7th Federal Intragency Sedimentation Conference March 25-29, 2001, Silver Legacy, Reno. Nevada Volume 1, pages II-124-131

RAPID ASSESSMENT PROCEDURE FOR AQUATIC HABITAT, RIPARIAN & STREAMBANKS (RAPFAHRS)

Frank Reckendorf, Engineering Geologist, Reckendorf and Associates, Salem, OR; Ben Tice, Biologist, USACE, Walla Walla, WA.

INTRODUCTION

Since July 1998 periodic stream assessment work along private land has been ongoing in Walla Walla and Columbia Counties, Washington. This work has been done for the Walla Walla County and Columbia Conservation Districts. These conservation districts want to determine total watershed health, stream corridor condition, and the proper context for districts, in their partnerships with the Natural Resources Conservation Service and the Washington Department of Fish and Wildlife, to install projects that lead to stream restoration. The procedure developed to accomplish the stream assessment work has been named the Rapid Assessment Procedure For Aquatic Habitat, Riparian, and Streambanks (RAPFAHRS)

DATA COLLECTION

The field assessment work along streams is generally a continuous recording of data that includes: (1) reach designation, (2) riparian reach length and rating, (3) large woody debris or overhead cover in percent of pool surface, (4) pool substrate, (5) pool depth, (6) pool quality rating index (PQI), (7) stream bank erosion reach length, height, and rating, (8) stream percent slope, (9) stream d50 and bimodal condition if present, (10) Rosgen Stream Classification (Rosgen, 1996), (11) fencing, (12) stream bank geomorphic surface type (i.e. floodplain, terrace, steep hillside, side slope, etc.), (13) locations of water diversions and returns, and (14) potential conceptual treatments, and aquatic winter rearing habitat. Periodic measurements or recordings were also made for: (1) water temperature and diurnal variation during assessment, (2) riparian type (trees, brush or grass), (3) Global Positioning (GPS), (4) streambed d100, (5) stream bank stratigraphy, (6) d50 and d100 of streambank gravels, cobbles, and boulders, (7) percentage of substrate covered with algae, (8) livestock presence in the river, (9) Montgomery and Buffington Stream Classification (Montgomery and Buffington, 1997), (10) Stages of channel evolution (CEM) according to Schumn, Harvey, and Watson, and (11) sinuosity. Frequently the reach length, specific erosion, or habitat conditions were photographed. In general these photographs were taken in a downstream direction. Reaches were usually evaluated from upstream to downstream with right and left banks determined looking downstream. Whenever possible 1998 aerial photographs with a scale of about one-inch equals 500-ft. (1:6,000) were used for designating the reach breaks. New reaches were established based on changes in riparian vegetation, erosion, large woody debris, stream slope, width, substrate, or stream type. Access to stream reaches was provided by notification to landowners by the two conservation districts. The procedure used both written notification and follow-up phone calls. Denied access only occurred in about 5 to 10% of the reaches. Data was collected during low flow conditions in the late summer and early fall whenever possible. However, do to funding constraints, some of the data had to be collected during winter and spring flow conditions up to water depths of half bankfull condition. Follow-up visits were made to get low flow pool conditions. Measurements were made from the reach photos and from older photos and maps to determine stream sinuosity.

EVALUATION

The data was summarized for the districts in spreadsheet format. Graphical presentations and queries were also provided. Pool quality, riparian buffer quality, and erosion severity indexes were developed to provide visual aids to help identify priority areas for treatment and differences in stream reach watershed health. Criteria to establish a pool quality rating for a given pool are shown in Table 1. The Pool Quality Index (PQI) is modified from Idaho, WRD (1993). To form the index, the sum of all pool quality ratings in a reach were subtracted from 10. Therefore, the lowest rating of 0 or lower was considered to have the highest pool quality. A reach pool rating of 10 had no pools. Criteria to establish a riparian quality rating are shown in Table 2. An area with a healthy riparian buffer received a rating of 1. Areas with little or no vegetation received a rating of 10. An erosion severity index was created in a similar fashion and is shown in Table 3. A rating of 0 depicts a reach with no erosion. A rating of 10 depicts a highly eroded reach.

Most potential erosion problems are a result of a combination of factors of the type shown in Table 3. A common condition encountered in the field was modified channels with push-up gravel and cobble side slopes. These were rated 6 or 7 depending on side slopes. It is assumed at bankfull and higher flows that the pushed-up or stacked stream cobble and gravel will slough. This is common for this type of stream material when used as a "sugar dike" (one that essentially melts away in high flows).

