturbance, or the cumulative effects of disturbance in streams may simply lag behind changes in watersheds. Considering current knowledge and uncertainty of outcomes for existing fish strongholds, management to restore forest structure and composition may well represent some of the most important risks and potential conflicts for maintaining productive aquatic ecosystems. Watershed analysis could be an important tool for increasing the certainty of outcomes from terrestrial ecosystem restoration activities in these subbasins. Hydrologic integrity of these subbasins is low to moderate. Disturbance of hydrologic function from past management activities is moderate to high, due in large part to roads, mines, and cropland conversion of lower-elevation valleys. Most subbasins in this theme are classified as having moderate aquatic integrity. Subwatersheds may be vulnerable to future degradation owing to existing development or dramatic changes in watershed processes from large fires that could produce extensive, synchronous changes in watershed condition.

Forest Cluster 4: Low integrity, moist forests--Forests in these subbasins exhibit low integrity and are likely to be dominated by moist, productive forest types and be heavily roaded. Forest structure has likely been altered by past management and forests generally show moderate to strong shifts in fire severity, but less change in fire frequency. Forest structure shows: decreases in late-seral structures in all elevation settings; large increases in mid-seral; decreases in early-seral; and a more homogeneous structure overall. Risks to terrestrial vertebrates that rely on late or early forest structure in the moist forest have increased significantly. Those species that are vulnerable to human disturbance or exploitation have relatively low amounts of secure habitat as a result of extensive roading. Forest homogeneity has resulted in fewer canopy gaps and non-forest openings. Although the aquatic systems often have the connectivity to sustain multiple fish life histories, the distribution of important watersheds is often fragmented, perhaps through habitat disruption associated with intensive forest management. Hydrologic integrity of these subbasins is moderate. The moist landscapes are often associated with relatively high-frequency rain on snow events. Where timber harvest and roading are extensive, as in the Coeur d'Alene and St. Joe subbasins, peak flow events may be exaggerated resulting in aggravated channel scour and aggradation that may negatively influence some salmonids and their habitats (Rieman and McIntyre 1993). Fuel management is a priority for maintenance of hydrologic function in these subbasins. Aquatic integrity in these subbasins is judged low or moderate. Recovery of both aquatic and terrestrial ecosystems requires active and intensive restoration efforts. These subbasins have high restoration potential with much to gain and relatively little to lose.

Forest Cluster 5: Low-integrity, dry forests--Forests in these subbasins are dominated by dry-forest with approximately 60 percent of the area showing changes in fire frequency. They are extensively roaded and have little wilderness. Late-seral structure increased significantly in montane forests resulting from conversion of a variety of forest structures dominated by shade-intolerant conifers (such as, pine) to forests dominated by shade-tolerant species (such as, fir). Mid-seral structure increased in lower montane and montane settings. Increases in late-seral montane have benefited species preferring densely-stocked forests composed of shade-intolerant species (for example, American marten, northern spotted owl, and red-backed vole). Habitat for species preferring more open, park-like structures (for example, white-headed woodpecker, silver-haired bat, and flammulated owl) has declined. Nearly 80 percent of the area in this cluster is classified as low forest and rangeland integrity. Hydrologic integrity of these subbasins is low to moderate. The subbasins associated within the Grande Ronde and John Day river basins are in better condition than average, supporting from 15 to 30 percent of the potential salmonid subwatersheds in a strong condition. Several of the subbasins in this cluster (that is, Lower Deschutes, Upper and Lower Grande Ronde, Umatilla, and the Upper, Middle, and North forks of the John Day) support sensitive populations of anadromous salmonids (the latter three subbasins also support endangered chinook salmon). Forests are less productive than those associated with Forest Cluster 4, and historical disturbance regimes imply the need for more frequent silvicultural and prescribed fire treatments. These subbasins show moderate opportunities for restoration.

Forest Cluster 6: Mixed-integrity dry and moist forests with low aquatic integrity--Half the forested area in this cluster is composed of dry forest types, the other half is split between dry and cold forest types. This cluster has the smallest amount of FS- and BLM-administered lands of all the forest clusters, yet still has over one-third of its area in low road-density classes. This cluster has the largest proportion of its area rated as low hydrologic integrity and aquatic integrity. Late- and early-seral structures have declined in most elevation settings; an increase in mid-seral was the most compensating change. Species vulnerable to human exploitation and disturbance have a relatively low amount of secure habitat. The aquatic systems tend to be especially fragmented and remaining populations of native species are often isolated. The subbasins seem to support few and widely scattered strongholds and the poorest measures of condition for fish communities. There will be little chance for recreating fully connected aquatic systems either because habitats are seriously degraded or because remaining populations are strongly isolated. Disturbance of hydrologic function from management activities is high primarily because of roads, dams, and cropland conversion of lower elevation valleys. Because remaining intact aquatic ecosystems are found primarily on Federal land, and because these lands represent a small area of these subbasins, flexibility in management may be limited.

Rangeland Cluster 1: Juniper woodlands--Juniper woodlands are more common in this cluster than any other cluster within the Basin; additionally woodland area has substantially increased in each subbasin. Herblands and shrublands have significantly decreased. Forest rangelands included in this cluster are found in the lower montane settings. Forested rangeland changes have resulted in declines in ungulate forage and displacement of native ungulates from historic winter ranges to less productive montane forests. Climate associated with juniper woodlands is dry. Large areas receive an average of 12 or fewer inches of annual precipitation, especially in the Lower Deschutes, Trout, Lower Crooked, Upper Crooked, and Beaver South Fork subbasins in central Oregon. Juniper woodlands are frequently subjected to hot, droughty summers, and cold winters. Western juniper communities in the subbasins of this theme typically exist as (1) inclusions in the forest zone, (2) old juniper woodlands, and (3) young woodlands that in the recent past have expanded into the sagebrush zone. Old western juniper woodlands contain an old tree component, one that contains trees that generally exceed 150 years. These old woodlands typically persisted on mesa edges, ridges, and knolls characterized by fractured bedrock near the surface, and well-drained, shallow soils that produced relatively little understory herbaceous vegetation. These sites were not relatively disposed to fire. Fire, typically occurring at intervals ranging from 5 to 50 years, tended to restrict western juniper woodland extent in the sagebrush-bunchgrass zone. Fire frequency has declined substantially in the western juniper woodland areas between historic and current time periods. This is because of a decline in fires set by American Indians, concurrently with a reduction in fire fuel availability caused by domestic livestock grazing. Climate and fire combined were likely causal in western juniper expansion and retraction before 1800. The combined effects of extensive livestock grazing in the late 1800s and early 1900s, fire exclusion over large areas, and possibly climate changes probably are responsible for expansion of western juniper woodlands during the last 100 years. Concomitant reduction in the area of historical herblands and shrubland cover generally has not proceeded at a rate that equals or exceeds the rate of western juniper woodland expansion.

