Monitoring & Control Systems

Project: Sediment Transport Study
Client: Fort Carson Army Base
Location: Fort Carson, Colorado
Year: 1997

Application Notes:

Fort Carson is located in the Southwestern corner of Colorado, in the Colorado Springs area. The Southwest Watershed Research Center (SWRC) in Tucson, Arizona was awarded a contract from the Dept. of the Army, Directorate of Environmental Compliance and Management (DECAM) at Fort Carson, Colorado to measure and quantify sediment transport on the Fort Carson Army Base.

Installation and System Design:

Two sites were identified for continuous monitoring. The monitoring sites were located at Red Creek and Pond 212. Red Creek is a 30' wide, normally dry, channel, which flows during spring run-off and in the summer after thunderstorms in the nearby foothills and mountains. Pond 212 is a stock pond created years earlier to catch run-off from a small watershed.

At Red Creek a continuous record of stream stage, temperature, and precipitation, was required as well as a method to automatically draw sediment samples during a flood event. Another requirement of the project was two-way remote telemetry. The two-way telemetry would permit personnel in Tucson Arizona to monitor the sites in real-time as well as remotely download historical data.

Pond 212 site with Precipitation Gauge, Temperature Sensor, and a Shaft Encoder attached to a CR10X data logger.

Pond 212 had similar requirements, excluding the need for automatic sample collection. The base of the stock pond is surveyed periodically to quantify sediment deposition.

Shaft encoders were selected for water level measurement because of their reliability and accuracy. These were installed in stilling wells constructed at each site by SWRC personnel. A Campbell Scientific CR10X data logger was used to record measurements from the SE107 shaft encoder, AT107 air temperature sensor and RG2501 tipping bucket rain gauge. The CR10X is also used to control the Manning Environmental 4901 Automatic Sampler SIRCO. Data transmission from the remote sites is via cellular telephone. The CR10X logger controls the cellular transceiver, turning it on each morning and off again in the evening to conserve battery power.

The installed system also includes some redundant components to insure data integrity and accuracy. In addition to the shaft encoder, a DACOM Technologies Aqua Pod is installed in each stilling well. The Aqua Pod functions autonomously from the main system, utilizing its own float-style sensor, data logger and power supply to measure and record water level. The main data logger also has back-up data storage using the SM192 Removable Data Storage Module that can store up to 96,000 data points.

Pond 212 site close up of Shaft Encoder and Aqua Pod Water Level Logger installed on the stilling well.

The data logger is programmed to sample all sensors every minute and record data to storage every hour. If the logger views a water level increase greater than 0.5 feet as sensed by the shaft encoder, two actions are initiated: (1) the data logger triggers the sediment sampler, and (2) the logger advances to a faster, 5-minute recording interval. The faster recording interval results in a very smooth peak section of the hydrograph. This water level is examined every minute and compared to the previous level. If the water level is still 0.5 feet or greater than the initial threshold, another sample is taken and the logger continues to record data every five minutes. The data logger returns to an hourly recording interval when the water level decreases to a point that it is less than 0.5 feet above the initial threshold.

Personnel from IEI and the SWRC performed the installation in June 1997. The installation crew had a rare opportunity to see an immediate, real-life test of the instruments on the first day at Red Creek. That evening, a major summer thunderstorm hit the area, and in the middle of the night, within a two-hour period, stream stage at Red Creek went from dry to over 2 ft.

The instrumentation has been in place and operating successfully for many years. Very accurate stage and climate data is being reported at both sites. Preliminary results from the automatic sediment sampler reveal the following: (1) vertical placement of the strainer (sampler intake) is very critical and can bias the samples when compared to manual grab samples taken by DECAM personnel during each event. If the intake is too low, it can easily be covered by layers of sediment in the middle of each event clogging the sampler hose resulting in missed samples. (2) Grab samples reveal a difference in sediment transport horizontally across the stream. To accurately quantify sediment transport in wide-channels with an automatic sampler samples should be taken at multiple points across the channel.

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