Table 1. **Pool Quality Rating Index**

1. Depth		
	<0.5 feet	= 0
	between 0.5 and 1.5 feet	= 1
	>1.5 feet	= 2
2. Substrate		
	gravel (<2.5 inches)	= 0
	cobble (2.5-10 inches)	= 1
	boulder (>10 inches)	= 2
3. Overhead cover		
	<10% of the pool surface	= 0
	10-25% surface area	= 1
	>25% surface area	= 2
4. Submerged cover: large organic debris, small woody debris, and other forms below or on the water surface.		
	<10% of the pool surface	= 0

10-25% surface area	= 1
>25% surface area	= 2

Table 2. **Riparian Rating Index**

Needs Trees		Needs enhancement		Good
10 9	8 7	6 5 4	3	2 1
-Farmed to edge -Overgrazed -No strm. shade	-Sparse buffer -weedy -livestock dmg. -human disturb.	-Narrow buffer with minimal older trees that provide shade	-Trees in buffer -some shade -No livestock	-Many lrg. tr. -good shade -veg. healthy

Table 3. **Erosion Rating Index**

The number of items present that are listed below the rating are used to establish the rating.

10 (3 or more) 9 (at least 2) 8 (at least 1)
Unvegetated, with high stream bank overhang angle.
Unvegetated with high uncemented sandy stream bank.
Unvegetated with a stratigraphy of fines and sands over uncemented gravels and cobbles that occur within bankfull flow condition.
Unvegetated with uncemented gravels and cobbles that occur within bankfull flow condition.
High depth (> 3 ft.) of washed root zone.

7 (3 or more) 6 (at least 2) 5 (at least1)
Unvegetated with moderate stream bank height (1/3 of stream banks still above bankfull) with vertical to 1:1 sloped stream banks.
Unvegetated moderate height of stream bank with uncemented sands.
Unvegetated stratigraphy of fine sand over uncemented gravel or cobble, and contact is above bankfull depth (i. e. terrace).
Low percentage (<25%) of stream bank with roots.
Uncemented pushed-up gravels and cobbles against stream bank or as a "sugar dike".
Moderate depth (2ft. to 3ft.) of washed root zone.
Cultural evidence of erosion such as stream undercut fences, pipes, buildings, and roads.

4 (4 or more) 3 (at least 3) 2 (at least 2) 1 (at least 1) 0 (no items).
Low (1ft. to 2ft.) of washed root zone.
Low percentage (<25%) of stream bank with roots.
Evidence of recent stream bank sloughing.
Unvegetated stream bank with vertical to flatter slope, unless bedrock.
Unvegetated, uncompacted (i.e. loose) sands.
Unvegetated, uncompacted gravels or cobbles.
Unvegetated, uncompacted stratigraphy of fines over sands or gravel.

Unerosive, very stable stream banks, such as those along bedrock or ones with a good cover of grasses, shrubs, or trees, or those with a high percentage (>50%) of stream bank with roots would rate a zero. In addition stream banks with compacted fines, sands, or gravels that eroded at slow rates were rated between 1 and 3 depending on location (i.e. outside curve position rated higher). Previously treated areas with tree revetments (TrR) or rootwads and boulders (R&B) frequently still showed some low rate of erosion so they may have been rated to show erosion. The reason for this was that there may not have been any associated soil bioengineering treatment, or the treatment was not successful.

A list of potential conceptual treatments used in the assessment is shown in Table 4. The terms Vanes and Barbs are shown to be used interchangeably. However vanes are typically built with uniform rock; barbs are typically built with graded rock sizes.

In general no rock or rootwad treatment was shown for erosion rates of 4 or less. In these reaches only soil bioengineering treatment such as staking were recommended. The exception was when channel reconstruction (CR) or rock weirs (RW) are shown to narrow the channel width and to deepen the thalweg.

All rock structures such as rock weirs (RW) and vanes (V) should be assumed to be installed in Walla Walla and Columbia counties with associated rootwads unless there are special circumstances like a bridge constriction that would preclude their desirability. In addition, unless there are special circumstances, all structures are assumed to be installed with associated soil bioengineering treatment to restore the riparian area, as well as fencing and grazing management.

The final determination of conceptual treatment should be based on a follow-up field visit, discussion with the landowner, and NRCS Standards. The follow-up field visit will place the conceptual treatments into the specific context of bankfull depth, width, and slope. In addition the field visit will establish the associated treatments that may be located across the river or in another reach. For example, a winter rearing channel in one reach may need to be tied in with several R&B (rootwad and boulders) at an upstream location to keep flood flows and sediment from entering the winter rearing channels at the upstream end. A field visit is also essential to determine if there is sufficient channel width or the right stream bank height to install TrR (tree revetment of rootwads with boles into stream bank), verses R&B (rootwad and boulders parallel to stream bank) or OPL (overlapping, parallel logs with rootwads).

