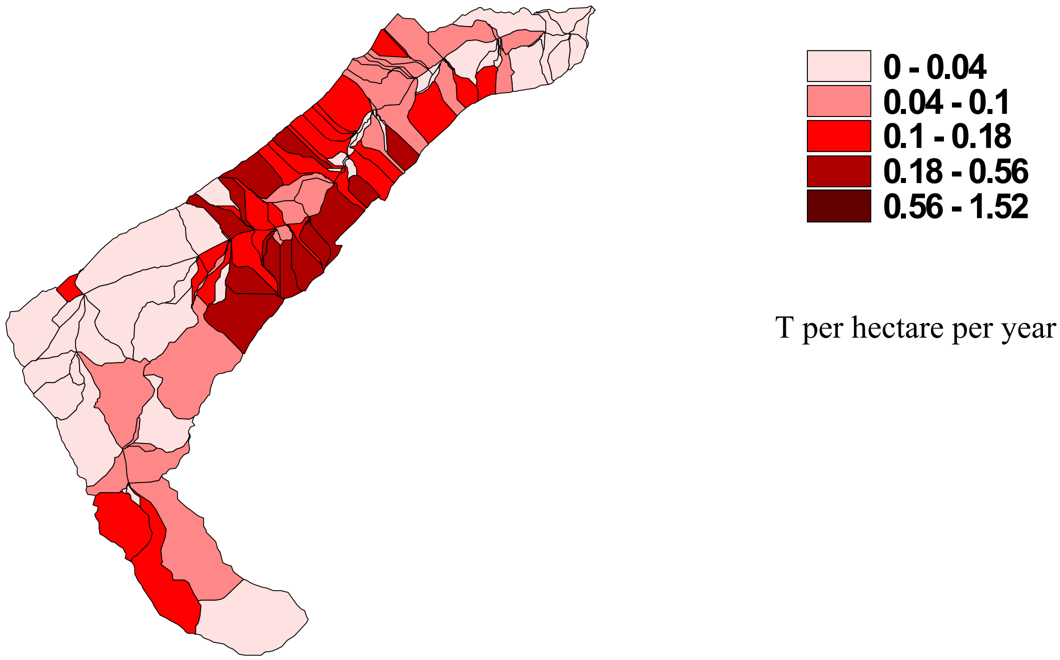


**Figure 5-41. Average annual erosion simulated from AnnAGNPS for each cell on General Creek watershed.**

**Table 5-5. Comparison of measured and simulated annual peak discharge at USGS gaging station 10336645 on General Creek. Values are in cubic meters per second.**

| Water year | Observed | CONCEPTS | Water year | Observed | CONCEPTS |
|---|---|---|---|---|---|
| 1981 | 3.79 | 5.73 | 1992 | 2.80 | 4.82 |
| 1982 | 21.66 | 25.45 | 1993 | 8.16 | 10.13 |
| 1983 | 9.49 | 9.10 | 1994 | 2.46 | 4.55 |
| 1984 | 10.17 | 8.43 | 1995 | 9.37 | 12.32 |
| 1985 | 3.65 | 4.66 | 1996 | 15.94 | 14.09 |
| 1986 | 15.12 | 28.80 | 1997 | 22.57 | 47.90 |
| 1987 | 2.92 | 5.26 | 1998 | 8.58 | 22.55 |
| 1988 | 1.22 | 3.46 | 1999 | 8.69 | 9.27 |
| 1989 | 5.69 | 8.07 | 2000 | 5.83 | 12.31 |
| 1990 | 2.46 | 4.58 | 2001 | 3.23 | 5.37 |
| 1991 | 4.36 | 6.55 | | | |

**CONCEPTS Validation**

Calculated suspended-sediment loads at station 10336645 (see section 3.4) and the observed changes at cross sections 2, 4, 6, and 13 between 1983 and 2002 were used to validate CONCEPTS for the period August 1983 through December 2002. Figures 5-43 through 5-46 show the results of the validation. Simulated annual peak discharges are listed in Table 5-5 and discussed above.

Changes in cross section geometry. Figure 5-43 shows that simulated cross-sectional changes between 1983 and 2002 agree very well with those observed. Changes in bed elevation along General Creek are negligible and channel width adjustment is minor. The simulated adjustment occurred in February 1986, whereas in reality it probably occurred during the high runoff events in the first week of January 1997 (see next subsection).

Sediment Load. Figure 5-44 compares measured and simulated monthly loads of fines (clay- and silt-sized particles), sands, and total suspended sediments. The points plot around the line of perfect agreement. The observed scatter is to be expected due to of the variability between measured and simulated monthly runoff (Figure 5-37). The $r^2$ values for the fines, sands, and total suspended sediments are 0.67, 0.43, and 0.70 respectively.

Generally, annual loads of fines, sands, and total suspended sediment appear to be correlated with variations in annual runoff (Figure 5-45). Years with low runoff correspond to years with low annual sediment loads. Increased measured load in 1997 is caused by streambank erosion, whose occurrence was simulated by CONCEPTS in 1986. The channel erosion has a similar effect on the measured and simulated magnitude of the annual load. The measured and simulated annual loads in the year in which channel adjustment occurred are approximately 1250 T. Between 1984 and 2001 measured average-annual sediment loads of fines, sands, and total suspended sediment are 61, 178, and 238 T, respectively. The corresponding simulated average annual loads are 64, 208, and 272 T, respectively. The simulated average annual load of fines (clays and silts) agrees well with that measured. The average annual load of sands is slightly overestimated.

Annually-averaged monthly sediment load of fines, sands, and total suspended sediment for each month is shown in Figure 5-26. Most sediment is transported during the snowmelt period from April through June. The simulated sediment loads agree quite well with those measured for this period. The high measured average sediment load for the month of January is caused by channel erosion during January 1997. The simulated erosion occurred in February 1996, increasing the simulated average sediment load for that month.

Of the total amount of fines delivered to the channel 78% is eroded from the uplands and 22% from the streambanks (Table 5-6). Streambanks contributed 60% of the sands and 53% of the total suspended sediment. Simulated total suspended-sediment loads averaged over the validation period are 241 T/y (41 T/y of fines), compared to 176 T/y calculated at station 10336645. Part of this discrepancy is due to the fact that CONCEPTS loads shown in Table 5-6 represents all sediment inputs along the modeled reach. In fact, some of this material is deposited on the bed during downstream transport.