Diffuse knapweed, yellow starthistle, medusahead, whitetop, and Canada thistle are examples of problematic exotic weed species in this cluster on rangelands. Subbasins in this cluster support the highest average road densities, and roads are causal in the past and current spread of several exotic weed species in this cluster, for example diffuse knapweed. Diffuse knapweed, medusahead, and whitetop are extensive in some locations along the Deschutes and John Day rivers and tributaries.

Average area in cropland and pasture is low. The hydrologic integrity of these subbasins ranges from low to moderate and the riparian environment integrity is commonly low. Rangeland and forest integrity are low while aquatic and hydrologic integrity are mixed low and moderate; the composite integrity rating is low. The Lower Deschutes and the Upper John Day subbasins are strongholds for native rainbow and redband trout. The Lower Deschutes and Upper John Day subbasins currently contain important native steelhead and chinook salmon stocks and habitats, and dams do not preclude connecting these existing habitats with larger functional networks. These subbasins and their resident populations are key to any strategy to restore conditions for anadromous fish. The Trout subbasin (Trout Creek primarily) also contains native steelhead stocks but habitats are in poor condition.

Rangeland Cluster 2: High-integrity dry-forest rangelands--Dry forested rangelands of these subbasins have been altered by livestock grazing, timber harvest, and exclusion of fire, but are rated as the cluster with the highest proportion in high forest, range, aquatic, and hydrologic integrity. The resulting composite integrity rating was high. Subbasins are largely blocks of wilderness and minimally roaded areas with more than 70 percent in low or minimal roading classes. Herblands, shrublands, and woodlands have significantly declined. In this century, conifers have invaded meadows, grassland and shrubland areas, and savannah woodlands reducing both livestock and big game forage, as well as creating elevated fuel and increasing fire. The loss of woodlands is most likely the result of conifer woodland progression to dry forest. Terrestrial vertebrates most associated with ecotones between shrubland and herbland and dry forests would be most affected. Lower elevations of forested rangelands support domestic livestock and big game, and are generally where conflicts arise between livestock production and big game management.

Diffuse knapweed, yellow starthistle, leafy spurge, and spotted knapweed are examples of problematic exotic weed species in this cluster on rangelands. Diffuse knapweed is especially prevalent in the Methow subbasin in north-central Washington; yellow starthistle is prevalent in the Hells Canyon subbasin. For the cluster as a whole, exotic weed acreage is not extensive on rangeland.

Hydrologic and riparian environment integrity of these subbasins is high. These subbasins support riparian environments that are some of the most resilient to livestock grazing. The best conditions in the aquatic ecosystems within rangelands are associated with the subbasins in this cluster. The subwatersheds and aquatic systems that are most degraded, however, may be associated with the lower gradient and lower elevation rangeland portions of these subbasins. Connectivity of subwatersheds that function as native fish strongholds is good, and strongholds for more than one species are often present in subwatersheds throughout the subbasins. Fish populations and communities associated with these subbasins are among the most resilient in the Basin and represent core distributions for many of the sensitive salmonids. Because these lands tend to be productive and more resilient to disturbance than others, there could be some opportunities to maintain commodity production with little risk to other components of the system provided they are focused in the areas least important to the aquatic system. These subbasins can likely withstand the consequences of some large-scale fires in the higher elevation cold and moist forest areas, and fish populations will likely persist in the absence of management intervention. The occurrence of large fires in the lower-elevation dry forests poses a somewhat different threat.

Rangeland Cluster 3: Moderate integrity dry-forest rangelands--These subbasins are among the most altered by livestock grazing, timber harvest practices, and exclusion of fire compared to presettlement condition. These subbasins are dominated by moderate or high road densities and have the highest level of fire frequency among the rangeland clusters. Substantial declines in the amount of herblands, shrublands, and mixed conifer woodlands have occurred. Effects of fire exclusion and grazing have been compounded by harvest practices in dry-forest types promoting dense, multi-layered forests with increasing amounts of shade-tolerant, insect and pathogen-susceptible conifers, and reduced understory shrub and herbaceous cover. Shrub and herbaceous understories are also typically less productive and diverse than they were historically. Subbasins of this cluster were severely affected by extensive, heavy cattle and sheep grazing in the late 1800s and early 1900s, both at low and high elevations. Many areas are recovering as a result of decreased grazing pressure (Skovlin and Thomas 1995), prescribed fire, and cultural treatments.

Curbing the expansion of introduced exotic weeds continues to be a substantial management challenge in these subbasins. Whitetop, diffuse knapweed, spotted knapweed, yellow starthistle, leafy spurge, sulfur cinquefoil, and medusahead are examples of problematic exotic weed species in this cluster on rangeland. Examples of subbasins that support extensive infestations of these exotic weeds include the Powder in northeast Oregon (whitetop and medusahead), Kettle, Sanpoil, Franklin D. Roosevelt Lake, Colville, and Lower Spokane in northeast Washington (diffuse knapweed), the Little Spokane, Upper Spokane, and Hangman in eastern Washington (spotted knapweed), and the lower Flathead, Blackfoot, Bitterroot, and Upper Clark Fork in Western Montana (spotted knapweed, leafy spurge, sulfur cinquefoil).

In this century, conifers have invaded meadows, grassland and shrubland areas, and savannah woodlands reducing both livestock and big game forage, as well as increasing fuel loadings and fire intensity and severity. Hydrologic and riparian integrity is low.

Aquatic integrity is rated as moderate or low, while forest and range integrity are mostly low. For the most part, remaining native fish populations are fragmented, represented by remnant and isolated populations scattered throughout the subbasins. Some subwatersheds within these subbasins support remnant strongholds, isolated populations of listed or sensitive species, or narrowly endemic species that will be priorities for conservation. More than 50 percent of the area of these subbasins is on public lands.

Rangeland Cluster 4: Columbia croplands--These subbasins are primarily composed of croplands and pasture. Rangelands in these subbasins have the lowest overall integrity of all rangelands in the Basin. Extensive irrigation systems are present. Herbland and shrubland have significantly decreased compared to presettlement. The climate of these subbasins is typically dry; area of subbasins experiencing less than 12 inches of average annual precipitation is 51 percent. Although the climate of the area is relatively dry, protracted droughts do not occur as commonly in subbasins of this cluster as in those of other clusters, and growing seasons are fairly long. Soils of the Columbia croplands are deep, wind-deposited loessial soils that developed with the retreat of the glaciers. Topography is gentle and much of the area was dominated by dry shrubland and dry grasslands. Narrow to wide, gentle valley bottoms were once dominated by riparian woodland, riparian shrub, or riparian herb types. Most of these areas have been converted to herbaceous pasture, hay, or croplands. Small areas of native herbland and shrubland amongst cropland still exist where steep slopes and relatively shallow soils predominate, or in military reservations, nuclear reservations, parks, reserves, cemeteries, or railroad rights-of-way. Of the grassland and shrubland areas that have not been converted to cropland or pasture, many have been heavily grazed and are now undergoing invasion by exotic weeds.

