Report for 2004OR49B: Riverine gravel supply in Oregon

There are no reported publications resulting from this project.

Report Follows

Start Date: February 15, 2004

End Date: February 14, 2005

Title: Riverine gravel supply in Oregon

Focus Categories: Geomorphology Processes, Hydrology, Sediments

Principal Investigator: Peter Klingeman, Professor, Department of Civil, Construction and Environmental Engineering Oregon State University, Corvallis, OR 97331, Telephone: 541-737-4977

Congressional Districts: Oregon, 1st and 5th

Abstract

The relative abundance and availability of river gravel in lower reaches of coastal streams will be determined for Oregon's coastal streams. The determination involved documentation of its presence in channels, verification of its availability for transport, identification of the source areas for gravel supply and recruitment, and location of the delivery and deposition zones in the tidal reaches. Available gravel quantities were determined by basic sediment mass balances and the use of formulas to estimate transport capabilities and transport occurrences.

Statement of Critical Regional Problem

River gravel occurring in tidewater reaches of Oregon's coastal streams is a natural resource subject to three main conflicting concerns and stream uses. These are: habitat, gravel mining, and flood control. Each is briefly described in the following paragraphs.

River gravel is an essential physical element for most stream ecosystems, particularly the coastal streams of the Pacific Northwest. Beyond the natural physical boundary provided by such material, gravel also forms a substrate where benthic organisms live and other organisms and species use the material for portions of their life cycles. In particular, the several salmonid species that are found in the Pacific Northwest use gravel for spawning, egg incubation, and fry habitat. Gravel also provides a growing medium for various rooted aquatic plants. There is no substitute to take the place of river gravel for these uses.

River gravel that occurs in the lower reaches of rivers near roads and communities has a high demand for its use as aggregate for making concrete. Such gravel has already survived the abrasion associated with river transport and hence tends to have more durable properties than quarry rock or hillside material derived from bedrock weathering. River gravel may also be closer to potential use areas than some floodplain gravels or may not be affected by competing, expensive floodplain land uses. Royalties to the State for mining of river gravel may be much smaller than the alternative land acquisition costs. Hence, river gravel is

favored for its strength, its proximity to potential markets, and its apparent fewer cost barriers. Counterbalancing these are restrictions on removal of gravel from stream channels.

Flooding in the tidewater reaches of coastal streams often results from a combination of circumstances. For example, river floods lead to high water levels; tidal reaches are subject added elevation changes due to ocean tides; and during high-tide phases of tidal cycles the estuarine water levels may retard the outflow of and add to the water elevations of river runoff. To the extent that river gravels are abundant in such tidewater zones, they are viewed by some people as either adding to the flooding problem or offering a means (through dredging) to lower flood levels. A variation on this example involves past efforts of agencies or adjacent landowners to confine floodplain channels, thus reducing the flow capacity. When a flood occurs in a tidal reach of stream, the problems already described are compounded.

The tidal reaches of five main rivers entering the Tillamook plain and estuary are particularly susceptible to the combination of all three pressures on the gravel resource -- habitat, aggregate, and flood mitigation. This is in part due to the flat river gradients in the tidal reaches and in part because of floodplain encroachment by the town of Tillamook and by nearby agricultural zones.

Tidal reaches of other coastal rivers also experience some of the same problems, although to a lesser combined degree. In some places other issues also arise. For example, the lower reaches of the Umpqua River tend to be affected mainly by habitat and aggregate issues, but with the added problem of storm-caused landslides along adjacent steep tributaries draining lands with a history of forest clear-cut harvesting.

Statement of Results

One result of the geomorphic assessment was to have a clear idea of the physical nature of each studied stream based on several evaluation criteria. These criteria included:

- whether the stream reach is dominated by gravel or by bed material having other size descriptions;
- whether the stream appears to be "choking" with gravel or to be deficient of gravel;
- whether the bed has well-formed geomorphic features that suggest active fluvial processes or instead has poorly-formed features that suggest zones of net deposition;
- whether the overall channel alignment or the specific morphological features of the bed contribute to bank erosion;
- whether the channel appears to offer a "reasonable" capability to carry floodwaters and sediment, relative to the contributing drainage area, or appears to be too small or large to be an effective conveyance system for water and sediment;
- indicators of habitat diversity, complexity, and connectivity in lateral channel directions and with respect to the adjacent riparian and floodplain areas.

One result of the hydrologic assessment was to provide quantitative information on flow availability for sediment transport and on periods of flow capability to transport sediment. This was needed to determine the actual delivery of gravel to the lower reaches and replenishment (recruitment) of gravel from upstream sources.

One result of the hydraulic assessment was to develop a basic mass balance of inputs, outputs, and storages for gravel for the lower reaches of the study streams. A second result was to develop a gravel recruitment relationship for each reach.

These results lead to initial conclusions regarding the relative supply and replacement of gravel to lower reaches of the studied coastal streams. Thus, a physical basis was developed, along with quantitative information, for use to address some of the main gravel resource issues.

References

Bogavelli, Vaishali. Streamflow Research Web Site: Development of Hydrologic Analysis Techniques Section. Master of Science Report; Department of Civil, Construction & Environmental Engineering; Corvallis. July 2002.

Coles, Derron. Streamflow Research Web Site: Web Design Process. Master of Science Report; Department of Civil, Construction & Environmental Engineering; Corvallis. July 2002.

Graduate Student Training

A major part of the budget for the proposed research is for student support. One graduate student, Josh Wyrick, pursued a Ph.D. while working on this project leading to his dissertation entitled "On the Formation of Fluvial Islands,". The project provided training opportunities that are not normally available in regular graduate educational program.

Publication

Institute of Natural Resources, 2005, Draft Technical Report on Aggregate Resources to the Aggregate/Agriculture Consensus Group: Research Report prepared for the National Policy Consensus Center, Portland State University