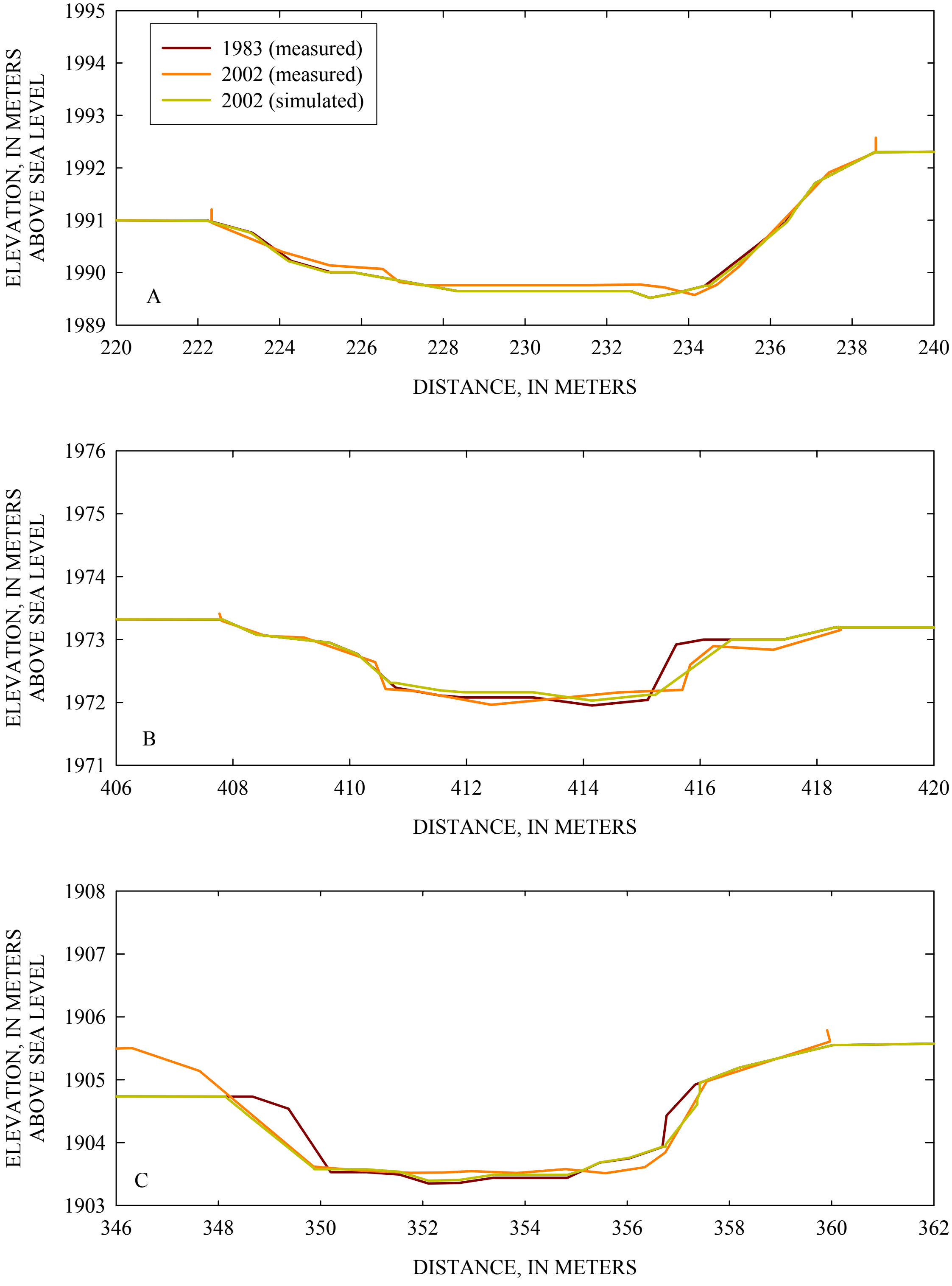


**Figure 5-43. Comparison of observed and simulated cross-sectional changes at: A) CONCEPTS cross section 4 and NH60, B) CONCEPTS cross section 6 and NH70, and C) CONCEPTS cross section 13 and NH90.**

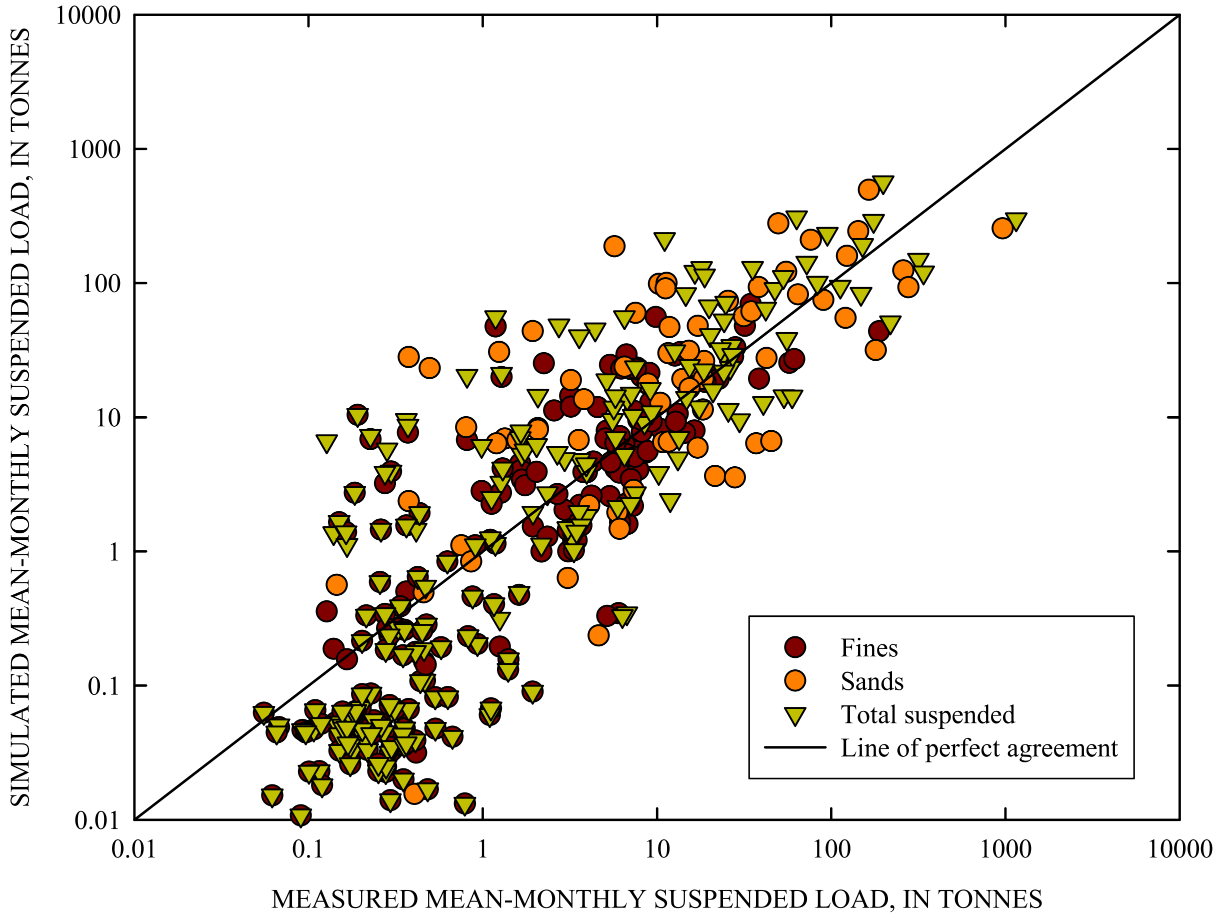


**Figure 5-44. Comparison of measured and simulated monthly loads of fines (clay and silts), sands, and total suspended sediments at station 10336645, General Creek.**

**Table 5-6. Relative contributions of uplands and streambanks to suspended sediment load at the outlet of General Creek for the validation period.**

| Sediment size | Uplands (%) | Streambanks (%) | Total (T/y) |
|---|---|---|---|
| Fines | 78 | 22 | 48 |
| Sands | 40 | 60 | 193 |
| Total suspended | 47 | 53 | 241 |