Whitetop, diffuse knapweed, yellow starthistle, Russian knapweed, Canada thistle, Scotch thistle, and cheatgrass are examples of problematic exotic weed species in this cluster on rangeland. Of these species, Canada thistle and cheatgrass are widespread in the cluster. For the remaining weeds listed, examples of

subbasins that support extensive infestations include the Okanogan, Lower Yakima, Banks Lake, and Lower Crab (diffuse knapweed and/or Russian knapweed), and the Walla Walla, Lower Snake-Tucannon, Lower Snake-Asotin, and Umatilla (yellow starthistle and/or Scotch thistle). Conversion of native herblands and shrublands to agricultural types has diminished habitat for a large number of species.
Hydrologic and riparian environment integrity of these subbasins is low. The potential for streams to recover following disturbance is the lowest of any rangeland setting within the Basin. The subbasins in this cluster are strongly degraded from an aquatic perspective. Most native fishes currently exist as very isolated populations. There is little opportunity for restoration to more functional aquatic ecosystems.

Rangeland Cluster 5: Moderate integrity upland shrublands--These subbasins represent the bulk of high elevation ranges. Shrublands in this cluster, although influenced by grazing, fire exclusion, and exotic weed invasion, are least affected by humans. They have low levels of road densities and cropland, but have high levels of wildland/urban fire risk interface. Declines in herbland and shrubland habitats observed within Rangeland Cluster 5 have contributed to observed declines in populations of species associated with these habitats. An average of nearly 4 percent of the area of each subbasin has been invaded by exotic plants in this cluster.

Diffuse knapweed, yellow starthistle, spotted knapweed, leafy spurge, rush skeletonweed, medusahead, cheatgrass, and Canada thistle are examples of problematic exotic weed species in this cluster on rangeland. Examples of subbasins that support extensive infestations of these exotic weeds include the Upper Columbia-Entiat and Upper Yakima in Washington (diffuse knapweed), the Imnaha in Oregon (yellow starthistle), and the Upper Owyhee, Bruneau, and Salmon Falls in Idaho (cheatgrass and/or medusahead). Hydrologic and riparian environment integrity of these subbasins is high and moderate, respectively. These subbasins commonly provide the fewest limitations to rangeland management from a hydrologic integrity perspective (that is, they are resilient and have not been overly affected in the past). Areal extent of upland shrubland in the cool shrub PVG is larger relative to other clusters. Rangelands in these subbasins tend to be more resilient to grazing pressure and can be more likely maintained and/or restored to proper functioning condition. Because of the relatively good or improving condition of many of the rangeland communities and the remaining integrity in aquatic ecosystems, there is opportunity for management to benefit both.

Rangeland Cluster 6: Low integrity upland shrublands--These subbasins are primarily located on the Snake River Plain and in south-central Oregon and have been significantly altered by grazing and fire exclusion. They are dominated by dry shrubland vegetation, which is the most extensive rangeland PVG in this cluster. It is highly sensitive to overgrazing and susceptible to invasion by exotic grasses and forbs. Agriculture, dry forest, and cool shrub, in that order, follow in sensitivity the dry shrub PVG. Shrublands and herblands have declined owing to conversion to agriculture, change in fire regimes, increases in conifer woodlands, and encroachment by exotics, including the conversion to crested wheatgrass and other desirable exotic grasses. Similar to Rangeland Cluster 5, an average of nearly 4 percent of the area of each subbasin has been invaded by exotic plants in this cluster.

Dyers wood, diffuse knapweed, yellow starthistle, leafy spurge, medusahead, cheatgrass, Mediterranean sage, and whitetop are examples of problematic exotic weed species in this cluster on rangeland. Examples of subbasins that support extensive infestations of these exotic weeds include the Warner Lakes, Guano, and Upper Malheur in Oregon (medusahead and/or Mediterranean sage), the Lake Wolcott and American Falls in Idaho, (cheatgrass), and the Middle Snake-Payette (yellow starthistle). The increase in mixed conifer woodlands is most likely the result of conifer invasion of herbland and shrubland areas.

Hydrologic integrity of these subbasins ranges from low to moderate, whereas the integrity of the riparian environments they contain is commonly low. The subbasins in this cluster represent some of the most strongly altered conditions for aquatic systems in the assessment area. Where redband trout now persist, they generally occur in highly fragmented habitat and in isolated populations. Steelhead historically inhabited tributary basins of the middle Snake River (such as the Malheur and Owyhee Rivers), but are now blocked by the Hells Canyon complex of hydroelectric dams. The lower Grande Ronde and Middle Fork John Day River subbasins are exceptions within this cluster as they both support native chinook salmon and steelhead trout. In addition to the Federally listed chinook salmon, the Lower Grande Ronde River contains numerous continuous strongholds of native rainbow and bull trout. Aquatic integrity of the lower Grande Ronde River is among the highest because of the presence of native fish strongholds, even though it has low forest and hydrologic integrity. Consequently, these strongholds may be short lived. The Middle Fork John Day River subbasin has numerous strongholds of native rainbow and steelhead trout and has high fish community integrity; few exotic fishes have been introduced into this subbasin. Subbasins along the middle Snake River above Hell's Canyon historically supported anadromous fish, but do so no longer. In many of these subbasins, there is little hope of restoring any resemblance of historical structure and composition of aquatic communities.

Table 1— Summary of characteristics of Forest Clusters.

Variable	**Forest Cluster**					
	1	**2**	**3**	**4**	**5**	**6**
	---------------------------percent of area---------------------------					
Ownership						
BLM/FS	80	86	40	58	50	35
Other	20	14	60	42	50	65
Potential Vegetation Groups						
Dry Forest	13	26	22	14	43	23
Moist Forest	23	25	33	67	6	16
Cold Forest	47	30	15	7	4	9
Dry Grass/Shrub	7	11	6	3	24	15
Cool Shrub	3	3	1	1	8	11
Other	8	5	24	8	15	26

Forested Vegetation Groups						
Dry Forest	16	37	55	18	81	51
Moist Forest	27	27	52	73	11	21
Cold Forest	57	36	13	9	8	28
Road Density Classes						
Low or none	85	62	32	20	22	36
Moderate or higher	15	38	68	80	78	64
Cropland/pasture	0	3	20	2	11	21
<12" annual precipitation	1	4	2	3	14	14
Fire frequency change	37	60	66	51	60	60
Fire severity increase	36	50	57	47	35	36
High wildland/urban fire interface risk	0	17	6	1	29	10
Moderate wildland/urban fire interface risk	29	61	36	13	30	23
Increase in juniper woodland	0	0	0	0	0	0
Forest Integrity						
Low	0	10	67	86	79	59
Moderate	0	43	33	10	21	17
High	100	47	0	4	0	24
Range Integrity						
Low	0	29	100	57	100	66
Moderate	61	48	0	43	0	35
High	40	23	0	0	0	0
Aquatic Integrity						
Low	5	0	8	54	52	87
Moderate	38	59	85	46	44	13
High	58	41	7	0	4	0
Hydrologic Integrity						
Low	0	4	47	12	39	76
Moderate	4	30	49	54	41	17
High	96	66	4	34	20	7
Composite Ecological Integrity						

Low	0	0	4	83	96	100
Moderate	0	3	96	17	4	0
High	100	97	0	0	0	0

Source: ICBEMP GIS data (converted to 1 km^2 raster data).

