APPENDIX 1

RUSSIAN RIVER CREEK STEWARDSHIP MONITORING PROGRAM: SUMMARY OF PROTOCOLS

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The Stewardship Program involves a number of steps and collection of field measurements of several types. This summary report briefly outlines the monitoring program detailed in the Watershed Atlas and Monitoring Program Watershed Stewardship Workbook by Dennis Jackson and Laurel Marcus.

INITIAL REVIEW AND ANALYSIS

The first step in any watershed program is the delineation of the streams of the drainage network and the watershed boundary on topographic maps. Year round and seasonal streams are outlined and ephemeral creeks are delineated to define the ridgetops of the watershed boundary. Sub-watersheds within a larger tributary basin may also be delineated.

A series of evaluations of slope, soil type, geology, vegetation, land use and other information is completed. Easily available information sources such as soil surveys, geologic maps, topographic maps, and County General Plans are used to gather information and describe features of the watershed. A web search is done for monitoring data available for the watershed from specific agencies, such as the Department of Fish and Game or Regional Water Quality Control Board. This basic information-gathering phase is followed by a specific analysis of the creeks in the watershed to identify potential sites, or study reaches, for monitoring work and locations for water temperatures and water quality monitoring stations.

STUDY REACHES

Study reaches are established in an area of the creek with particular physical features where a number of parameters are monitored. This approach is used to evaluate changes in siltation in gravel riffles and pools, and in the width and depth of the channel. These parameters reflect changes from watershed processes of erosion, infiltration and runoff. These changes can occur over a long time and due to a distant, upstream land disturbance. The riparian corridors, water temperatures and a suite of water quality parameters may also be monitored. Siltation, channel form and riparian corridors are monitored on an annual basis, while water temperatures are monitored using data loggers left in the channel from spring to fall.

To select potential study reaches, the slopes of the major creek channels in the watershed are calculated from topographic mapping data and each major creek in the watershed is broken into a set of slope classes. Monitoring sites for siltation and channel form must be of low slope ($<2\%$) in order for the measurements to reflect conditions of the watershed upstream of the monitoring site. High slope sites have a tendency to scour and transport sediment and are not good choices for study reaches.