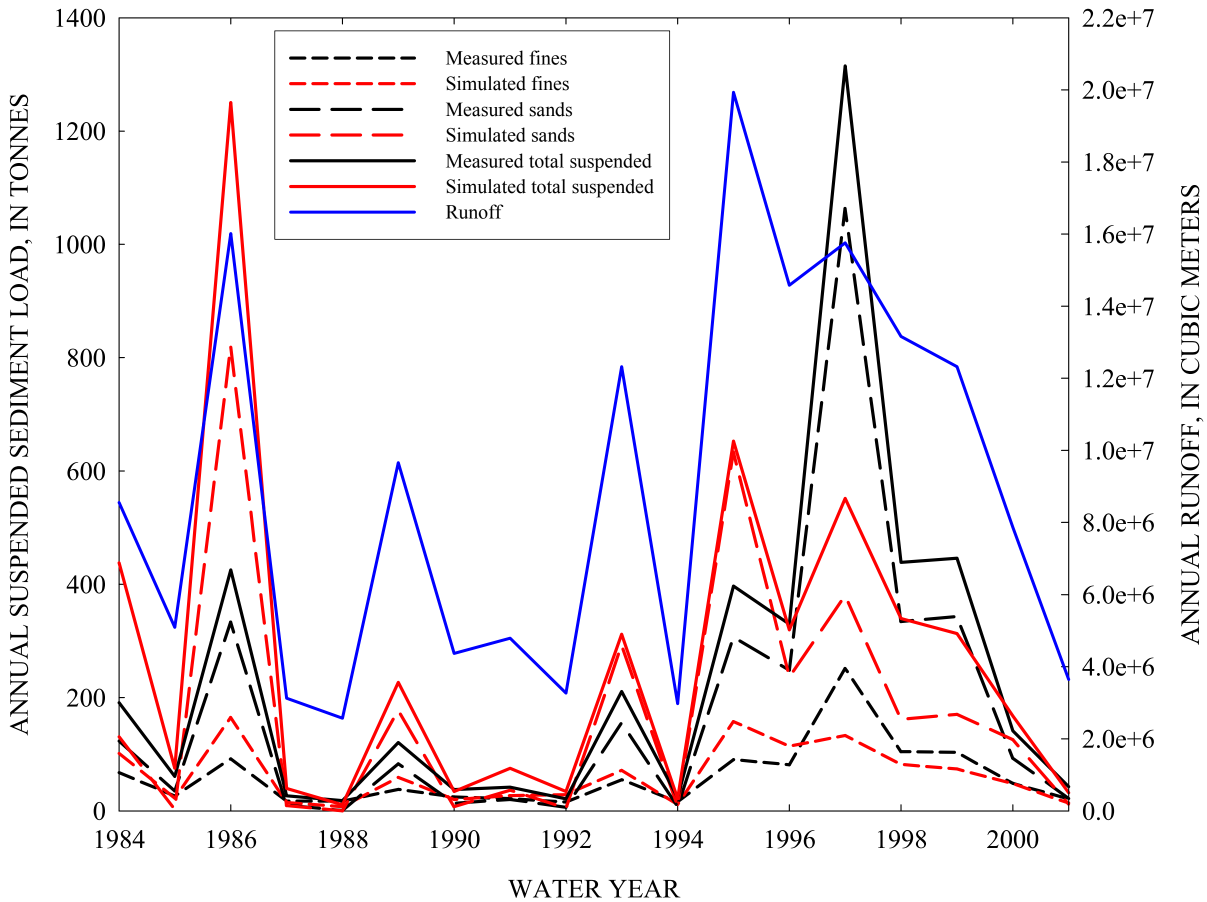


**Figure 5-45. Comparison of measured and simulated annual loads at station 10336645, General Creek.**

### CONCEPTS 50-Year Simulation

A simulation with a 50-year flow record was performed to determine trends in sediment loads. Channel geometry is based on the 2002 cross-section surveys. All physical properties are those determined from the validation. The records of tributary and lateral inflow of water and sediments were constructed in the same way as the validation case. The runoff in years 28 through 50 is the same as in years 1 through 23 of the 50-year flow record, except the large storm event on January 2 of year 22 is not repeated in year 49.

Figure 5-47 shows changes in channel top width and bed elevation over the 50-year simulation period. Measurable changes in top width occurred at cross sections 2 (5 m) and 14 (2 m). Changes in thalweg elevation range from 0.05 m of erosion at cross section 9 to 0.12 m of deposition at cross section 14.

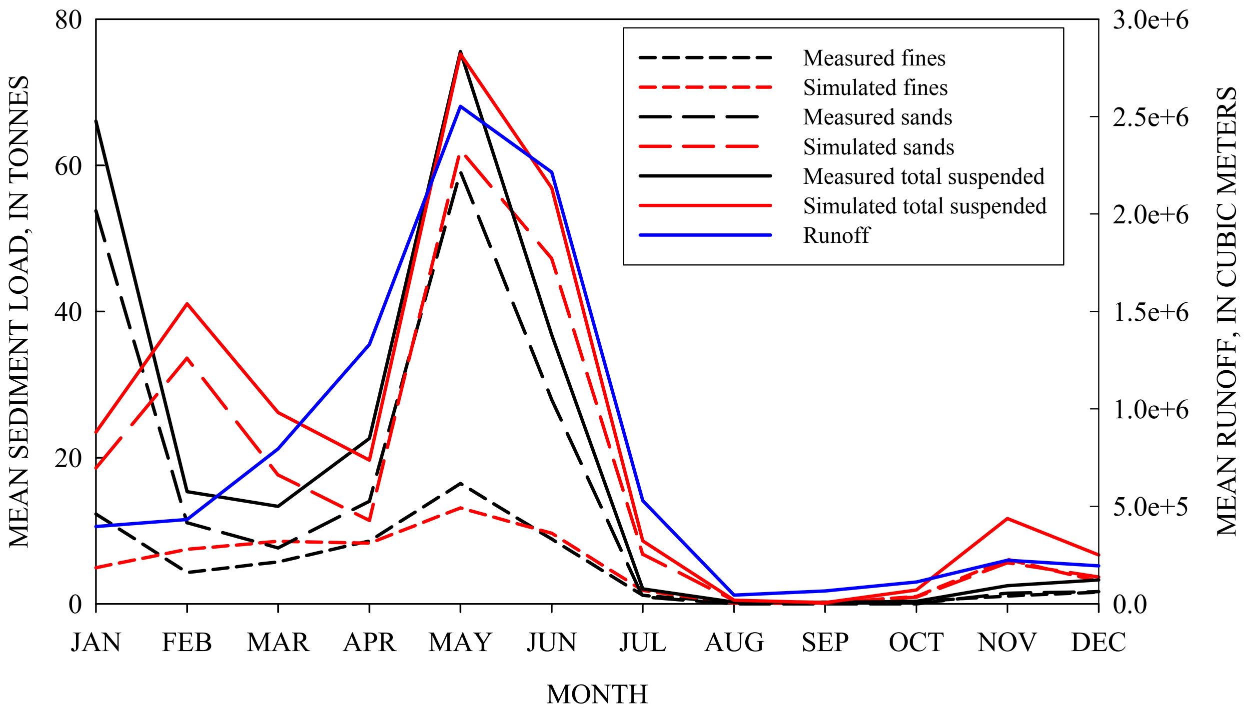


**Figure 5-46. Comparison of measured and simulated annually-averaged monthly sediment loads and runoff at USGS gaging station 10336645 in General Creek.**

Figure 5-48 shows the simulated annual runoff, and annual loads of fines, sands, and total suspended sediments at the outlet of General Creek. The annual loads in years 1 through 27 are larger than those in years 28 through 50 though annual runoff is the same. However, the annual load in year 38 is slightly larger than the corresponding load in year 11 because of an increase in sands transport. Channel adjustments over the first 27 years have led to a fairly stable-channel configuration, hence reducing the amount of sediments eroded from the channel. Thus, the 1997 runoff event does not seem to have rejuvenated the General Creek channel.