Table 2— Summary of characteristics of Range Clusters.

	Range Cluster					
Variable	**1**	**2**	**3**	**4**	**5**	**6**
	percent of area					
Ownership						
BLM/FS	36	81	44	5	75	55
Other	64	19	56	95	25	45
Potential Vegetation Groups						
Dry Forest	29	21	34	8	10	12
Moist Forest	5	33	28	4	5	2
Cold Forest	1	34	14	30	11	4
Dry Grass/Shrub	32	4	4	26	45	50
Cool Shrub	22	1	2	3	20	9
Other	11	7	18	59	9	23
Rangeland Vegetation Groups						
Dry Rangeland	49	34	17	30	61	61
Cool Rangeland	34	8	8	3	27	11
Other	17	58	75	67	12	28
Road Density Classes						
Low or none	20	71	30	62	64	30
Moderate or higher	80	29	70	38	36	70
Cropland/pasture	9	3	14	56	5	17
<12" annual precipitation	23	1	2	51	33	38
Fire frequency change	37	51	67	17	24	17
Fire severity increase	18	47	49	13	16	9

High wildland/urban fire risk interface	32	7	12	0	6	8
Moderate wildland/urban fire risk interface	10	59	33	4	58	39
Increase in juniper woodland	12	0	0	0	0	0
Forest Integrity						
Low	100	6	76	79	12	37
Moderate	0	37	15	21	27	43
High	0	57	9	0	61	20
Range Integrity						
Low	100	6	76	100	26	79
Moderate	0	37	15	0	50	21
High	0	57	9	0	24	0
Aquatic Integrity						
Low	39	4	43	84	37	79
Moderate	61	24	50	16	57	18
High	0	72	7	0	6	3
Hydrologic Integrity						
Low	34	6	49	100	7	44
Moderate	66	16	35	0	35	34
High	0	78	16	0	58	22
Composite Ecological Integrity						
Low	100	0	58	97	8	80
Moderate	0	3	32	3	63	20
High	0	97	10	0	29	0

Source: ICBEMP GIS data (converted to 1 km^2 raster data).

Table 3— Forest and Rangeland Clusters - primary characteristics, risks to ecological integrity, and opportunities to address risks to integrity.

Forest or Range Clusters	Primary characteristics	Primary risks to ecological integrity	Primary opportunities to address risks to integrity
Forest 1	1. Moist and Cold Forest types 2. Minimally roaded 3. High aquatic, forest, hydrologic, and composite integrity	1. Severe fire potential in lower elevations 2. Higher elevations sensitive to soil disturbances (i.e., roading)	1. Prescription of natural or prescribed fire to reduce risks of severe fire 2. Reduction of stocking levels in lower elevations - reductions of fire severity 3. Maintenance of integrity in higher elevations
Forest 2	1. Minimally roaded 2. Mix of high and moderate forest, hydrologic, and aquatic integrity 3. High composite integrity 4. Mix of cold, moist, and dry forest types (nearly equal)	1. Cold forest types sensitive to soil disturbance (i.e., roading) 2. Fire severity in lower elevations and dry forest types 3. Aquatic integrity induced by low forest integrity in dry and moist forest types	1. Reduction of fire threat in lower elevations and manage road densities 2. Improvement of aquatic integrity through improving connectivity 3. Reduction of fire severity through restoration practices
Forest 3	1. Moderately roaded 2. Moderate aquatic and composite integrity 3. Low and moderate forest and hydrologic integrity 4. Dry and moist forest types	1. Fire severity in dry/moist forest types 2. Aquatic integrity at risk in areas of high fire potential 3. Old/late forest structures in managed areas	1. Restoration of forest integrity 2. Maintenance of aquatic and hydrologic integrity 3. Management of road densities
Forest 4	1. Moist forest types 2. Highly roaded 3. Low forest, aquatic, and composite integrity 4. Moderate to high hydrologic integrity	1. Hydrologic and aquatic systems from fire potentials 2. Late and old forest structures in managed areas 3. Forest compositions - susceptibility to insect, disease, and fire	1. Restoration of late and old forest structure in managed areas 2. Connection of aquatic strongholds through restoration 3. Treatment of forested areas to reduce fire, insect, and disease susceptibility
Forest 5	1. Dry forest types 2. Low to moderate aquatic integrity and low forest integrity and low composite integrity 3. Sensitive watersheds to disturbance 4. Highly roaded	1. Fish strongholds from sediment/erosion potential 2. Forest composition and structure, especially old/late 3. Hydrologic integrity due to fire severity and frequency	1. Restoration of forest integrity through vegetation management 2. Restoration of old/late forest structure 3. Restoration of aquatic and hydrologic integrity by reducing risk of fire, insect, and disease and road management
Forest 6	1. Dry forest types 2. Low hydrologic, forest, aquatic, and composite integrity 3. Moderately roaded	1. Forest composition and structures especially old/late 2. Primarily present at finer resolutions	1. Restoration of forest structures 2. Maintenance of the scattered aquatic strongholds that exist 3. Reduction of risk of fire, insect, and disease

Forest or Range Clusters	Primary characteristics	Primary risks to ecological integrity	Primary opportunities to address risks to integrity
Range 1	1. Highest level of juniper woodlands 2. High road densities 3. Low forest, range, and composite integrity 4. Moderate aquatic and hydrologic integrity 5. Fire regimes are more severe	1. Juniper encroachment into shrubland 2. Forage for ungulates (wild/domestic) reduced through woodland encroachment 3. Noxious weed expansion	1. Reduction of forest stocking could improve forage/cover relationships for livestock and big game 2. Curtailment of juniper expansion 3. Curtailment of noxious weed expansion 4. Management of riparian areas to enhance stream bank stability and riparian vegetation
Range 2	1. Forested rangelands in moderate to high integrity 2. High aquatic, hydrologic, and composite integrity 3. Minimally roaded	1. Fish and aquatic systems from dry vegetation types with fire severity/frequency changes 2. Dry forest types - especially late/old structures 3. Aquatic system sensitivity to disturbance	1. Restoration of vegetation and fuels treatments in dry forest types 2. Maintenance of aquatic and hydrologic integrity - emphasize connectivity 3. Restoration of maintenance sagebrush ecotone 4. Restoration of forage production in winter range
Range 3	1. Low forest and range integrity 2. Low and moderate hydrologic, aquatic, and composite integrity 3. Highly roaded	1. Conflicts with big game management from conifer invasion reducing forage 2. Elevated fuel and fire from conifer invasion 3. Riparian conditions from disturbances 4. Increased susceptibility to insect, disease, and fire in forested areas	1. Management of to restore/maintain riparian conditions 2. Prescription of fire to reduce risks from fire, insect, and disease in forested areas 3. Containment of noxious weeds 4. Maintenance of water quality for native and desired non-native fish
Range 4	1. Very low levels of FS/BLM lands 2. Lowest integrity in all components 3. Low levels of residual rangeland	1. Reduced fish habitat and populations from agricultural conversions	1. Reduction of threats to local populations of fish and their habitat
Range 5	1. Minimally roaded 2. Low croplands and other disturbances 3. High hydrologic and forest integrity 4. Moderate and low range and aquatic integrity 5. Moderate and high composite integrity	1. Continued declines in herbland and shrubland habitats 2. Risks to local populations and habitats for fish	1. Maintenance restoration of riparian condition 2. Restoration of productive aquatic areas 3. Conservation of fish strongholds and unique aquatic areas

