

Herd Creek

General Information

Herd Creek is a tributary of the East Fork of the Salmon River. The study reach is a 600 ft length of stream about 1.6 miles upstream from the confluence with the East Fork Salmon River. The site is below the Bennett Ranch on land administered by the Bureau of Land Management at an elevation of about 5,900 ft above sea level. The drainage area is 110 mi² and the geology of the watershed is predominantly mixed volcanics.

In 1994 and 1995, personnel of Case Western Reserve University established a stream gage and measured sediment transport and streamflow at this site. Additional measurements included a survey of the stream reach, pebble counts of the substrate surface and transport distance of painted rocks during high flows. Figures 1 and 2 show photographs of Herd Creek looking upstream and downstream from the measurement location for stream discharge and sediment transport.



Figure 1. Herd Creek looking upstream from the measurement site.



Figure 2. Herd Creek looking downstream from the measurement site.

Streamflow was recorded for water years 1994 and 1995 from the beginning of the spring snowmelt hydrograph until fall. Estimated average annual streamflow (Q_a) for the stream is $46.2 \text{ ft}^3/\text{s}$ and the estimated bankfull discharge (Q_b) is $193 \text{ ft}^3/\text{s}$. Stream discharge was recorded in 1994 from May 5 to October 22. Stream discharge was very low in 1994 and the largest daily mean discharge was only $42 \text{ ft}^3/\text{s}$. In 1995, stream discharge was recorded from April 20 to November 2 and the largest daily mean discharge recorded was $275 \text{ ft}^3/\text{s}$ on June 28, well above bankfull discharge.

Channel Profile and Cross-Section

Figure 3 shows the longitudinal profile for the channel bed in the center of the channel, the water surface elevations along each bank at the time of the survey and bankfull flow elevations (floodplains). The average gradient for the study reach is 0.0077 ft/ft. Cross-sections of the channel were surveyed at four locations. Discharge and sediment transport measurements were made at cross-section 1 (XS1) and the movement of painted rocks during the spring and early summer snowmelt flows in 1995 were measured at two transects (PR transects in Figure 3) about 39 and 56 ft downstream of XS1.

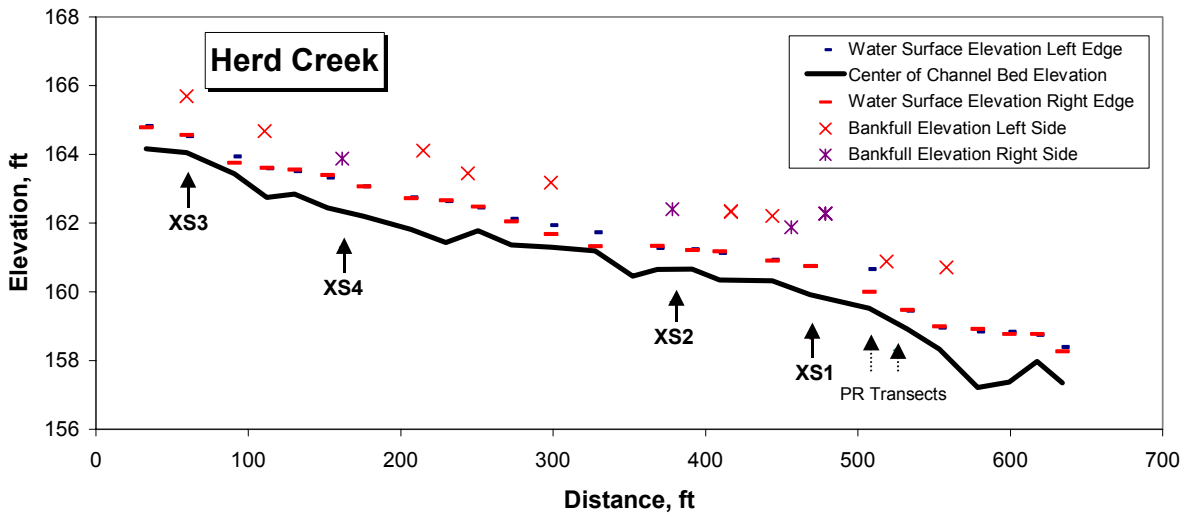


Figure 3. Longitudinal profile of the study reach in Herd Creek.