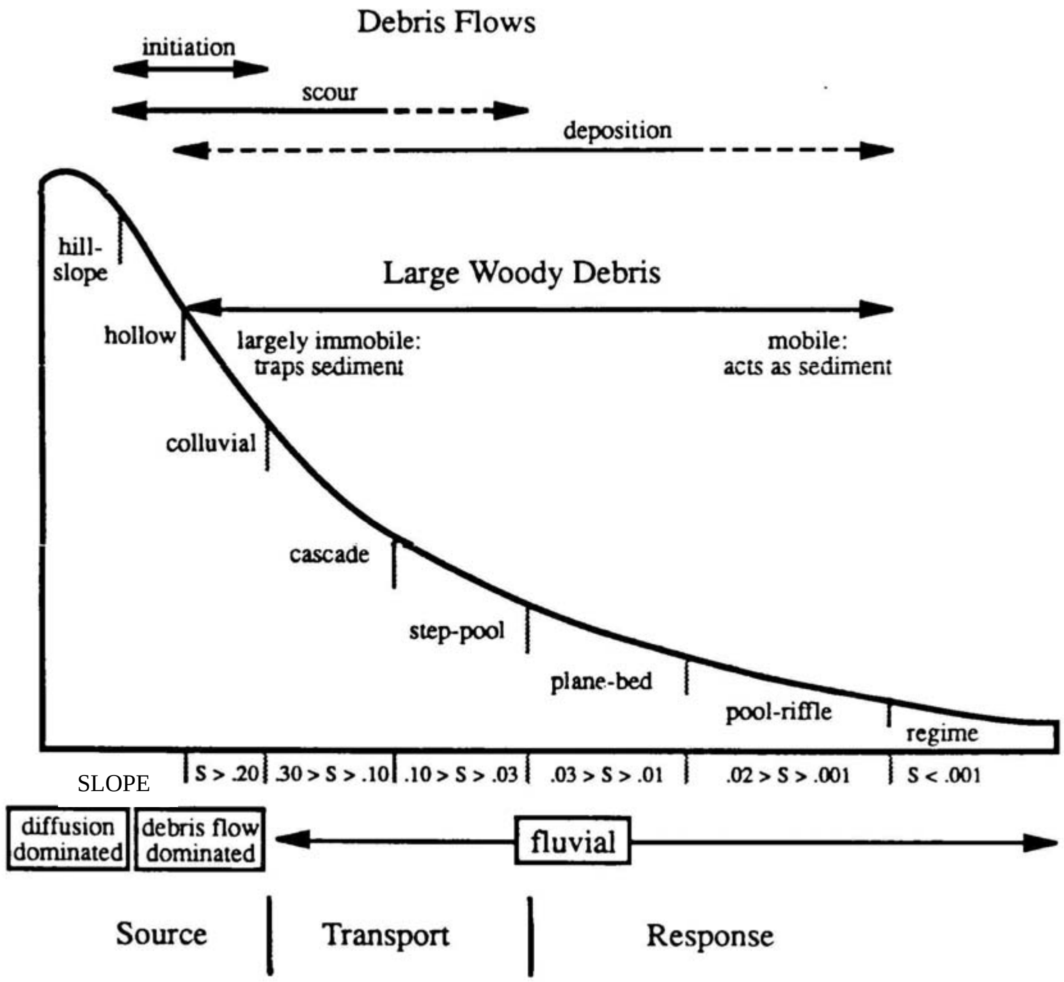
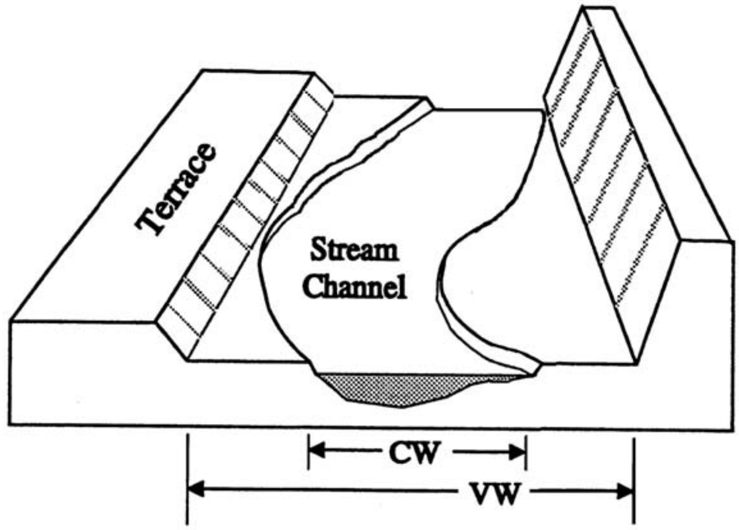
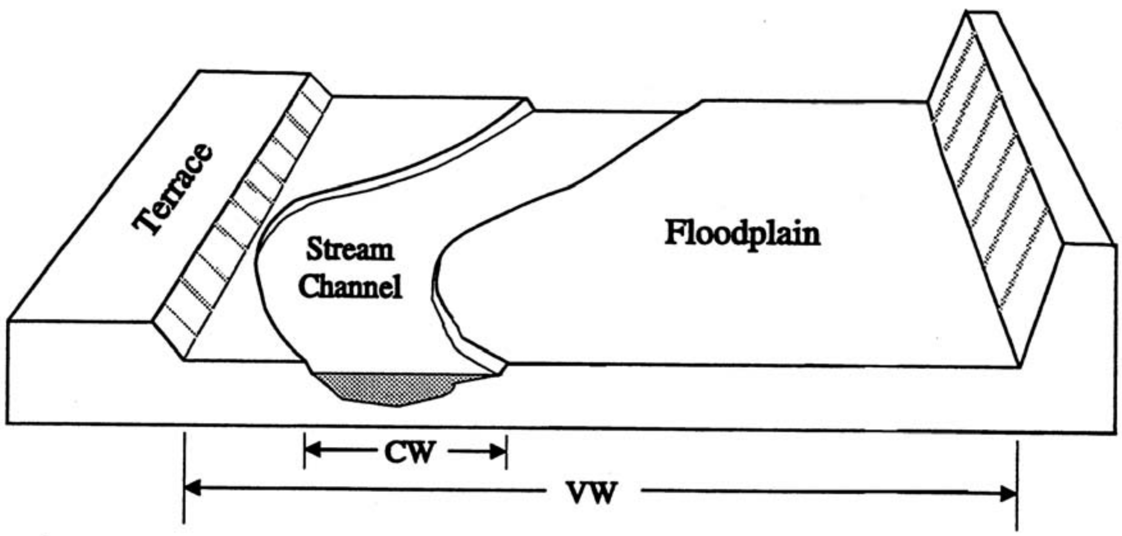


Illustration of an idealized stream showing the general distribution of channel types from the hilltop down through the channel network. From Montgomery and Buffington, 1993.