Forest or Range Clusters	Primary characteristics	Primary risks to ecological integrity	Primary opportunities to address risks to integrity
Range 6	1. Highly roaded 2. Highly altered from grazing and fire exclusion 3. High exotic species 4. Low composite integrity	1. Continued declines in herbland and shrubland 2. Dry shrubland highly sensitive to overgrazing and exotic grass and forb invasion	1. Containment of exotic weed expansion 2. Maintenance restoration of riparian conditions 3. Management of grazing intensity, duration, and timing 4. Conservation of fish strongholds and unique aquatic areas

ECOLOGICAL INTEGRITY

The land ethic recently described by the Chief of the Forest Service articulates the priorities and commitments toward an ecosystem-based management approach (Thomas 1994). This land ethic links together the concepts of sustainable interactions between humans and ecosystems to maintain health, diversity, and productivity. The management context and priorities are: 1) protect ecosystems, 2) restore deteriorated ecosystems, 3) provide multiple benefits for people within the capabilities of ecosystems, and 4) ensure organizational effectiveness. The SIT assumed the broad goal for ecosystem management of trying to maintain ecosystem integrity. We interpreted this as a focus on the component goals of ecological integrity and socioeconomic resiliency. From the scientific perspective, the ICBEMP has attempted to bring together an understanding of the capabilities of ecosystems within the Basin, to determine the current status of the ecosystems, and to describe the ecological risks and opportunities associated with attempts to achieve assumed goals.

We recognize that there are no direct measures of ecological integrity and that this process is not strictly a scientific endeavor (Wickium and Davies 1995). Our assessment of ecosystem integrity draws from the assumed intent of the FS and BLM to achieve particular ecological goals in the Basin. These two agencies have stated their intentions to file two EISs in order to achieve broad purposes and needs [see U.S. Government 1994c, (Feb. 28, 1994, 59 FR 4680; revised: May 23, 1994, 59 FR 26624; Dec. 7, 1994, 59 FR 63071)]. These broad purposes are to enhance or maintain ecological integrity while simultaneously providing a sustainable flow of desired goods and services consistent with the capability of the ecosystems.

To provide information useful to FS and BLM managers which was to be considered in the development of new management direction, the SIT addressed three broad questions:

(1) Where within the Basin is ecological integrity and socioeconomic resiliency high, medium, or low?

(2) Where are there opportunities to improve (restore) ecological integrity?

(3) Where are there opportunities to produce desired goods, functions, and conditions with a low risk to ecological integrity?

Both Chapter 4 and Chapter 5 of the Integrated Scientific Assessment for Ecosystem Management in the Interior Columbia Basin[1] address these questions. Discussions related to questions 2 and 3 are mostly contained in Chapter 5.

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[1] Quigley, Thomas M.; Haynes, Richard W.; Graham, Russell T., tech eds. 1996. Integrated scientific assessment for ecosystem management in the interior Columbia basin and portions of the Klamath and Great Basins. Gen. Tech. Rep. PNW-GTR-382. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 303 p.

The integrity of ecosystems encompasses both social and biophysical components. In this context, ecological integrity refers to the presence and functioning of ecological components and processes. To address the three previously listed questions, we developed ecological integrity ratings which were derived from more specific ratings for individual processes or functions. Application of these ratings to detailed planning at subregional or landscape levels may be inappropriate.

We began by carefully examining all the information brought together through the ICBEMP process to determine which elements might prove most useful in explaining differences in ecological processes and functions across Basin ecosystems. Use of these elements to classify subbasins resulted in six forest and six rangeland clusters of subbasins with common characteristics and descriptions of current ecological conditions. The variables found most useful to explain and characterize the clusters were used to develop relative integrity estimates across the 164 subbasins. We assume that high levels of ecological integrity indicate that evolutionary and ecological processes are being maintained; functions and processes dependent on multiple ecological domains and evolutionary timeframes are being maintained; and viable populations of native and desired non-native species are being maintained. These processes and functions are evaluated in a relative sense within the Basin, so that those areas exhibiting the most elements of a system were rated as high, and those with the fewest elements were rated low. The basic components of ecological integrity include the forest, range, and aquatic systems with a hydrologic system that overlays the landscape as a whole. These actual ratings are shown in table 4.

We present these integrity ratings as initial estimates based on available information. We acknowledge that these estimates are based on broad proxies for various processes. Some of the proxies for ecological measures, for example, reflect structure rather than the underlying process. These proxies represent the best approximations at this broad extent for the underlying processes that we have at this time. We do not presume to have measured nor revealed the absolute levels of integrity or resiliency within the Basin. Rather, these ratings represent the first attempt at estimating integrity and resiliency at this spatial level. Given more time and information, integrity indices might include direct consideration for elements such as recovery cycles, synergistic interactions between environmental components and biophysical linkages, and feedback mechanisms operating on different spatial and temporal scales within the area.

Ecological Integrity Ratings

Based on the data sets and analysis conducted through the project, each subbasin (4th Hydrologic Unit Code level) was rated as having high, medium, or low ecological integrity for forestlands, rangelands, forestland hydrology, rangeland hydrology, and aquatic systems. These ratings were based on relative differences between subbasins. The ratings were described for the 164 subbasins [each approximately 800,000 to 1,000,000 acres/325,000 to 400,000 ha and included all ownerships within the Basin (for more detail see Sedell and others 1996)]. The actual ratings combined analysis based on descriptive data layers, empirical process models, trend analysis, and expert judgment. The basic data sets on which the ratings were based are aggregations of data from broad scale map themes, subwatershed (approximately 8,500 to 25,000 acres/3,500 to 10,000 ha) information, or model projections. We examined all the data sets, model outputs, and map themes brought forward through the ICBEMP or otherwise available for use as possible measures for estimating ecological integrity. We did not have consistent measures of elements that might be considered direct measures of integrity across all ownerships within the Basin. Proxies were selected from the data available to represent a broad array of functions, processes, conditions, and outcomes.

Forestland and Rangeland Integrity

A forest and range (terrestrial environment) system that exhibits high integrity is defined here as a mosaic of plant and animal communities consisting of well connected, high-quality habitats that support a diverse assemblage of native and desired non-native species, the full expression of potential life histories and taxonomic lineages, and the taxonomic and genetic diversity necessary for long-term persistence and adaptation in a variable environment. This interpretation is consistent with, and driven by, the goal of sustainable biotic diversity and the maintenance of ecological processes. Areas exhibiting the most elements of a system with high integrity were rated as high and those with the fewest elements were rated low; the medium rating fell in between.