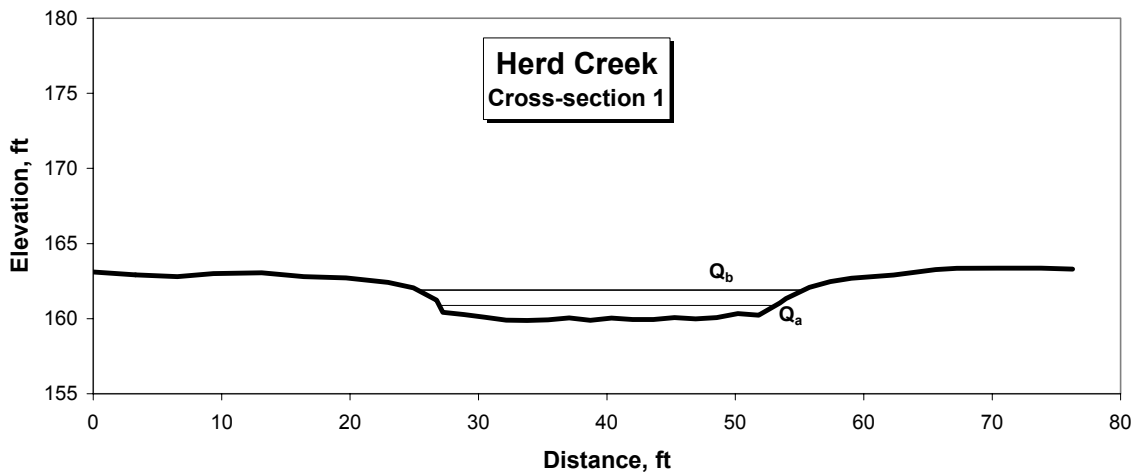


Figure 4. Cross-section of Herd Creek at the sediment transport measurement site.

Channel Geometry

Figure 4 shows the cross-section at the sediment transport measurement site, cross-section 1. The channel geometry relationships for this cross-section are shown in Figure 5. All data collected in 1994 and 1995 were used to develop the displayed power relationships with discharge. Over the range of discharges when sediment transport was measured (10.2 to 287 ft³/s) estimated stream width, estimated average depth and estimated average velocity varied from 23.9 to 30.31 ft, 0.40 to 1.89 ft, and 1.1 to 5.0 ft/s, respectively. The average reach gradient is 0.0077 ft/ft.