The upper illustration shows a confined channel. The valley width (VW) in the upper illustration is less than twice the channel width (CW). The lower illustration shows an unconfined channel. The valley width, in the lower illustration, is greater than four times the channel width. A terrace is a former floodplain that is too high to flood.

An evaluation of the level of confinement of the creek channel is also done. Confinement, as applied in this evaluation, refers to the geologic confinement of the channel by bedrock or valley walls. Unconfined channels have floodplains and can meander over the valley floor. The evaluation of channel confinement is done using the topographic maps and measuring the width of the valley that the stream flows through. If there is a narrow valley or canyon, it is likely that the channel is confined. Wider valley areas are likely to have unconfined channels.

Another evaluation done for the watershed is to determine where large, or significant, tributaries meet the main creek channel. A significant tributary contributes more than 10% of the flow to a section of creek or its drainage basin is greater than 10% of the total drainage basin of the main creek. Study reaches are not located just downstream of a significant tributary.

Once all this information is calculated about the creek system, several potential study reaches are identified. Each potential study reach is field reviewed to make sure it is not significantly altered through channelization, riprap or other measures. Once the potential study reaches are determined, the Sotoyome RCD staff contacts the property owners to secure access agreements to allow monitoring.

Additional monitoring stations are established in each watershed for water quality and temperature, including both main stem creeks and small tributaries.

MONITORING PARAMETERS

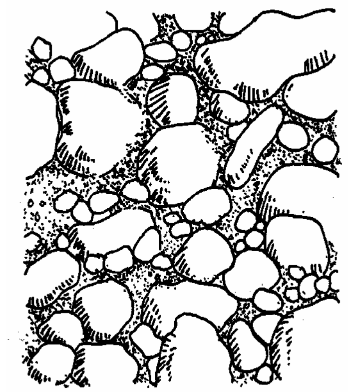
Establishing the Study Reach

The study reach(es) is established by one of the scientists who work with the Sotoyome RCD staff. A permanent bench mark is placed on site and the reach is defined in width and length by the estimated bankfull width of the creek.

Surveying the Channel

The scientists and staff at the RCD usually complete the surveys of each study reach. Surveying involves measuring the elevation and distance of a set of points along a transect perpendicular to the creek channel. A series of transects, or cross sections, are surveyed along the study reach.

Once established, the entire study reach is 10 bankfull widths long. The survey will also record features such as the low point in the channel (thalweg), bankfull channel edges, floodplain and terrace elevations over the length of the study reach to produce a series of longitudinal profiles. The surveying information is compared from year to year and over a ten year period of time to establish if the stream channel form is changing, an indication of major watershed trends.



Gravel embedded with silt and fine sediment impairs salmon and steelhead spawning.

<u>Siltation and Channel Bed Composition</u>

Annually each study reach has a pebble count completed with the assistance of community volunteers. Pebble count and embeddedness measurements record the size of the stones on the channel bed and the amount of silt around the larger stones. The pebble count is done in the dry season and this evaluation shows if there is too much fine sediment. Since salmon and steelhead use the channel bed for their nests, or redds, the composition of the gravels is an important parameter to evaluate and can only be correctly evaluated using quantitative methods.

At each cross section, a sample area is established that extends one half bankfull width upstream and one half to the downstream of the cross section. Within this square, the scientists help the volunteers to delineate regions of the streambed with similar size material. A typical square might have sample region A that mostly has coarse to very coarse gravel, sample region B with fine gravel and sand, and sample region C with large cobbles.

Within each sample region, a random sampling of 100 stones/silt is done. The stones are picked up without looking, then are measured and recorded. If the stone is a small cobble or larger, the degree of embeddedness is measured. Embeddedness is the percentage of the cobble that is buried in fine sediment. Optimal salmon habitat has an embeddedness of less than 25%.