Forestland integrity ratings were estimated for each subbasin if the forested vegetation component was at least 20 percent of the area. Likewise, relative rangeland integrity ratings were estimated if the rangeland potential vegetation types within a subbasin comprised at least 20 percent of the area of the subbasin. This resulted in 112 subbasins with a forest integrity rating and 86 subbasins with rangeland integrity ratings. Thirty-nine subbasins were classified as both forest and rangeland. There were five subbasins that were predominantly agricultural and were not rated as forest or rangeland.

Forestland integrity--Measures of forestland integrity include such elements as: (1) consistency of tree stocking levels with long-term disturbances typical for the forest vegetation present; (2) the amount and distribution of exotic species; (3) the amount of snags and down woody material present; (4) disruptions to the hydrologic regimes; (5) the absence or presence of wildfire and its effect on the composition and patterns of forest types; and, (6) changes in fire severity and frequency from historical (pre-1800s) to the present. Specific proxies for forestland integrity include: (1) proportion of area in dry and moist forest potential vegetation groups; (2) proportion of area having estimated road densities of moderate or greater (> 0.7 miles/sq. mile); (3) proportion of the area in wilderness or essentially unroaded (< 0.1 miles/sq. mile); (4) proportion of the area where fire severity increased between historical (early 1800s) and current periods by at least one class (that is, nonlethal to mixed severity, mixed to lethal, or non-lethal to lethal); and, (5) proportion of area where fire frequency declined between historical and current periods by at least one class (fire frequency classes were 0-25 year return interval, 26-75 year interval, 76-150 year interval, and greater than 150 year interval). Seventeen percent of the forested subbasins have high integrity.

Rangeland integrity--Measures of rangeland integrity include such elements as: (1) grazing influences on vegetation patterns and composition; (2) disruptions to the hydrologic regimes; (3) expansion of exotic species; (4) changes in fire severity and frequency; (5) increases in bare soils; and (6) expansion of woodlands into herblands and shrublands. Specific proxies for rangeland integrity include: a) proportion of area in dry grassland and shrubland potential vegetation groups; b) proportion of area having estimated road densities of moderate or greater (> 0.7 miles/sq. mile); c) proportion of the area in potential agricultural vegetation groups; and, d) the proportion of the area comprised of western juniper and big sage vegetation types. Six percent of the rangeland subbasins have high integrity.

Aquatic Integrity

An aquatic system that exhibits high integrity has a mosaic of well-connected, high-quality water and habitats that support a diverse assemblage of native and desired non-native species, the full expression of potential life histories and dispersal mechanisms, and the genetic diversity necessary for long-term persistence and adaptation in a variable environment. This definition is consistent with, and driven by, the goal to sustain biotic diversity and maintain ecological processes. Subbasins exhibiting the greatest level of these characteristics were rated high, those exhibiting the least were rated low, with medium ratings in between.

We have characterized subbasins along a gradient of conditions relative to a full complement of native fish and other aquatic species, well distributed in high-quality, well-connected habitats. Subbasins that support the full expression of life histories and a strong mosaic of productive and well-connected populations should be relatively self-contained and resilient to the natural disturbances anticipated over time periods approaching 100 years.

High aquatic integrity--These subbasins most closely resemble natural, fully functional aquatic ecosystems. In general they support large, often contiguous blocks of high-quality habitat and watersheds with strong populations of multiple species. Connectivity among watersheds and through the mainstream river corridor is generally unimpeded, and all life histories, including migratory forms, are present and important. Native species predominate, though introduced species may be present. These subbasins provide a system of large, well-dispersed habitats that are resilient to large-scale catastrophic disturbances.

Medium aquatic integrity--These subbasins support important aquatic resources, often with watersheds classified as strongholds for one or more species scattered throughout. The integrity of the fish assemblage is moderate or high. The most important difference between high integrity and medium integrity is increased fragmentation that has resulted from habitat disruption or loss. These subbasins have numerous watersheds where native species have been lost or are at risk. Connectivity among watersheds exists through the mainstem river system, or has the potential for restoration of life-history patterns and dispersal among watersheds. Re-establishing the necessary mosaic of habitats will often require conservation of existing high-quality sites as well as the restoration of whole watersheds that continue to support remnant populations.

Low aquatic integrity--These subbasins may support populations of key salmonids or have other important aquatic values (that is, threatened and endangered species, narrow endemics, and introduced or hatchery supported sport fisheries). In general, however, these watersheds are strongly fragmented by extensive habitat loss or disruption throughout the component watersheds, and most notably through disruption of the mainstem corridor. Although important and unique aquatic resources exist, they usually are localized.

Hydrologic Integrity

Landscapes jointly encompass the terrestrial and aquatic environments so that hydrologic networks operate within basins on the landscape. A hydrologic system that exhibits high integrity is defined here as a network of streams, along with their unique ground water ecosystems, within the broader landscape where the upland, floodplain, and riparian areas have resilient vegetation; where the capture, storage, and release of water limits the effects of sedimentation and erosion; and where infiltration, percolation, and nutrient cycling provide for diverse and productive aquatic and terrestrial environments. This definition is consistent with, and driven by, the goal to maintain ecological processes. Subbasins exhibiting the greatest level of these characteristics were rated high, those exhibiting the least were rated low; subbasins that were between high and low were rated as medium.

A lack of fine resolution stream characteristic data for the Basin necessitated a generalized probabilistic approach for use in determining subbasin hydrologic integrity in this analysis. Information concerning the resiliency of watersheds to disturbance and estimates of past management disturbance to watersheds were both used in determining the current hydrologic integrity of subbasins. Rangeland and forestland subwatersheds were assessed independently in this analysis to facilitate characterization of these environments separately at the subbasin level.

Measures of hydrologic integrity include such elements as: (1) disturbance to water flow; (2) bare soil and disturbances to soil structure; (3) riparian vegetation; (4) sensitivity of stream banks and hill slopes to disturbance; (5) cycling of nutrients, energy, and chemicals; (6) surface and sub-surface flows; (7) stream-specific measurements such as gradient, stream bed substrate, full bank width, and depth; and, (8) recovery potential following disturbance. Specific proxies for forest and rangeland hydrologic integrity include: (1) hydrologic effect variables (for example, surface mining, dams, cropland conversion, and roads); and (2) sensitivity of stream banks and stream channel function to disturbance. Ratings include potential for sediment to reach streams following road construction; potential for sediment to reach streams following fire or vegetation removal; potential to adversely affect stream hydrologic function through increased sediment or stream flow; inherent stream bank sensitivity; rating of riparian vegetation importance to stream function; and potential for a watershed to recover hydrologic functions following disturbance. Twenty-four percent of the forestland subbasins have high forestland hydrologic integrity. Twenty-one percent of the rangeland subbasins have high rangeland hydrologic integrity.