Table 4 **Conceptual Treatments**

Treatment	Abv.	Gen. Site Condition & Special Treatment
Staking	S	Floodplain (F. P.) & low terrace (T) scarps and top.
Staking and Geotextile	S&G	Same except add geotextile when gravel side slope.
Dormant Post Planting	DPP	Low and high F. P. and low T scarp and top.
Whole Plant Transplant	WPT	In areas behind TrR, R&B, OPL, J, V, & Other.
Joint Planting	JP	In existing riprap.
Facine	F	Above bankfull condit. on F. P. and T. scarps.
Facine & Geotextile	F&G	Same except add geotext. for gravel, cobble scarp.
Fence	Fn.	Along all stream banks with stock access.
Vegetated Geogrid	VG	Shaped F. P. and T. slopes and repairs.
Live Cribwall	LC	Base of F. P. and low terrace side slopes.
Tree Revetment	TrR	Base of F. P. or T side slopes (boles into bank).

Rootwad and Bldrs.	R&B	Base of F. P. or terrace scarps (parallel bank).

Table 4 (Cont.)

Overlap. Prl. Logs	OPL	Base of F. P. or terrace scarps slopes.
Instream R&B	IRB	Within channel rootwads and boulders primarily in C's, but also in B's and F's stream types.
Bank Shaping and Vegetation	BS& V	F. P. and some terrace side slopes, especially low terrace scarps.
Rootwad Vanes/Barbs	RV	Rootwad installed as a vane at base of slope.
Vane/Barb	V	Rock vanes should be installed rather than barbs (up to bankfull and pointed upstream).
J Vanes (curved tip)	J	Base of F. P. and T. especially with stable far bank.
Vanes/Barbs With Rootwads	VR	Vanes/barbs with rootwads in pool.
Channel Reconstruction	CR	Blown out C, E., and D Stream Types.
Log Cover Structure	LCS	F. P and T. damaged and reshaped slopes.
Lunker Structures	LS	Base of F. P. or T for fish hab., and bank protect.
Rock Vortex Weirs	RVW	Across channel for aquatic hab. and to narrow.
Rock Vortex Weirs (with Rootwads)	RVW /R	Same with instream rootwads for aquatic habitat.
Rock Weirs	RW	Across channel to narrow, create pools for fish passage and to direct flow direction.
Rock Weirs and R	RWR	Same & inchannel rootwad, to create habitat
W Rock Weir	WRW	To direct flow into two channels.
Toe Rock	TR	Base of F. P. or T.
Blders. & Clust.	B & BC	In some B 2,3, & 4; F 2,3, & 4; and C 2,3, & 4 To create pools.
Boulder Clusters	BC	Same
Single or Double Wing Deflectors	SW/ DW	Base of F. P. or T slope.
Cabled Cross Logs	CCL	Cabled logs to streambed to trap sediment.
Saw-toothed Gabon	STG	Bank protection and edge complexity.

FIELD APPLICATION OF RAPFAHRS

This version of RAPFAHRS has been used for field assessment on about 90 miles of channel or 180 miles of stream banks in the Walla Walla River Basin in Washington. An analysis of factors limiting the abundance and distribution of salmonids within the basin is underway. The RAPFAHRS stream assessment data has been very beneficial to the limiting factors analysis. The amount of large woody debris, pool frequency, and pool quality have been shown in the RAPFAHRS assessment to generally be poor throughout the basin. Also within the basin there are extensive reaches which are at or shallow to bedrock. These areas have minimal spawning habitat as well as minimal pools for rearing habitat. Stream bank stability (erosion) and riparian zone quality are generally fair, however, there are many miles of stream corridors that are overgrazed or farmed very close to the stream bank. Locally their are extensive reaches of degraded C4 and D4 stream types. These areas have very wide bankfull width to depth ratios, are braided, have only a few inches of water at low flow conditions, and have poor shade conditions. The assessment sinuosity data shows extensive reduction in the meandering of the streams in the Walla Walla Basin. in historic time.

Some obvious problems with procedure measurements have been noted. For example, reach and erosion lengths may be underestimated because distance is measured with a Laser Distance Measurer, which may not always get an accurate measurement of distance around the stream curves. In addition, narrow stream widths (<51 ft.) are sometimes estimated because the lower limit for the laser is 17 yards. (i.e. 51 ft.). However, widths under 20 ft. were usually measured with an extended survey rod. Bankfull depth was determined with a survey rod. Adequate pool length, width, and depth can only be determined at low flow so a follow up visit is needed at selected sites to correct preliminary estimates. Temperature measurements only reflect the narrow time widow that the assessment team was in the river. The d50 and d100 particle size was occasionally measured with a tape, but data for most of the reaches are based on visual estimates because of the size consistency of particle sizes along most streams. In addition the difference between, for example, C3 and C4 is not relevant for most of the potential conceptual treatments. However, there are some stream reaches in the basin that appear to reflect a bimodal distribution of the gravel and cobble sizes. The coarser sizes in these areas were selectively measured.