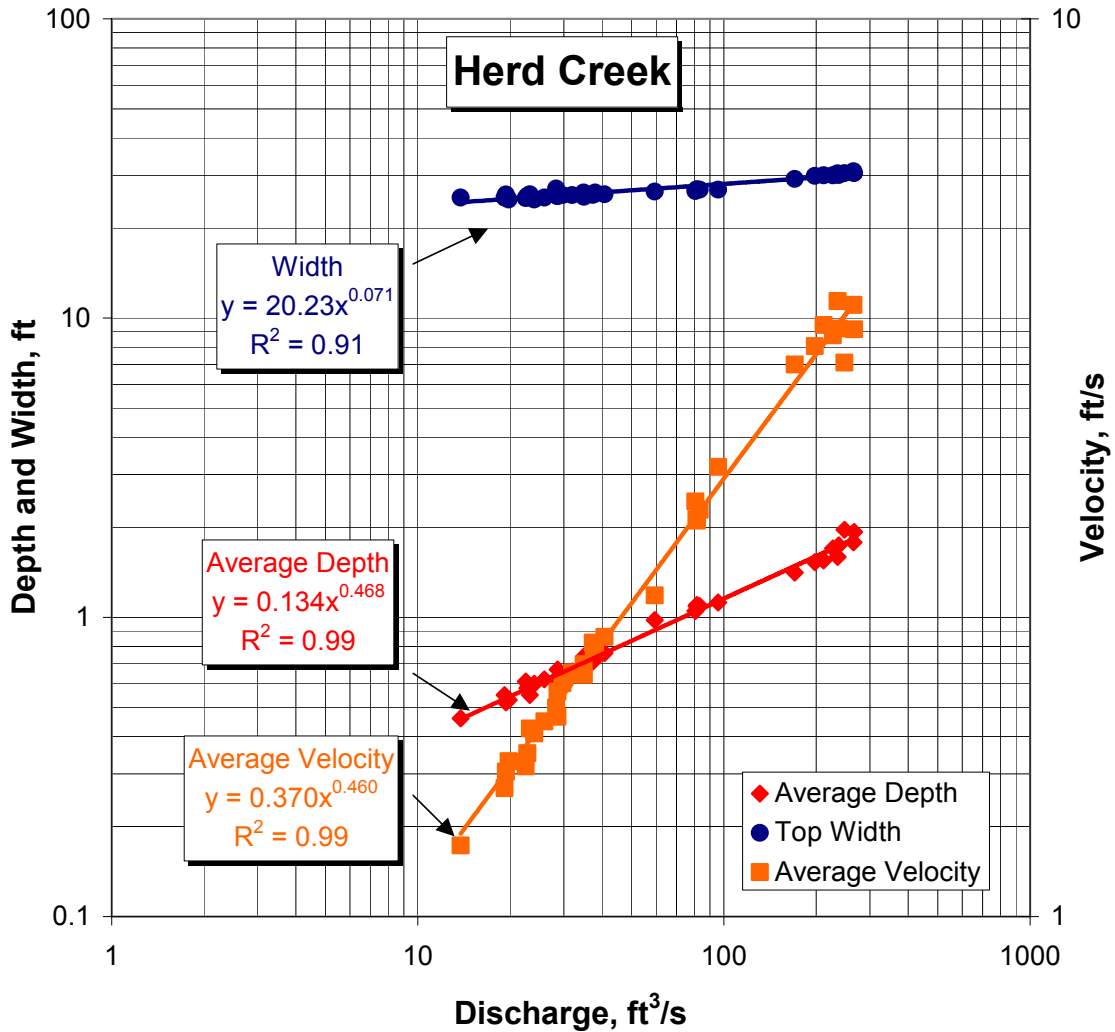


Figure 5. Width, average depth and average velocity versus stream discharge at the measurement cross-section on Herd Creek.

Channel Material

Surface pebble counts were made along four transects near cross-section 1 in July 1994. No subsurface core samples were collected at this site. The average D_{50} and D_{90} for the surface material was 67 mm and 122 mm, respectively (Figure 6).