Riparian disturbance was estimated based on information concerning the sensitivity of stream banks to grazing and the sensitivity of stream channel function to the maintenance of riparian vegetation (*Component Assessment*--Biophysical). In this approach the resiliency of grazed riparian areas was used to infer probable riparian area disturbance since most riparian areas of the Basin have experienced historically high grazing pressure. Areas with low relative grazing resiliency were considered to have high riparian disturbance while areas with relatively high grazing resiliency were considered to have lower riparian disturbance.

The hydrologic and riparian disturbance ratings reflect relative differences in management effect across subbasins within the Basin. These ratings do not, however, indicate the total resiliency of such watersheds to disturbance (that is, their ability to recover following disturbances). To better understand the potential hydrologic integrity of these subbasins, a variety of resiliency ratings were developed for each subwatershed and subbasin (*Component Assessment*--Biophysical). These ratings are used in conjunction with the hydrologic disturbance ratings in the assessment of overall hydrologic integrity. For example, areas with high hydrologic disturbance, and high stream and riparian vegetation sensitivities are considered to have the lowest probable hydrologic integrity across the Basin. Areas with high hydrologic disturbance and low stream and riparian vegetation sensitivity, however, would likely possess higher hydrologic integrity because they are better able to absorb such disturbances without loss of hydrologic function. For these reasons, hydrologic resiliency ratings are appropriately used to interpret the effects of past management activities on hydrologic integrity.

The hydrologic integrity values assume that areas with high disturbance and low recovery potential (that is, they are not resilient) are more likely to have higher probabilities of containing altered hydrologic functions than other areas. Consequently, they are described as possessing low integrity in this report. Conversely, areas with low relative disturbance by mining, dams, roads, cropland conversion, grazing and high recovery potentials are considered to have the highest probable hydrologic or riparian integrity. The integrity values presented in this report reflect probabilities of finding altered hydrologic functions within subbasins based on relative differences between subbasins. Information presented in this section is appropriate to the description of relative differences across the Basin at the subbasin level.

Composite Ecological Integrity

We used five component integrity ratings (forestland, rangeland, forestland and rangeland hydrologic, and aquatic systems) to estimate the current composite ecological integrity of each subbasin. Component integrity ratings were based on information brought forward through the *Component Assessment*, the *Evaluation of Alternatives* (Quigley and others 1996, hereafter called the *Evaluation*) which includes a discussion of landscape integrity, terrestrial integrity (Marcot 1996), and our understandings of conditions and trends. Composite integrity was estimated by comparing the component integrity ratings and our knowledge of actual on-the-ground conditions, with how each subbasin met the definitions described above for systems with high ecological integrity. We found that at present 16 percent of the area is in high (of which 84 percent is FS- and BLM-administered lands), 24 percent is in moderate, and 60 percent is in low ecological integrity. Much of this last category includes lands used for agricultural and grazing uses, and a low rating does not imply low productivity or other similar implications. The rating system emphasizes ecological processes and functions and thus, has a tendency to rate human-altered systems lower than systems dominated by more natural processes. Finally, 26 percent of the FS- and BLM-administered lands are rated as high integrity, 29 percent are rated as medium, and 45 percent as low.

Table 4— Integrity ratings for each subbasin within the Interior Columbia Basin Project area.

--------Subbasin--------		-----Cluster #-----		------------------------Integrity Ratings------------------------					
ID #	Name	Forest	Range	Forest	Range	Aquatic	Hydrology (Forest)	Hydrology (Range)	Composite Ecological
1	Alvord Lake		5		M	M		L	M
2	American Falls		6		L	L			L
3	Banks Lake		4		L	L		M	L
4	Beaver-Camas	6	6	M	L	L	L	H	L
5	Beaver-South Fork		1		L	L		H	L
6	Big Lost	6	5	H	M	L	H	L	L
7	Big Wood	6	6	H	M	M	M	H	L
8	Birch		5		M	L		M	M
9	Bitterroot	3	3	M		M	M		M
10	Blackfoot	3	3	M		M	L		M
11	Blackfoot		6		L	M			L
12	Boise-Mores	5	3	L		L	M		L
13	Brownlee Reservoir	6	5	M	M	L	L	L	L
14	Bruneau		5		M	M		M	M
15	Bully		6		L	L		H	L
16	Burnt	5	6	L	L	L	L	H	L
17	Butte	5	3	L		L	H		L
18	C. J. Strike Reservoir		6		L	L		M	L
19	Camas		6		M	L	L	H	L
20	Chief Joseph	6	4	M	L	L	L	M	L
21	Clearwater	3	3	L		M	L		M
22	Coeur d'Alene Lake	4		L		L	M		L
23	Colville	6	3	L		L	L		L
24	Crooked-Rattlesnake		6		M	L		L	M
25	Donner Und Blitzen		5		L	M		L	M
26	East Little Owyhee		5		H	L		L	M
27	Fisher	4		L		L	M		L
28	Flathead Lake	4	3	L		L	M		L
29	Flint-Rock	2	3	M		H	M		H
30	Franklin D. Roosevelt Lake	6	3	L		L	L		L
31	Goose		5		L	L		L	M
32	Goose Lake	5	1	L	L	M	L		L
33	Greys-Hobock	1	5	H	H	H	H		H
34	Gros Ventre	1	3	H		H	H		H
35	Guano		6		M	M		H	M
36	Hangman	6	3	L		L	L		L
37	Harney-Malheur Lakes		6		L	L		H	L
38	Hells Canyon	2	2	M	M	H	H	L	M
39	Idaho Falls		6		L	L			L

--------Subbasin--------		-----Cluster #-----		------------------------Integrity Ratings------------------------					
ID #	Name	Forest	Range	Forest	Range	Aquatic	Hydrology (Forest)	Hydrology (Range)	Composite Ecological
40	Imnaha	2	5	M	L	H	H	L	H
41	Jordan		6		L	L		L	M
42	Kettle	4	3	L		L	L		L
43	Klickitat	3	3	L		H	M		M
44	Lake Abert	5	6	M	L	L	H		L
45	Lake Chelan	1	2	H		M	H		H
46	Lake Walcott		6		L	L		H	L
47	Lemhi	2	5	H	M	M	M	L	H
48	Little Deschutes	5	3	L		L	M		L
49	Little Lost		5		H	M		L	M
50	Little Salmon	3	3	L		M	M		M
51	Little Spokane	6	3	L		L	L		L
52	Little Wood		6		L	L		H	L
53	Lochsa	2		L		M	H		H
54	Lost	5	1	L	L	L	L	M	L
55	Lower Boise		6		L	L		H	L
56	Lower Clark Fork	4		L		L	H		L
57	Lower Crab		4		L	L		H	L
58	Lower Crooked	6	1	L	L	L	M	M	L
59	Lower Deschutes	5	1	L	L	M	M	L	L
60	Lower Flathead	6	3	L		L	L		L
61	Lower Grande Ronde	5	6	L	L	H	L	M	M
62	Lower Henrys	6	6	H	L	L	L		L
63	Lower John Day		1		L	M		M	L
64	Lower Kootenai	4		L		L	M		L
65	Lower Malheur		6		L	L		H	L
66	Lower Middle Fork Salmon	1	2	H		H	H		H
67	Lower North Fork Clearwater	4	3	L		M	M		L
68	Lower Owyhee		6		M	L		M	M
69	Lower Salmon	3	3	L		M	L		M
70	Lower Selway	2	2	M		M	H		H
71	Lower Snake		4		L	L		M	L
72	Lower Snake-Asotin	3	4	L	L	L	L	L	M
73	Lower Snake-Tucannon		4		L	L		M	L
74	Lower Spokane	6	3	L		L	L		L
75	Lower Yakima		4		L	L		M	L
76	Medicine Lodge	6	6	H	M	L	L	H	L
77	Methow	2	2	M		M	M		H
78	Middle Clark Fork	4		L		M	M		L