Over the 50-year simulation period, 72% of the total amount of fines delivered to the channel eroded from the uplands and 28% from streambanks (Table 5-7). Streambanks contributed 59% of the sands and 51% of the total suspended sediment.

**Table 5-7. Relative contributions of uplands and streambanks to suspended-sediment load at the outlet of General Creek over the 50-year simulation period.**

| Sediment size | Uplands (%) | Streambanks (%) | Total (T/y) |
|---|---|---|---|
| Fines | 72 | 28 | 51 |
| Sands | 41 | 59 | 144 |
| Total suspended | 49 | 51 | 196 |

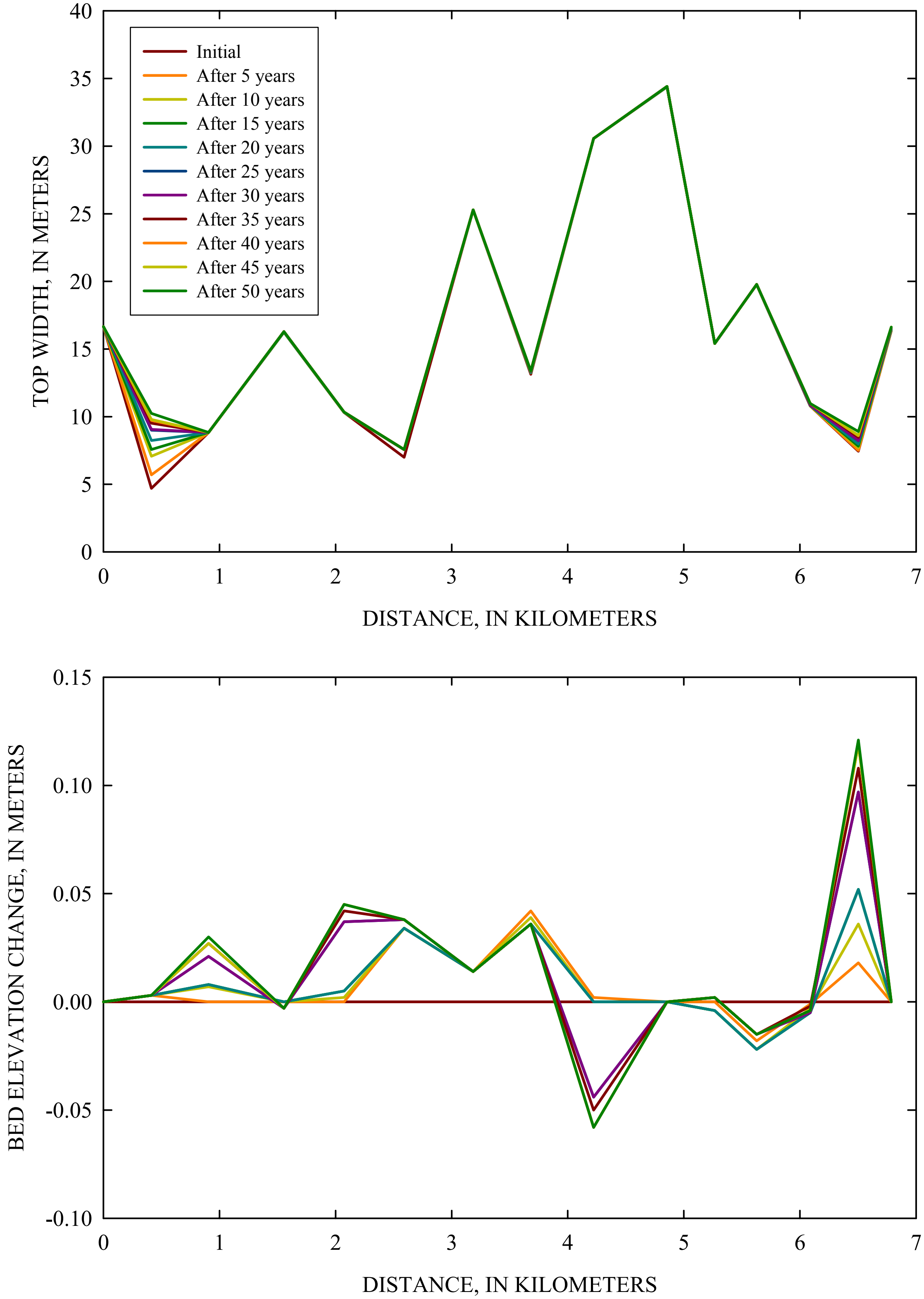


**Figure 5-47. Simulated changes in top width and bed elevation along General Creek over a 50-year period.**

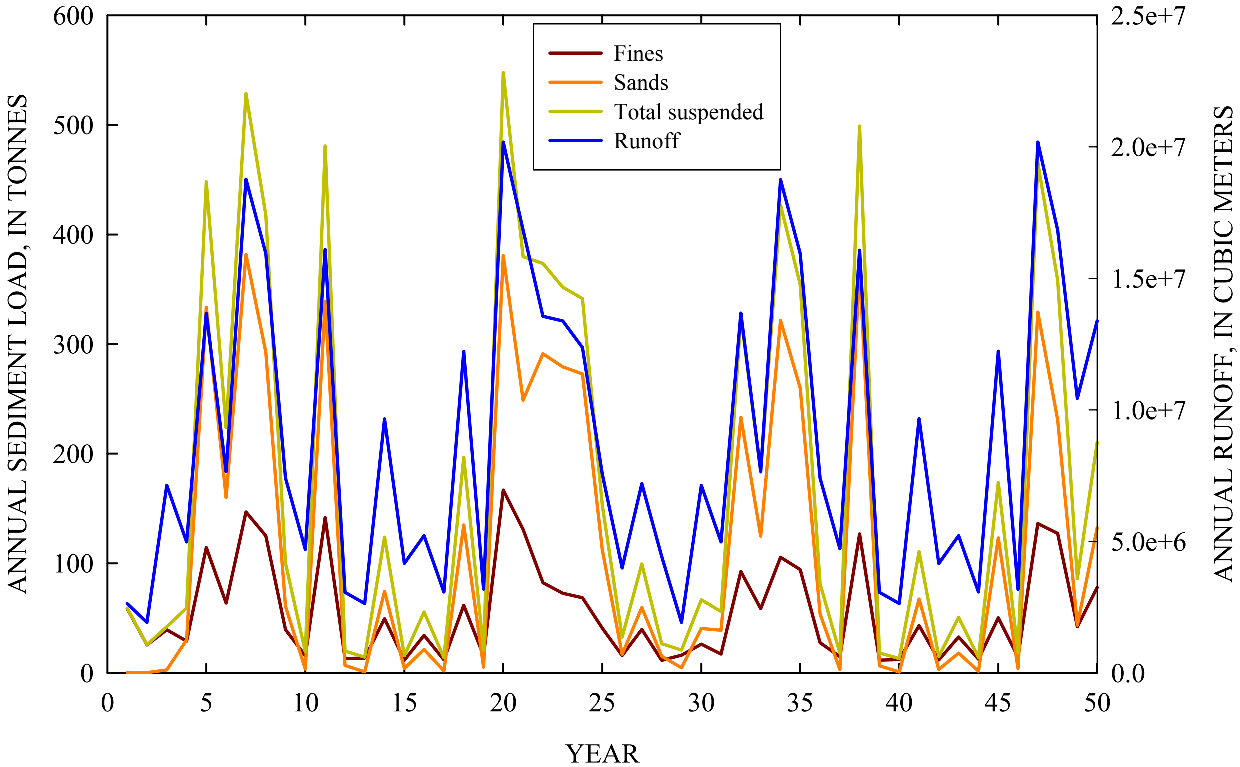


**Figure 5-48. Simulated annual runoff and loads of fines, sands, and total suspended sediments at the outlet of General Creek for the 50-year simulation.**