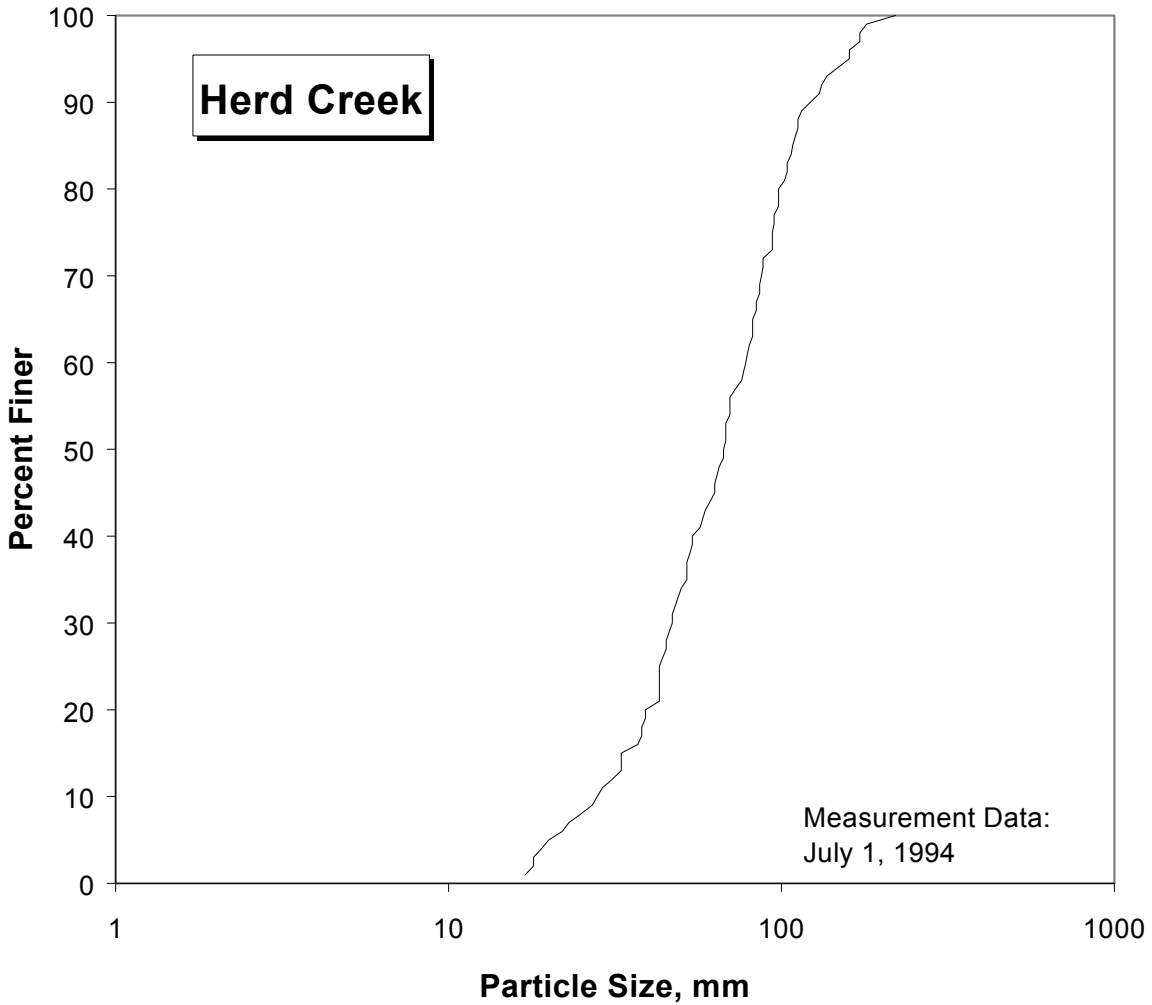


Figure 6. Particle size distribution for surface material samples in Herd Creek.

Sediment Transport

Sediment transport measurements made in 1994 and 1995 include 72 measurements of bedload transport and 23 measurements of suspended sediment transport. Sediment transport measurements spanned a range of stream discharges from 10.2 ft³/s (0.22Q_a; 0.05Q_b) to 287 ft³/s (6.21Q_a; 1.49Q_b). Bedload transport ranged from 0.000964 to 60.2 t/d and suspended transport ranged from 0.265 to 218 t/d. Over the range of measured discharges, suspended transport accounts for the majority of the material in transport with a four to over five fold greater transport rate than the bedload transport rate (Figure 7).