--------Subbasin--------		-----Cluster #-----		------------------------Integrity Ratings------------------------					
ID #	Name	Forest	Range	Forest	Range	Aquatic	Hydrology (Forest)	Hydrology (Range)	Composite Ecological
79	Middle Columbia-Hood	3	3	L		M	L		M
80	Middle Columbia-Lake Wallula		4		L	L		M	L
81	Middle Fork Clearwater	3	3	L		M	L		M
82	Middle Fork Flathead	1		H		M	H		H
83	Middle Fork John Day	5	6	L	L	M	M	M	L
84	Middle Fork Payette	6	3	L		L	M		L
85	Middle Owyhee		5		M	M		L	M
86	Middle Salmon-Chamberlain	2	2	H		H	H		H
87	Middle Salmon-Panther	2	5	H	M	M	H	L	H
88	Middle Snake-Payette		6		L	L		H	L
89	Middle Snake-Succor		5		L	L		M	M
90	Moses Coulee		4		L	L		M	L
91	Moyie	4		L		L	H		L
92	Naches	2	2	M		H	H		H
93	North And Middle Fork Boise	2	3	H		M	M		H
94	North Fork Flathead	1		H		M	H		H
95	North Fork John Day	5	3	L		M	M		L
96	North Fork Payette	6	3	L		L	L		L
97	Okanogan	6	4	L	L	L	L	L	L
98	Pahsimeroi	2	5	H	H	M	H	L	H
99	Palisades	2	5	H	H	M	H		H
100	Palouse		4		L	L		M	L
101	Payette	6	6	L	L	L	L	H	L
102	Pend Oreille	4		L		L	L		L
103	Pend Oreille Lake	4	3	L		M	H		L
104	Portneuf		6		L	M			L
105	Powder	5	3	L		L	L		L
106	Priest	4		L		L	M		L
107	Raft		6		L	L		M	L
108	Rock		4		L	L		H	L-NoOwn
109	Salmon Falls		5		M	L		L	M
110	Salt	6	3	H		M	M		L
111	Sanpoil	4	3	L		L	L		L
112	Silver		6		L	L		H	L
113	Silvies	5	6	L	L	L	M	H	L
114	Similkameen	1	2	H		L	M		H
115	Snake Headwaters	1	2	H		H	H		H
116	South Fork Boise	2	5	M	L	M	M	L	H
117	South Fork Clearwater	3	3	L		M	M		M

--------Subbasin--------		-----Cluster #-----		------------------------Integrity Ratings------------------------					
ID #	Name	Forest	Range	Forest	Range	Aquatic	Hydrology (Forest)	Hydrology (Range)	Composite Ecological
118	South Fork Coeur d'Alene	4		L		L	L		L
119	South Fork Flathead	1	2	H		H	H		H
120	South Fork Owyhee		5		H	L		L	M
121	South Fork Payette	2	3	H		M	H		H
122	South Fork Salmon	2	3	H		M	H		H
123	Sprague	5	3	L		M	H		L
124	St. Joe	4		L		M	H		L
125	Stillwater	4		L		L	M		L
126	Summer Lake	5	6	M	L	L	H		L
127	Swan	3		L		M	H		M
128	Teton	6	6	M	L	M	L		L
129	Thousand-Virgin		5		M	M		H	M
130	Trout		1		L	M		H	L
131	Umatilla	5	4	L	L	M	L	M	L
132	Upper Clark Fork	5	3	L		L	L		L
133	Upper Coeur d'Alene	4		L		M	H		L
134	Upper Columbia-Entiat	4	5	M	L	L	M	L	M
135	Upper Columbia-Priest Rapids		4		L	L		M	L
136	Upper Crab		4		L	L		M	L
137	Upper Crooked	5	1	L	L	L	L	H	L
138	Upper Deschutes	4	3	L		L	H		M
139	Upper Grande Ronde	5	3	L		M	L		L
140	Upper Henrys	4	6	H	M	M	M		M
141	Upper John Day	5	1	L	L	M	M	M	L
142	Upper Klamath	5	3	L		L	H		L
143	Upper Klamath Lake	3	3	M		L	M		L
144	Upper Kootenai	4		L		M	M		L
145	Upper Malheur	5	6	M	L	L	M	M	L
146	Upper Middle Fork Salmon	1		H		H	H		H
147	Upper North Fork Clearwater	4		M		M	M		L
148	Upper Owyhee		5		H	M		M	M
149	Upper Quinn		5		M	L		L	M
150	Upper Salmon	1	5	H	M	M	H	L	H
151	Upper Selway	2	2	H		H	H		H
152	Upper Snake-Rock		6		L	L		H	L
153	Upper Spokane	6	3	L		L	L		L
154	Upper Yakima	3	5	L	L	M	M	L	M
155	Walla Walla		4		L	M	L	M	L
156	Wallowa	2	2	L		H	L		H

--------Subbasin--------		-----Cluster #-----		------------------------Integrity Ratings------------------------					
ID #	Name	Forest	Range	Forest	Range	Aquatic	Hydrology (Forest)	Hydrology (Range)	Composite Ecological
157	Warner Lakes		6		M	L		H	M
158	Weiser	6	6	L	L	L	L	H	L
159	Wenatchee	2	2	M		H	H		H
160	Williamson	5	3	L		M	M		L
161	Willow	5	6	L	L	M	M		L
162	Willow		6		L	L		H	L
163	Willow		4		L	L		M	L
164	Yaak	4		L		M	H		L

H = high integrity rating
M = medium integrity rating
L = low integrity rating
NoOwn = no BLM/FS ownership in subbasin
1,2,3,4,5,6 indicate forest or rangeland cluster numbers

Sources:

Quigley, T.M.; Arbelbide, S.J., tech. eds. 1996. An Assessment of Ecosystem Components in the Interior Columbia Basin and Portions of the Klamath and Great Basins. Gen. Tech. Rep. PNW-GTR-XXX. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. [irregular pagination]. (Quigley, Thomas M., tech. ed. The Interior Columbia Basin Ecosystem Management Project: Scientific Assessment).

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