Pools are also a part of the channel, which can fill with fine sediment and impair fish habitat. A protocol termed V-star (V*) was developed to measure the percentage of a pool area filled with fine silt. To measure V-star, a grid of transects is set up along the pool from the riffle crest at the downstream end to the riffle crest at the top of the pool. Along these transects, a specially-made graduated measuring rod is inserted to the bottom of the pool and the water depth is recorded. Then the rod is pushed into the sediment of the pool bottom until resistance is encountered. The water level is read again. These measurements are done along the grid of transects and the measurements are used to complete a set of calculations to determine the final V-star value. The V-star value indicates a low, moderate or high sediment supply to the creek.

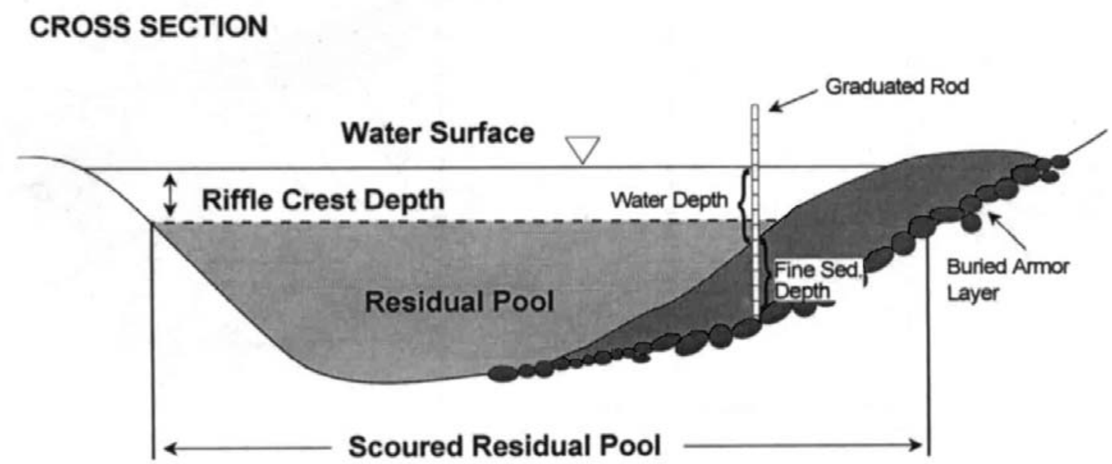


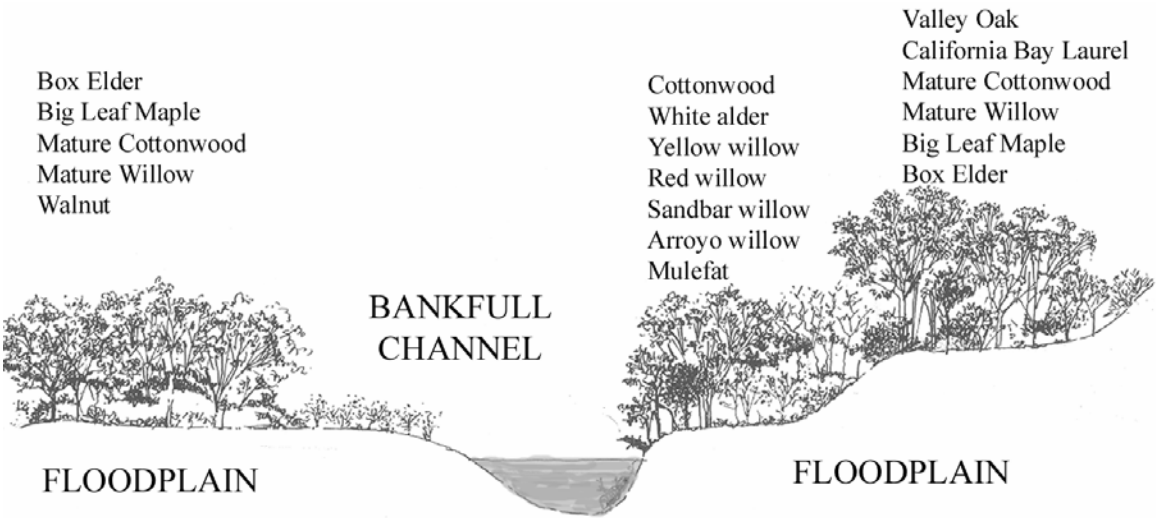
Diagram of V-star Measurement of Residual Pool Volume

