Ecological Flows, Rock Displosal Areas, Valley Fills, Water Quality, and Aquatic Biota (Newsletter)*

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Many common threads connect geographically separate regulatory and public concerns. Oregon has peak and ecological flows for water storage projects, Nevada has water quality draining from waste rock disposal areas (RDAs), West Virginia (and other Appalachian coal mining areas) has downstream water quality and aquatic biota from valley fill runoff. Related concerns involve fish and the Endangered Species Act (ESA): bull trout in Idaho; salmon in Oregon and Washington; Lahontan cutthroat trout in Nevada. The common threads include areas of topographic and hydrologic complexity, high variability, multiple basin sizes, and low confidence in scientific analyses of the processes and numeric modeling results.

Most mathematical and statistical models ignore geographic location and spatial relationships. Without these factors we have no confidence that results reflect what happened in the past and might predict future structures and processes. The most appropriate analytical approach is applying appropriate map-based and geostatistical models to the digital representation of the landscape. These digital elevation models (DEM) are sufficiently accurate and valid at multiple sizes of drainage basins and resolution cells.

Terrain analyses based on these DEMs help explain natural processes and allow planning and permitting decisions to be better informed. In addition to describing and characterizing drainage basins by curvature, size, aspect, and slopes appropriate models can estimate the likelihood of rockslides, avalanches, debris flows, landslides, flooding, and wildfire paths and rates of burn.

Questions about hydrology (surface and ground), hydraulics, erosion and sediment transport, stream channel networks, landscapes and wildlife habitats, and water quality can be answered using spatial analyses and statistics on the DEMs. These models include tracing flows, construction of flowlines, flowpath lengths, areas contributing to water volume at a point, topographic wetness index (locations of potential and actual wetlands), erosion/deposition and sediment transport in stream/river channels, drainage network analysis, and vegetation (habitat) patchiness and fragmentation.

When information on the historic and current distributions of fish and other biota are added to the analyses the resulting maps can illustrate potential changes in fish habitats (by species and life history stage), where and how structures can affect flows or clean runoff waters, and how chemical concentrations in runoff water change in mixing zones, at the discharge point of NPDES permits, and in basins without potable water supplies.

These analyses are used when you need to understand processes in addition to structures and when you need to clearly and effectively explain them to non-technical audiences. The tools can identify causes of observed effects as well as associations (correlations) and measure magnitudes of inherent variability in the system. As with any set of tools, knowing which tool to apply, how to properly apply it, and how to interpret the result to produce technically sound and legally defensible knowledge is different from knowing which end is sharp or where choices are located in the menu system. Knowing how to use a word processor does not make the user an effective writer. The concerns are the same with applying spatial analyses and statistics to real world planning and regulatory decisions.