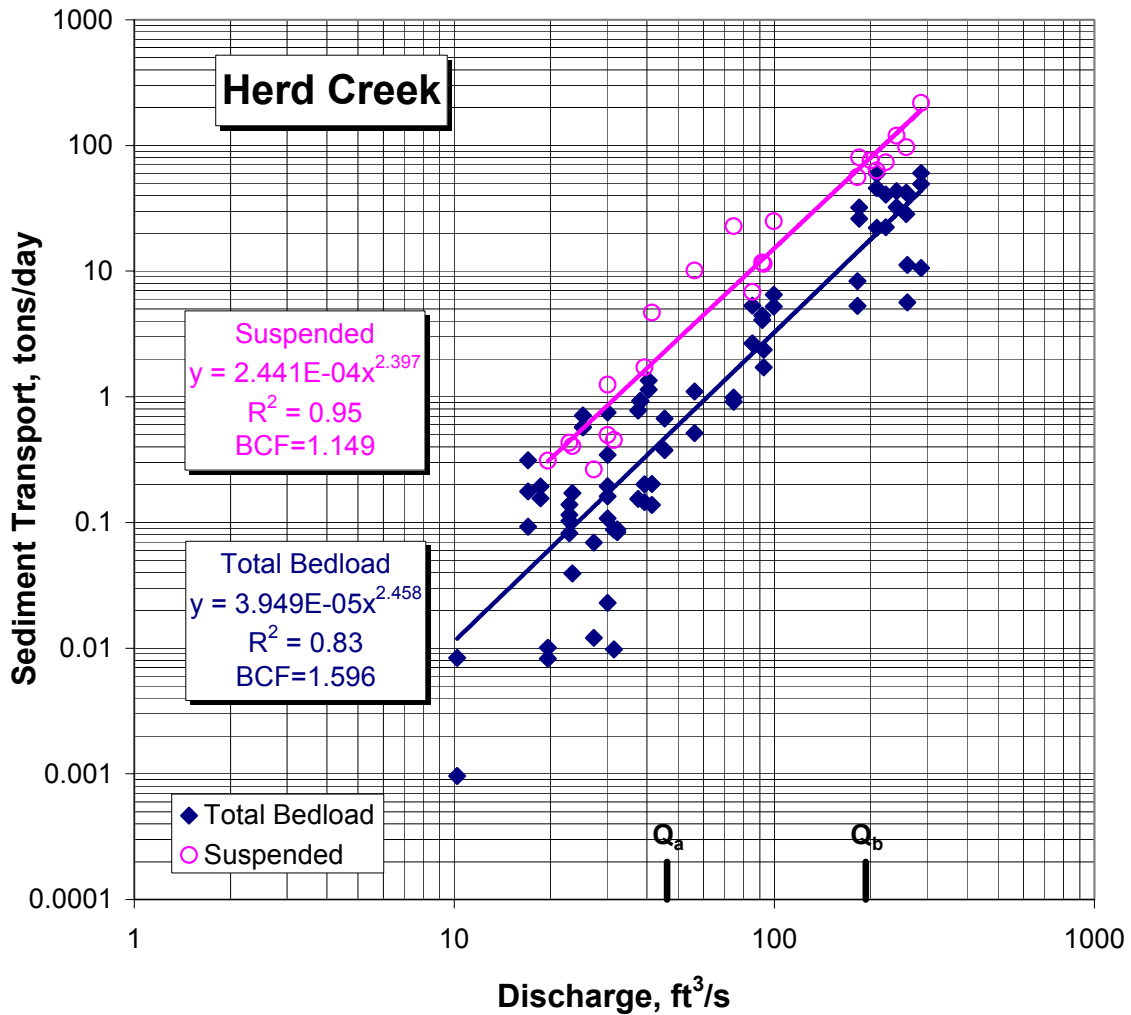


Figure 7. Bedload and suspended load transport rate versus discharge.

The bedload transport rates by size class (Figure 8) shows that the larger rates are associated with material in the 0.5 to 2mm diameter size class. No curve fitting was done for sediment >32mm diameter since only nine of the samples contained this size class of material. All discharges transporting material >32mm exceeded 100 ft³/s.

