Appendix L-1

Appendix L-1:
NMFS Matrix (1996)

Description of the Matrix:

The "Matrix of Pathways and Indicators" (Table 1) is designed to summarize important environmental parameters and levels of condition for each. This matrix is divided into six overall pathways (major rows in the matrix):

-- Water Quality -- Channel Condition and Dynamics
-- Habitat Access -- Flow/Hydrology
-- Habitat Elements -- Watershed Conditions

Each of the above represents a significant pathway by which actions can have potential effects on anadromous salmonids and their habitats. The pathways are further broken down into "indicators." Indicators are generally of two types: (1) Metrics that have associated numeric values (e.g. "six pools per mile"); and (2) descriptions (e.g. "adequate habitat refugia do not exist"). The purpose of having both types of indicators in the matrix is that numeric data are not always readily available for making determinations (or there are no reliable numeric indicators of the factor under consideration). In this case, a description of overall condition may be the only appropriate method available.

The columns in the matrix correspond to levels of condition of the indicator. There are three condition levels: "properly functioning," "at risk," and "not properly functioning." For each indicator, there is either a numeric value or range for a metric that describes the condition, a description of the condition, or both. When a numeric value and a description are combined in the same cell in the matrix, it is because accurate assessment of the indicator requires attention to both.

TABLE 1. MATRIX of PATHWAYS AND INDICATORS

(Remember, the ranges of criteria presented here are not absolute, they may be adjusted for unique watersheds. See p. 3)

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	AT RISK	NOT PROPERLY FUNCTIONING
Water Quality:	Temperature	50-57• F[1]	57-60• (spawning) 57-64• (migration &rearing)[2]	> 60• (spawning) > 64• (migration & rearing)[2]
	Sediment/Turbidity	< 12% fines (<0.85mm) in gravel[3], turbidity low	12-17% (west-side)[3], 12-20% (east-side)[2], turbidity moderate	>17% (west-side)[3], >20% (east side)[2] fines at surface or depth in spawning habitat[2], turbidity high
	Chemical Contamination/ Nutrients	low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303d designated reaches[5]	moderate levels of chemical contamination from agricultural, industrial and other sources, some excess nutrients, one CWA 303d designated reach[5]	high levels of chemical contamination from agricultural, industrial and other sources, high levels of excess nutrients, more than one CWA 303d designated reach[5]
Habitat Access:	Physical Barriers	any man-made barriers present in watershed allow upstream and downstream fish passage at all flows	any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at base/low flows	any man-made barriers present in watershed do not allow upstream and/or downstream fish passage at a range of flows
Habitat Elements:	Substrate	dominant substrate is gravel or cobble (interstitial spaces clear), or embeddedness <20%[3]	gravel and cobble is subdominant, or if dominant, embeddedness 20-30%[3]	bedrock, sand, silt or small gravel dominant, or if gravel and cobble dominant, embeddedness >30%[2]
	Large Woody Debris	Coast: >80 pieces/mile >24"diameter >50 ft. length[4]; East-side: >20 pieces/ mile >12"diameter >35 ft. length[2]; and adequate sources of woody debris recruitment in riparian areas	currently meets standards for properly functioning, but lacks potential sources from riparian areas of woody debris recruitment to maintain that standard	does not meet standards for properly functioning and lacks potential large woody debris recruitment

	Pool Frequency channel width # pools/mile[6] 5 feet 184 10 " 96 15 " 70 20 " 56 25 " 47 50 " 26 75 " 23 100 " 18	meets pool frequency standards (left) and large woody debris recruitment standards for properly functioning habitat (above)	meets pool frequency standards but large woody debris recruitment inadequate to maintain pools over time	does not meet pool frequency standards
	Pool Quality	pools >1 meter deep (holding pools) with good cover and cool water[3], minor reduction of pool volume by fine sediment	few deeper pools (>1 meter) present or inadequate cover/temperature[3], moderate reduction of pool volume by fine sediment	no deep pools (>1 meter) and inadequate cover/temperature[3], major reduction of pool volume by fine sediment
	Off-channel Habitat	backwaters with cover, and low energy off-channel areas (ponds, oxbows, etc.)[3]	some backwaters and high energy side channels[3]	few or no backwaters, no off-channel ponds[3]
	Refugia (important remnant habitat for sensitive aquatic species)	habitat refugia exist and are adequately buffered (e.g., by intact riparian reserves); existing refugia are sufficient in size, number and connectivity to maintain viable populations or sub-populations[7]	habitat refugia exist but are not adequately buffered (e.g., by intact riparian reserves); existing refugia are insufficient in size, number and connectivity to maintain viable populations or sub-populations[7]	adequate habitat refugia do not exist[7]
Channel Condition & Dynamics:	Width/Depth Ratio	<10[2,4]	10-12 (we are unaware of any criteria to reference)	>12 (we are unaware of any criteria to reference)
	Streambank Condition	>90% stable; i.e., on average, less than 10% of banks are actively eroding[2]	80-90% stable	<80% stable
	Floodplain Connectivity	off-channel areas are frequently hydrologically linked to main channel; overbank flows occur and maintain wetland functions, riparian vegetation and succession	reduced linkage of wetland, floodplains and riparian areas to main channel; overbank flows are reduced relative to historic frequency, as evidenced by moderate degradation of wetland function, riparian vegetation/succession	severe reduction in hydrologic connectivity between off-channel, wetland, floodplain and riparian areas; wetland extent drastically reduced and riparian vegetation/succession altered significantly