### 5.4.2 Upper Truckee River

#### AnnAGNPS

Three USGS gaging stations (10336610 at the lower end, 103366092 in the middle, and 10336580 at the upper end) were used to validate AnnAGNPS runoff simulations within the Upper Truckee River watershed. The diversion of water from Echo Lake out of the watershed required that those areas not be included in the AnnAGNPS simulation and thus were not be routed to the outlet.

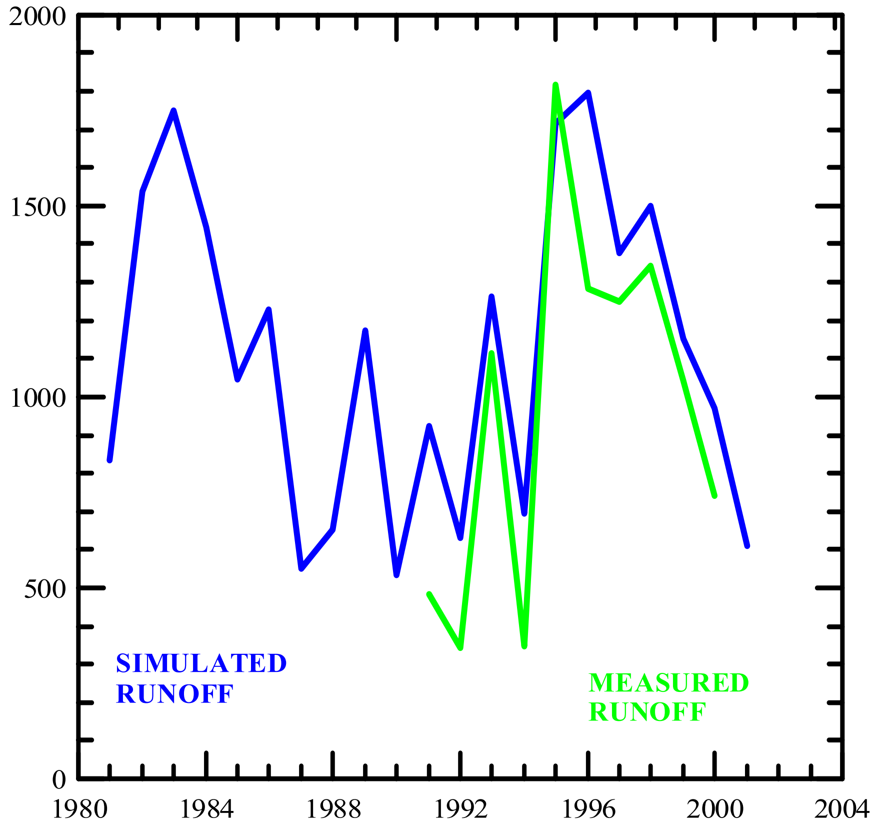


**Figure 5-49. AnnAGNPS simulated and measured annual runoff at the upstream station (10336580) of the Upper Truckee River watershed.**

Annual Runoff. Simulated annual runoff was determined from 1981 to 2001 at station 10336580, while measured runoff was available from 1991 to 2000 (Figure 5-49). The same years were available for station 103366092 (Figure 5-50). The simulated yearly runoff was determined from 1981 to 2001 at the USGS gaging station #10336610, while measured runoff was available from 1981 to 2000 (Figure 5-51). As with General Creek, simulated annual runoff results compare very well with those measured.

Monthly Runoff. Simulated runoff was compared with measured data from 1991-2000 at the upstream station (10336580; Figure 5-52), mid-reach station (103366092; Figure 5-53), and the downstream station (10336610; Figure 5-54). Monthly runoff volumes were not simulated well (Figure 5-52), particularly during periods of low and moderate flows. We suspect that this is due to over estimation of flows during winter months, thereby leaving an insufficient snowpack for large snowmelt peaks during April through June. Improved climatic information would also improve the model simulations.

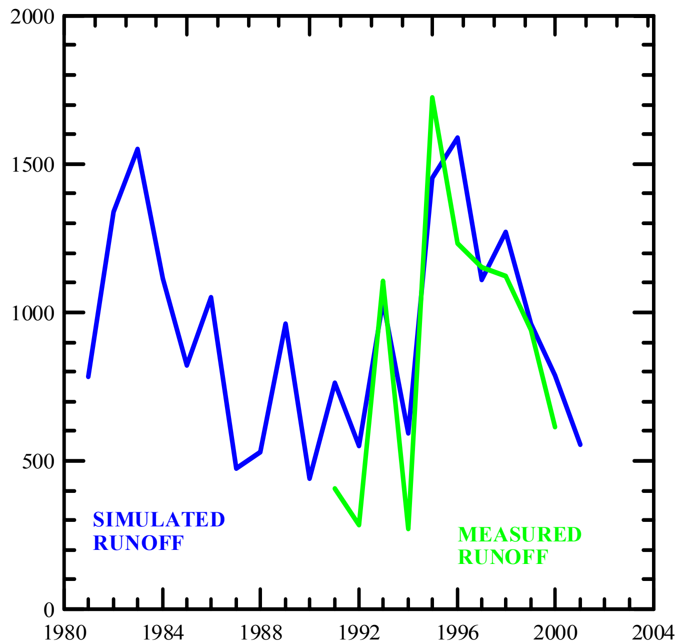


**Figure 5-50. AnnAGNPS simulated and measured annual runoff at the mid-reach gaging station 103366092 of the Upper Truckee River watershed.**