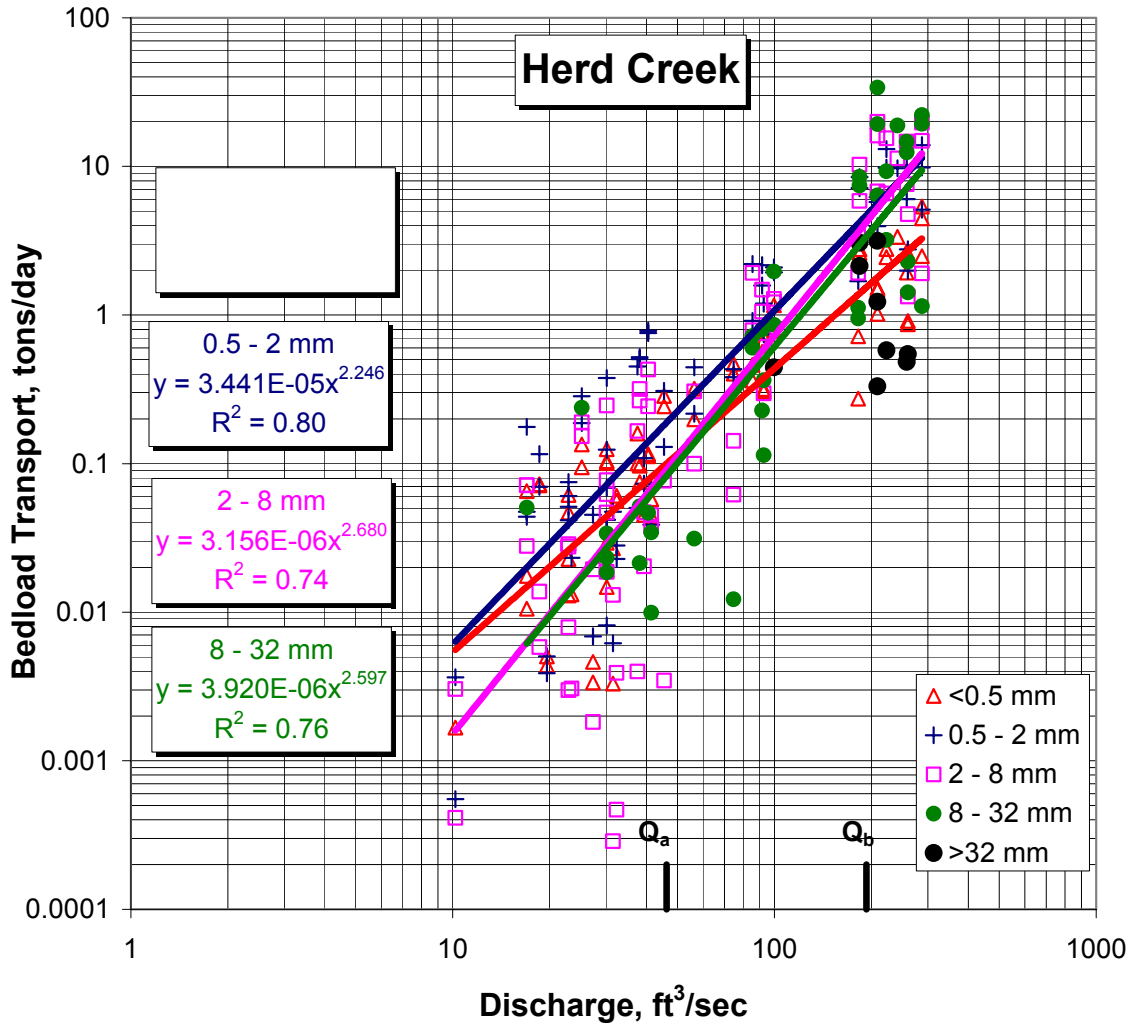


Figure 8. Bedload transport rate versus discharge for selected size classes.

The size of the largest particle in the bedload sample increased with discharge (Figure 9). The largest particle measured in a bedload sample was 60.5 mm at a discharge of 95.7 ft³/s. At discharges greater than bankfull (193 ft³/s) the largest particle usually exceeded 40 mm. There is also a trend of increasing median size of the bedload sample with increasing discharge. The D₅₀ for most of the bedload samples was in the sand size, 0.5 to 2.0 mm. The largest median diameter of a bedload sample was 9.7 mm. The information on the largest particle in the bedload sample and observations of painted rock movement suggest that discharges at or slightly above the bankfull discharge are capable of moving the median diameter particles on the channel surface.