Flow/Hydrology:	Change in Peak/ Base Flows	watershed hydrograph indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography	some evidence of altered peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography	pronounced changes in peak flow, baseflow and/or flow timing relative to an undisturbed watershed of similar size, geology and geography
	Increase in Drainage Network	zero or minimum increases in drainage network density due to roads[8,9]	moderate increases in drainage network density due to roads (e.g., • 5%)[8,9]	significant increases in drainage network density due to roads (e.g., • 20-25%)[8,9]
Watershed Conditions:	Road Density & Location	<2 mi/mi²[11], no valley bottom roads	2-3 mi/mi², some valley bottom roads	>3 mi/mi², many valley bottom roads
	Disturbance History	<15% ECA (entire watershed) with no concentration of disturbance in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except AMAs), • 15% retention of LSOG in watershed[10]	<15% ECA (entire watershed) but disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; and for NWFP area (except AMAs), • 15% retention of LSOG in watershed[10]	>15% ECA (entire watershed) and disturbance concentrated in unstable or potentially unstable areas, and/or refugia, and/or riparian area; does not meet NWFP standard for LSOG retention
	Riparian Reserves	the riparian reserve system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds, and buffers or includes known refugia for sensitive aquatic species (>80% intact),and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/ composition >50%[12]	moderate loss of connectivity or function (shade, LWD recruitment, etc.) of riparian reserve system, or incomplete protection of habitats and refugia for sensitive aquatic species (• 70-80% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition 25-50% or better[12]	riparian reserve system is fragmented, poorly connected, or provides inadequate protection of habitats and refugia for sensitive aquatic species (<70% intact), and/or for grazing impacts: percent similarity of riparian vegetation to the potential natural community/composition <25%[12]

[1] Bjornn, T.C. and D.W. Reiser, 1991. Habitat Requirements of Salmonids in Streams. American Fisheries Society Special Publication 19:83-138. Meehan, W.R., ed.
[2] Biological Opinion on Land and Resource Management Plans for the: Boise, Challis, Nez Perce, Payette, Salmon, Sawtooth, Umatilla, and Wallowa-Whitman National Forests. March 1, 1995.
[3] Washington Timber/Fish Wildlife Cooperative Monitoring Evaluation and Research Committee, 1993. Watershed Analysis Manual (Version 2.0). Washington Department of Natural Resources.
[4] Biological Opinion on Implementation of Interim Strategies for Managing Anadromous Fish-producing Watersheds in Eastern Oregon and Washington, Idaho, and Portions of Calfornia (PACFISH). National Marine Fisheries Service, Northwest Region, January 23, 1995.
[5] A Federal Agency Guide for Pilot Watershed Analysis (Version 1.2), 1994.
[6] USDA Forest Service, 1994. Section 7 Fish Habitat Monitoring Protocol for the Upper Columbia River Basin.

[7] Frissell, C.A., Liss, W.J., and David Bayles, 1993. An Integrated Biophysical Strategy for Ecological Restoration of Large Watersheds. Proceedings from the Symposium on Changing Roles in Water Resources Management and Policy, June 27-30, 1993 (American Water Resources Association), p. 449-456.

[8] Wemple, B.C., 1994. Hydrologic Integration of Forest Roads with Stream Networks in Two Basins, Western Cascades, Oregon. M.S. Thesis, Geosciences Department, Oregon State University.

[9] e.g., see Elk River Watershed Analysis Report, 1995. Siskiyou National Forest, Oregon.

[10] Northwest Forest Plan, 1994. Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. USDA Forest Service and USDI Bureau of Land Management.

[11] USDA Forest Service, 1993. Determining the Risk of Cumulative Watershed Effects Resulting from Multiple Activities.

[12] Winward, A.H., 1989 Ecological Status of Vegatation as a base for Multiple Product Management. Abstaracts 42nd annual meeting, Society for Range Management, Billings MT, Denver CO: Society For Range Managem nt: p277.