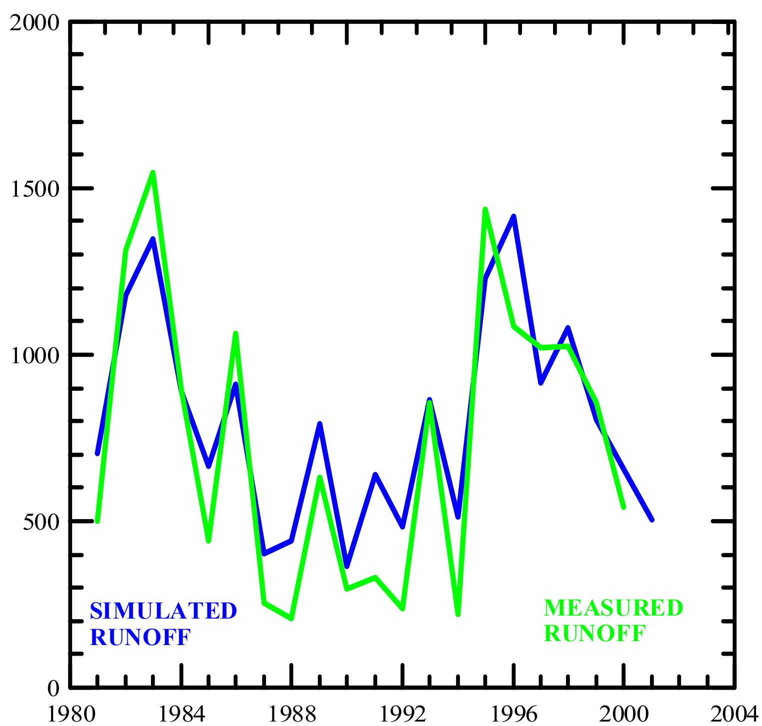


**Figure 5-51. AnnAGNPS simulated and measured annual runoff at the downstream station 10336610 of the Upper Truckee River watershed.**

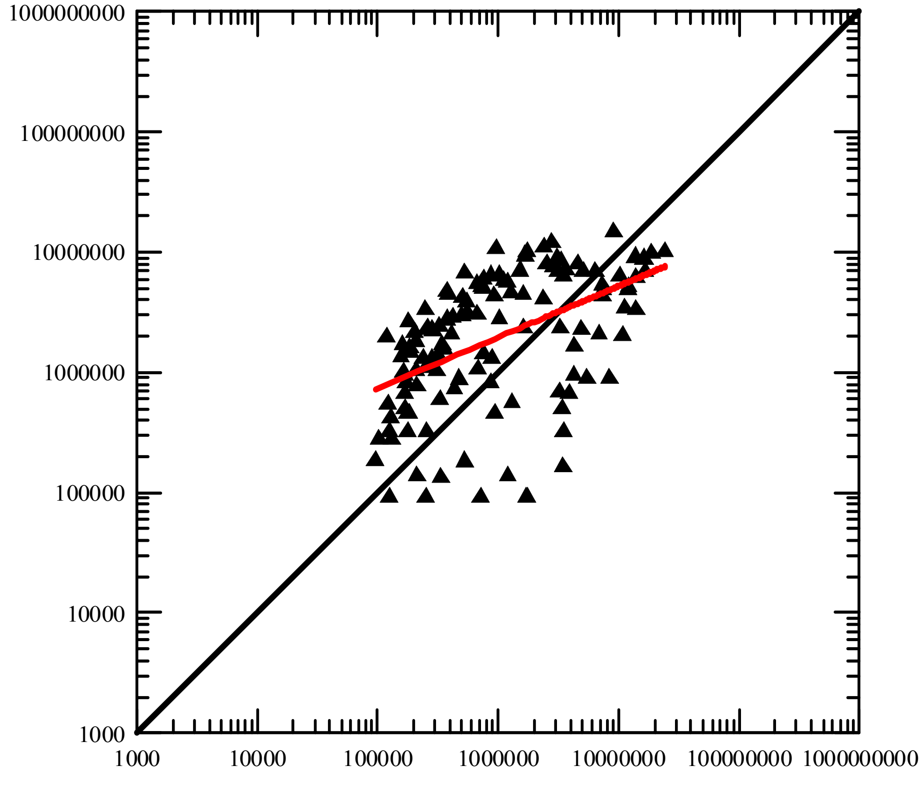


**Figure 5-52. AnnAGNPS simulated versus measured monthly runoff during 1991-2000 at upstream station 10336580, Upper Truckee River watershed.**

Annual Fine-Sediment Loads. Simulated annual fine-sediment loads were compared to measured data from the three gauging stations in the basin Figure 5-55 to 5-57. The comparisons show that at the upstream station (10336580) fine-sediment contributions from upland sources are proportionally high, relative to total suspended-sediment values measured at the station. With increasing distance downstream, the discrepancy between AnnAGNPS simulated loads and measured (calculated) loads increases due to greater contributions from channel sources that are not simulated by the upland model. These results agree with data on calculated suspended-sediment loads and yields discussed in sections 3.4 and 3.7.

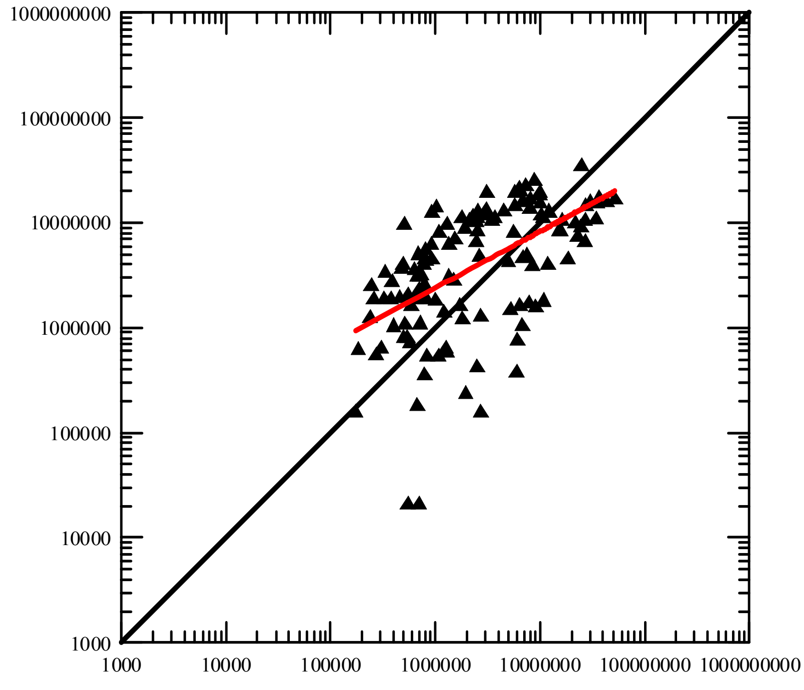


**Figure 5-53. AnnAGNPS simulated versus measured monthly runoff during 1991-2000 at mid-reach station 103366092, Upper Truckee River watershed.**

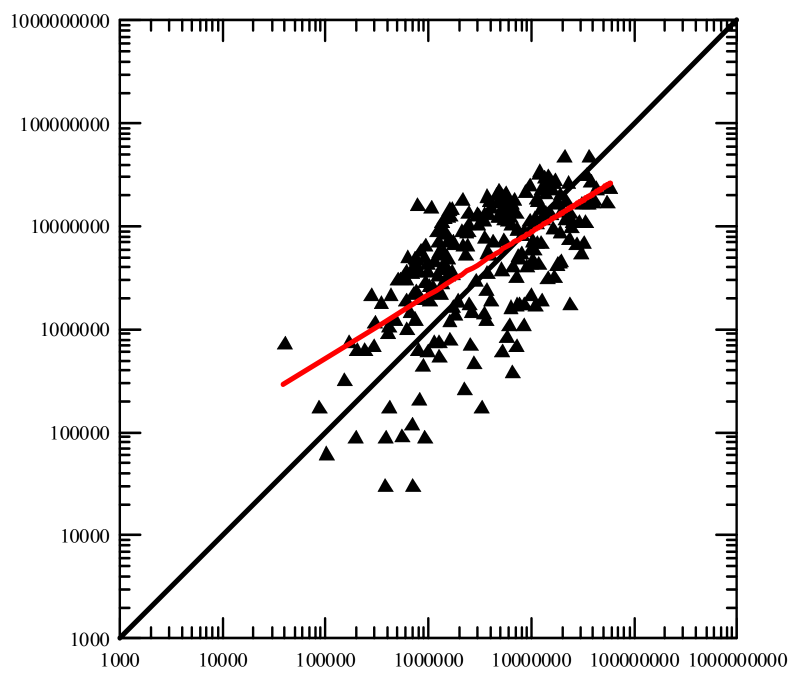


**Figure 5-54. AnnAGNPS simulated versus measured monthly runoff during 1981-2000 at the downstream station 10336610, Upper Truckee River watershed.**