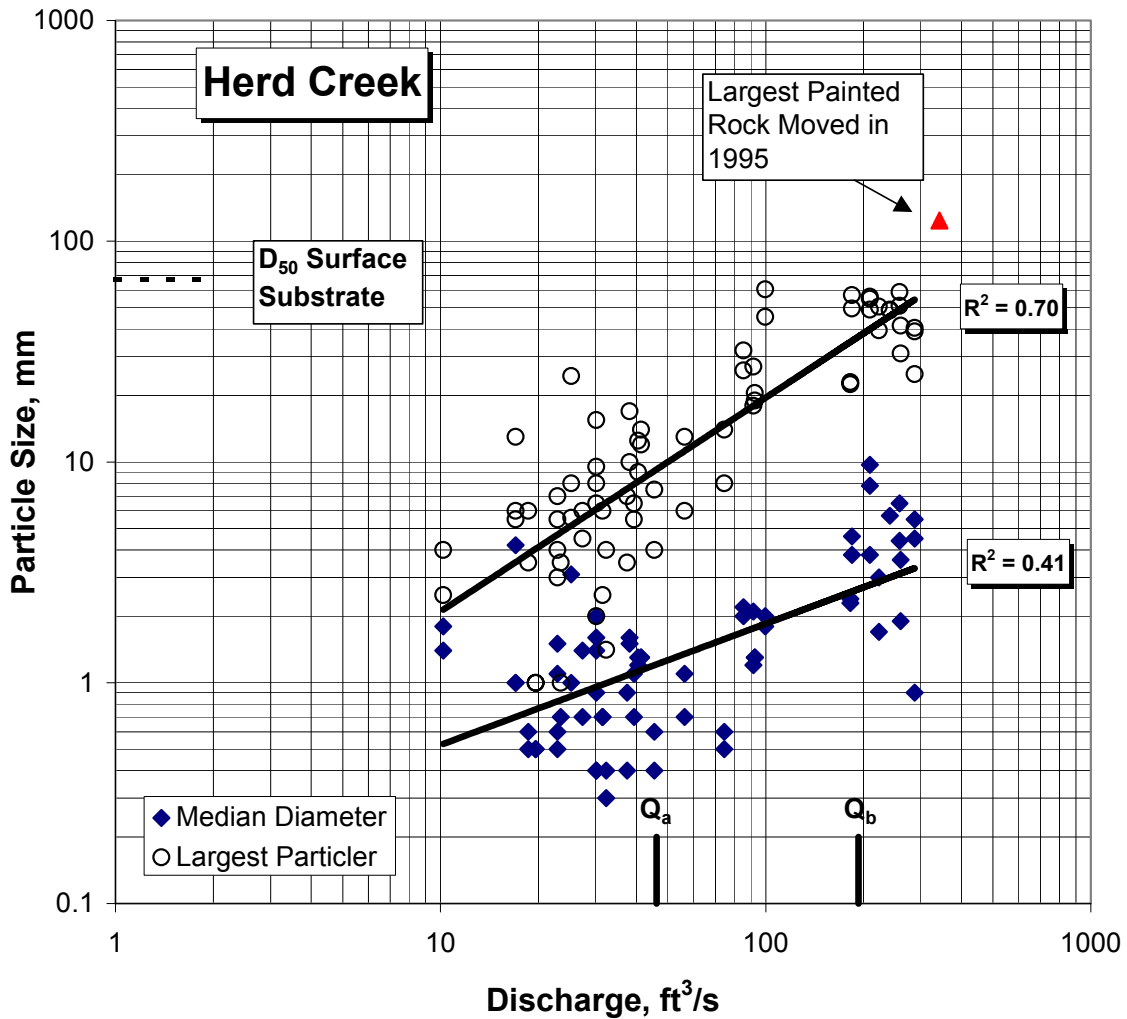


Figure 9. Median size of the bedload sample and the largest particle size versus stream discharge for Herd Creek.

Painted Rock Transport

A total of forty painted rocks were placed across two transects (twenty per transect) on April 27, 1995. Daily mean discharge on the day of rock placement was $18.75 \text{ ft}^3/\text{s}$. The size of the rocks ranged from 38 to 115 mm diameter (b-axis) which represents the D_{17} up to the D_{89} of the surface particle size distribution measured at cross-section 1. Transport of the rocks as of July 12, 1995 are shown in Figures 10 and 11.