The speed for doing the assessment varies by stream type, access, extent of fencing, amount of LWD in the river and on the stream banks, thickness of riparian vegetation, the number of times the stream is crossed, water depth, and landowner interest in discussion. Some of the LWD, water depth, and riparian vegetation delays are minimized by doing the work in chest waders so the stream can be crossed to avoid difficult areas. For the overall inventory, the slowest inventory was about 0.75 mile in a day and the fastest about 3.75 miles per day. The average was about 2 miles per day by the two-person team. The data is presently being analyzed for trends of the quality of aquatic and riparian area and stream bank erosion needs.

CONCEPTUAL DRAWINGS AND INSTALLATIONS

Some conceptual drawings have been prepared after consultation with landowners. These are for treatments that benefit aquatic habitat and reduce land loss due to stream bank erosion. This results in a win-win situation for aquatic habitat and landowners. Conceptual drawings have so far been prepared for about 46 locations, most of which are along Coppei Cr. in Walla Walla Co., which was inventoried using a different procedure. Aquatic habitat and related stream bank protection work was installed on about a dozen site reaches in the late fall of 1998 along Coppei Cr. Redd surveys along Coppei Cr., in the spring of 1999, have found 47 steelhead redds*around the project work.

* Personnel communication with Mike Pelissier, WWCD, Walla Walla, WA, June, 1999

ASSESSMENT USE

The assessment reflects that there are many miles of riparian area that need vegetative treatment and fencing in the Walla Walla Basin. The Walla Walla County Conservation District and Columbia Conservation District have already installed several miles of soil bioengineering treatment and fencing. The re-establishment of riparian corridors in the Walla Walla Basin will help to re-establish connectivity of the wildlife habitat.

The assessment is also being used to discuss with the landowners the various aquatic habitat, riparian area, and stream bank erosion problems that may exist along their specific stream reaches. The landowners decide if they want to participate in the restoration work. The districts, in consultation with their partners the Natural Resources Conservation Service (NRCS) and the Washington Department of Fish and Wildlife (WDFW), decide which projects have priority for conceptual design, analysis, permit, and treatment. The assessment provides some of the range of treatment strategies for a given reach. Not all treatments are applicable for every site and depend to a large degree on stream type and stream width considerations. At the conceptual treatment stage of project work, the range of treatments in the assessment may be expanded or reduced based on landowner, NRCS, or WDFW interest. Species listed as threatened under the Endangered Species Act are found within much of the Walla Walla Basin. Biological assessments are often needed prior to granting of permits. Both the stream assessment and conceptual drawings are being used as part of the biological assessment process. The stream assessment also gives a perspective of the watershed health of the various sub-watersheds, as well as the whole Walla Walla Basin.

REFERENCES

Rosgen, D. L. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

Montgomery, D. R. and J. M. Buffington. 1997. Channel-reach morphology in mountain drainage basins. Geological Society of America Bulletin 109 (5) 596-611. (ck)

Schumn, Harvey, and Watson ???????????????????/

Water Resources Department, Idaho. 1993. Monitoring protocols to evaluate water quality effects of grazing management on western rangeland streams. Report for the U. S. Environmental Protection Agency. Washington D. C.

AUTHORS

Frank Reckendorf, is a Fluvial Geomorphologist, and licensed Engineering Geologist in OR. Frank set up his own consulting business located in Salem, OR. after retiring in 1994 from the position of Sedimentation Geologist, for the West National Technical Center of the Soil Conservation Service, in Portland OR. (503) 364-6681, FAX (503) 399-9421; frecken@open.org. For all general questions and questions on Stream Reaches, Slope, Stream Classification, Erosion, and Erosion Rating Index., and Conceptual Treatments.

Ben Tice is a Biologist with the U.S. Army Corps of Engineers, Walla Walla District, Walla Walla, Washington. (509) 527-7267, FAX (509) 527-7825; ben.j.tice@usace.army.mil. For all questions on Pool Quality Rating Index, Riparian Rating Index, Excel Spread Sheets, and stream temperatures.

ACKNOWLEDGEMENT

The authors appreciated the financial support of Wallla Walla County and Columbia Conservation Districts to develop the RAPFAHRS procedure and for support in doing the assessment. In particular the help of District Managers Mike Pelissier and Terry Bruegman is appreciated. The staff help from the Natural Resources Conservation Service offices in Dayton, WA and Wallla Walla, WA is also appreciated. The Washington Department of Fish and Wildlife provided the financial grants and staff consultation which is also appreciated.