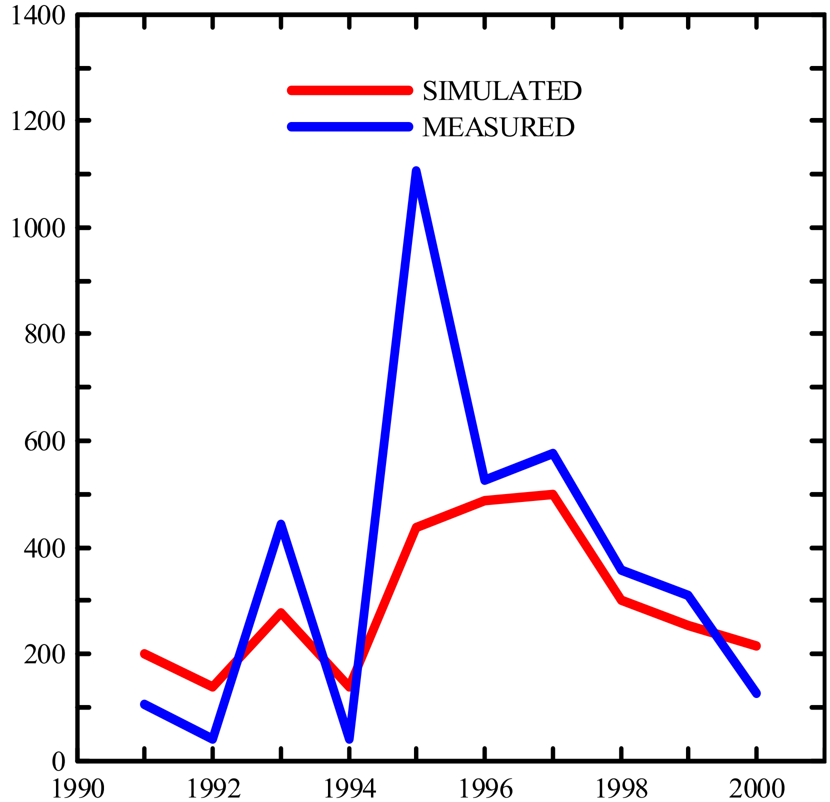


**Figure 5-55. AnnAGNPS simulated and measured annual sediment loads at the upstream station 10336580, Upper Truckee River watershed.**

Sources. A significant amount of runoff occurs in the upper end of the watershed where the land cover is rock outcrop (Figure 5-58). The fine sediment yield that reaches the edge of each AnnAGNPS cell also shows considerable variability throughout the watershed, but generally higher sediment yield values occur in the upper end of the watershed (Figures 5-59 and Figure 5-60).

Recurrence Interval for the Annual Maximum Instantaneous Peak Discharge. Tables 5-8 through 5-10 list the observed annual peak discharges at the USGS gaging stations 10336580, 103366092, and 10336610, respectively, and the annual (water year) peak discharges computed by AnnAGNPS routed to CONCEPTS. The simulated annual peak discharges are about 75 percent larger than those observed. The 2-year, 5-year, 10-year, and 20-year peak discharges calculated from the observed annual peaks are 11.2, 21.4, 31.9, and 45.9 $m^3/s$, respectively.

At the mid-reach station (103366092) simulated annual-peak discharges agree better for the less frequent, large runoff events, but are still far too high for the more frequent, moderate runoff events. The 2-year, 5-year, 10-year, and 20-year peak discharges calculated from the observed annual peaks are 23.9, 53.3, 84.3, and 125.5 $m^3/s$, respectively. The corresponding peak discharges computed by AnnAGNPS routed through CONCEPTS are 37.8, 70.8, 105.3, and 152.0 $m^3/s$, respectively.

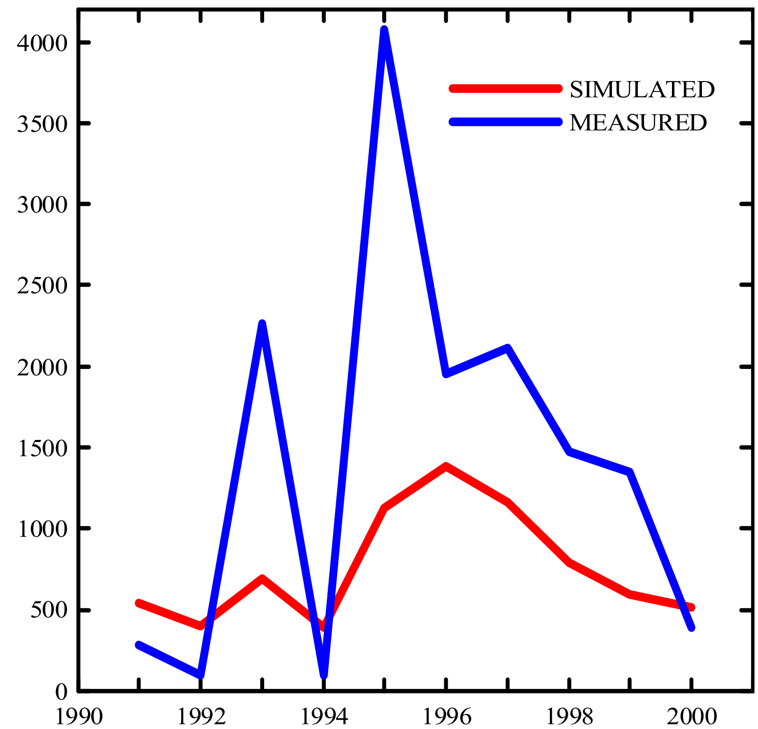


**Figure 5-56. AnnAGNPS simulated and measured yearly sediment loads at the mid-reach station 103366092, Upper Truckee River watershed.**

At the downstream, index station (10336610) the agreement between observed and simulated annual peak discharges worsens. The observed peak discharges reduce between stations 103366092 and 10336610, whereas the simulated peak discharges increase. The 2-year, 5-year, 10-year, and 20-year peak discharges calculated from the observed annual peaks are 21.7, 48.7, 75.8, and 110.6 $m^3/s$, respectively. The corresponding peak discharges computed by: 1) AnnAGNPS routed through CONCEPTS are 52.8, 90.3, 124.5, and 166.1 $m^3/s$, respectively.