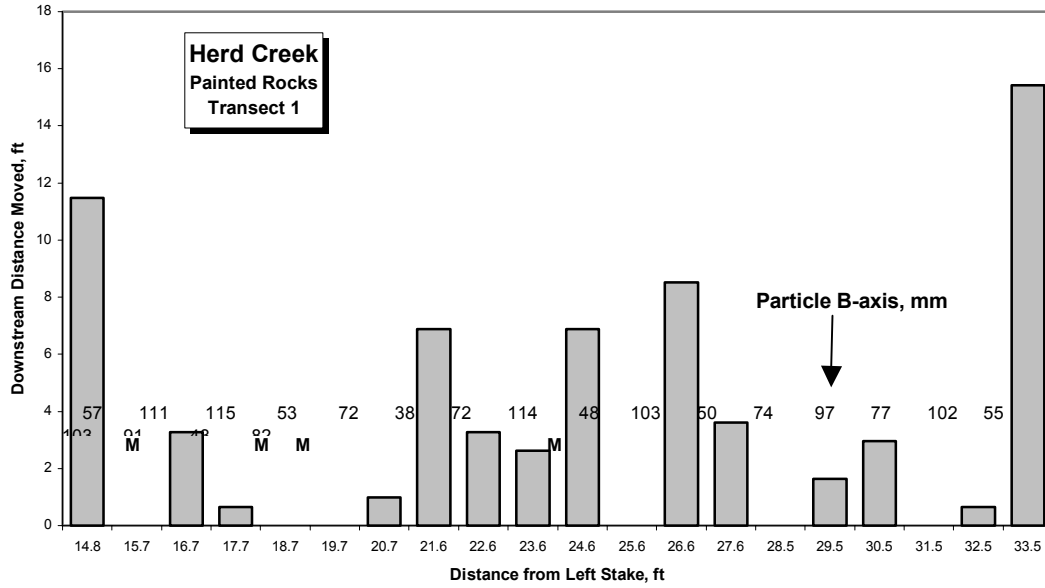


Figure 10. Transport distance of painted rocks at transect 1.

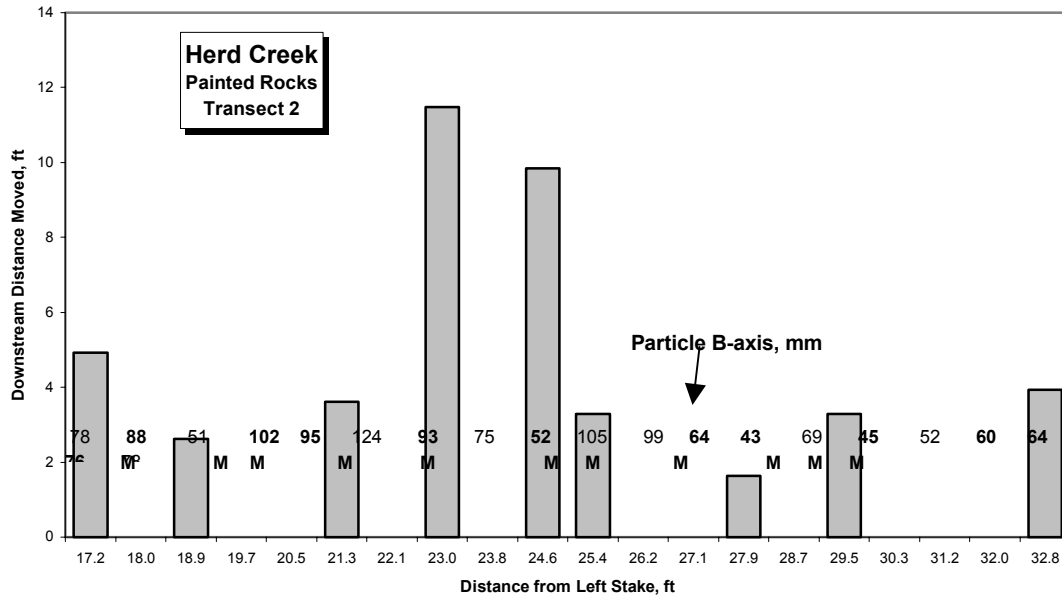


Figure 11 Transport distance of painted rocks at transect 2.

Twenty five of the forty rocks were found. Of those found, only two had not moved. The maximum transport distance was 15.4 ft for a 82mm diameter rock and the average was transport distance was 4.5 ft. The largest daily mean discharge during this period was 275 ft³/s on June 28, 1995 and the largest instantaneous discharge was 342 ft³/s.