Riparian Habitat and Vegetation

Riparian monitoring is done with community volunteers during the summer. The extent of riparian forest on unconfined channels is evaluated by the program scientist using aerial photographs. Several transects are established in the study reach or nearby and marked with a stake. A map of the site is drawn and a tape is stretched from one edge of the riparian corridor to the other. Every three feet along this transect a number of different measurements are completed. The overall density of the vegetation is recorded as high, medium or low and the number and species of all the trees within four feet of each measuring point is recorded. The height and dbh (diameter at breast height) are measured. Understory growth and any invasive, non-native species are recorded.

Where the transect crosses the creek channel, a canopy closure measurement is done every three feet. A spherical densiometer is used to record the canopy closure or the amount of shade over the creek.

After the vegetation transect is completed, the total width of the corridor is measured. Habitat elements such as snags, plants with seeds or berries, and features of the creek and corridor are also recorded.



Cross-section of Riparian Habitat in Floodplain Valley

Water Quality

Water quality monitoring is done for a basic suite of parameters using kits or meters. These parameters include:

- Nitrate
- Ammonia
- Phosphate
- pH
- Dissolved oxygen
- Alkalinity
- Temperature

Water in each study reach is sampled on a monthly basis from May to October. Chemettes kits, Winkler kits and meters were used for water quality monitoring.

Data loggers for temperature monitoring, called HoboTemps, are calibrated and placed in each study reach and monitoring site with perennial flows or pools from May to October. These data loggers are set to record temperatures at 30- or 60-minute intervals and are downloaded and re-launched on a regular basis. Canopy cover is measured at the time of deployment using a spherical densiometer at the location of the logger. The width and depth of water flow are recorded and stream flow is measured, if possible. Detailed field notes are taken during each download of site conditions.

Temperature monitoring was completed following the Stream Temperature Protocol of the Forest Science Project, Humboldt State University. Each data logger (Hobo temp H-08, manufactured by Onset Computer Corporation) was calibrated prior to use, in accordance with this protocol, using a NIST traceable thermometer in both a room temperature bath and an ice water bath. All data loggers performed within the manufacturer's specified accuracy range and protocol requirements.

Water temperature data are transferred into the BoxCar 4.0 program and then Excel for analysis. Water temperatures at all sites were recorded in 60-minute intervals continuously.

<u>Quality Assurance/Quality Control</u>

Quality assurance/quality control (QA/QC) plans are required as part of the creek monitoring program. QA/QC plans outline the procedures for each monitoring protocol to make sure the data is collected properly and the level of error is low. For most of the protocols in the volunteer monitoring program, the QA/QC plan requires that professional scientists calibrate all instruments, set up and select the monitoring site and oversee the data collection. Oftentimes, the scientists must make a judgment in the field about the monitoring and therefore must understand all aspects of the protocol to avoid creating errors in the data. Currently, the volunteer monitoring program only accepts data collected through these QA/QC procedures.

<u>Data Archiving and Interpretation</u>

Data sheets from each field date involving volunteers are reviewed by the program science director, Laurel Marcus, on the day of the monitoring to assure all information is complete and then enters the data into an archiving system. Each protocol has a specific Excel archiving sheet that includes analytical formulas as appropriate for each protocol. The data are reviewed by the program scientists and an annual summary report is prepared. This summary report is used by the stewardship program to identify the types of projects needed in each watershed.

For example, if the embeddedness and V-star monitoring data show high levels of fine sediment, additional road repair, gully repair and erosion control projects are needed. If the riparian overview shows many channel areas with little or no riparian corridor, revegetation projects are needed. If the riparian transect shows large infestations of invasive plants, removal of these plants and revegetation with native species is needed.

Some protocols such as channel surveys and pebble counts require a number of years of measurements before any conclusions can be drawn. Many measurements show long-term trends in watershed and creek conditions and assist in identifying watershed management needs. The data does not represent the results of the actions of the landowner where the study reach is located but describes overall watershed and creek processes. Stream channels are complex and reflect the natural features such as geology, topography, and climate, as well as land management practices and developments in the watershed.