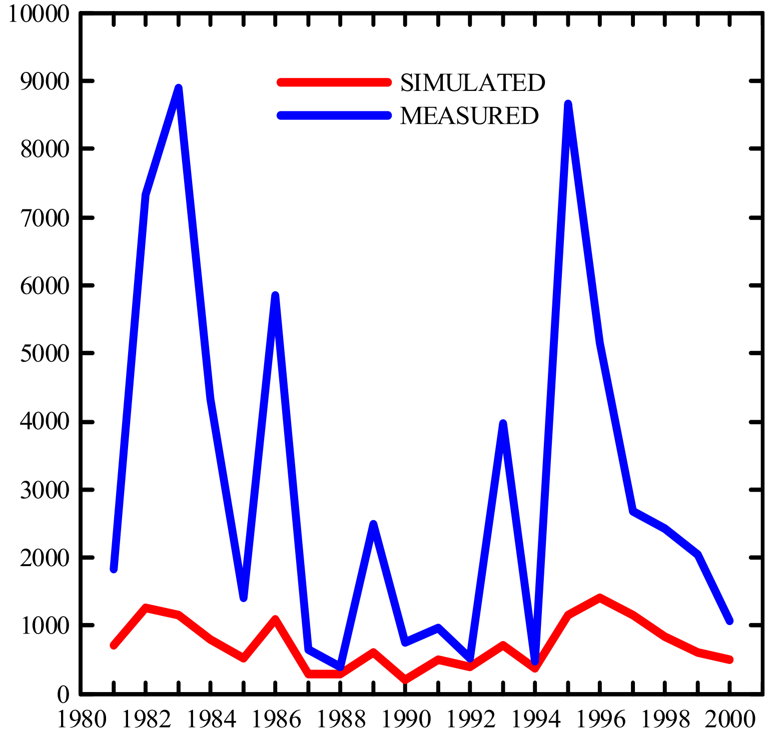


**Figure 5-57. AnnAGNPS simulated and measured yearly sediment loads at the downstream station 10336610, Upper Truckee River watershed.**

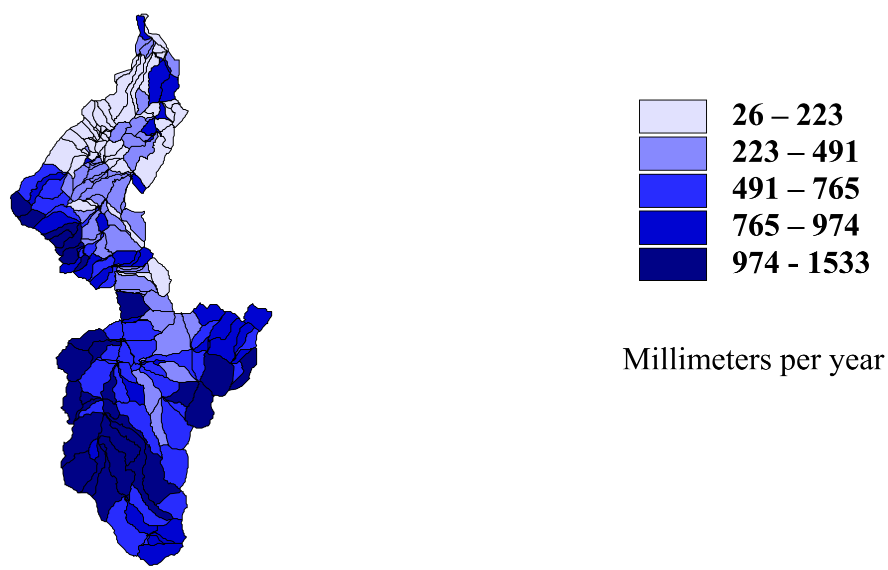


**Figure 5-58. Average annual runoff simulated from AnnAGNPS for each cell on Upper Truckee River watershed.**

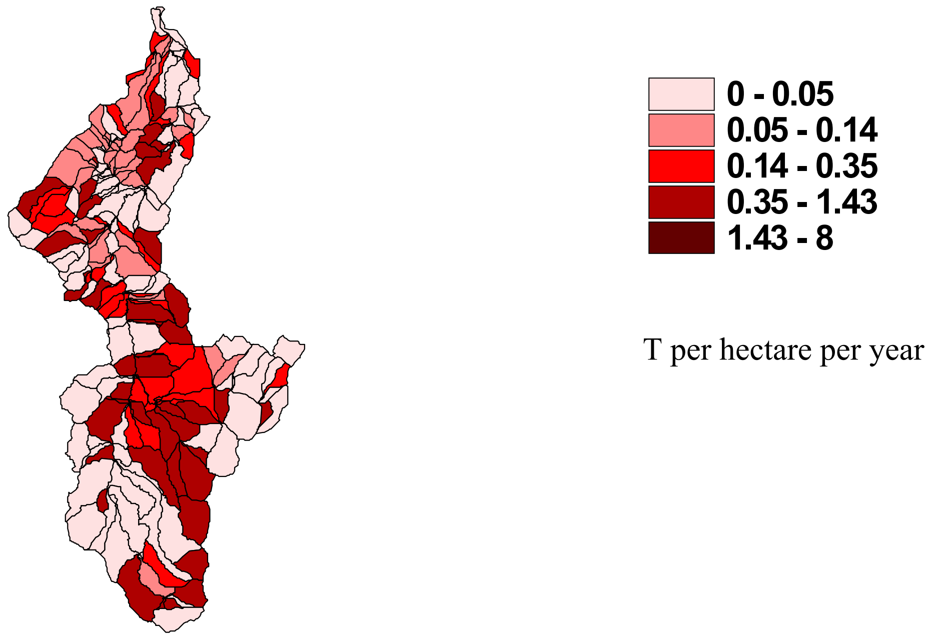


**Figure 5-59. Average annual erosion simulated from AnnAGNPS for each cell on Upper Truckee River watershed.**

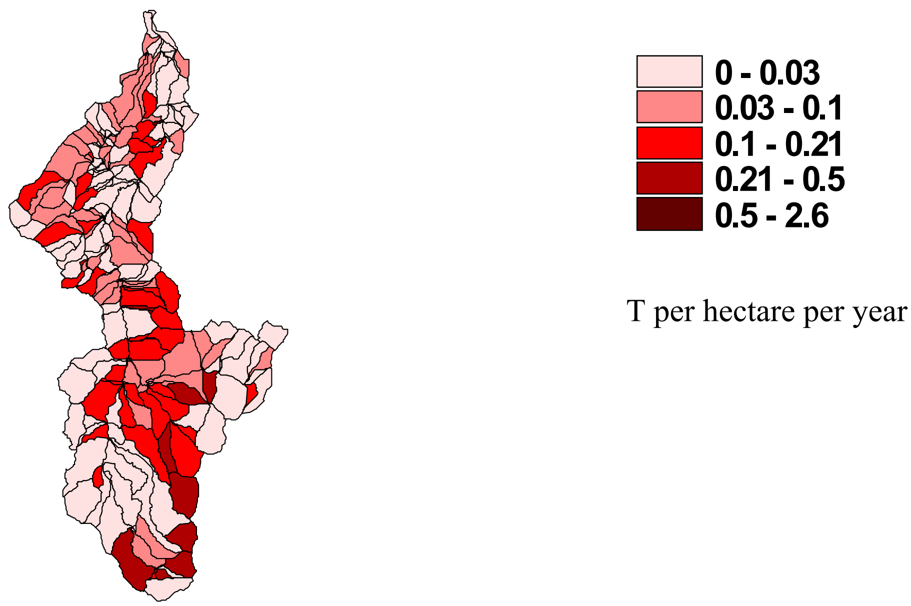


**Figure 5-60. Average annual sediment yield simulated from AnnAGNPS for each cell on Upper Truckee River watershed.**