05/10/2011

Publication list for General Hydrology

Publications and abstracts are listed in reverse chronological order. A limited number of reprints are available, and can be requested by referring to the NAEW number. Use your browser's "find" feature to search for words of interest. For more information, please contact:

James V. Bonta
Research Hydraulic Engineer
N. Appalachian Experimental Watershed
PO Box 488
Coshocton, Ohio 43812
USA

email: jim.bonta@ars.usda.gov
phone: 740-545-6349
fax: 740-545-5125

Owens, L.B., Bonta, J.V., Shipitalo, M.J. 2010. USDA-ARS North Appalachian Experimental Watershed: 70-Year Hydrologic, Soil Erosion, and Water Quality Database. Soil Science Society of America Journal. 74(2): 619-623. **(NAEW #463)**

Abstract:

Collection of long-term hydrologic data from agricultural watersheds requires a sustained investment of significant resources, but this type of data is necessary to identify long-term trends and to develop and validate hydrologic and water quality models. These types of data have been collected from the late 1930's to the present at the North Appalachian Experimental Watershed (NAEW) near Coshocton, OH. The NAEW has more than 20 small (0.5 – 3.0 ha), single land use watersheds for which surface runoff data have been collected year round on an event basis since 1939. There are 6 large (17 – 123 ha), mixed use watersheds with perennial streams where flow is measured continuously. Additionally, hydrologic data have been collected from eleven, 2.4 m deep, 8.1 m2 surface area monolith lysimeters for a similar period of time. Corresponding meteorological data are also available, as well as detailed information on land management and soil properties. Water quality data have been collected from watersheds and lysimeters since the early 1970's. Collaborative research efforts utilizing the resource are encouraged and detailed information on the available data is available at the NAEW web site: www.mwa.ars.usda.gov/coshocton. Interested scientists are urged to contact the authors.

Bonta, J.V., Owens, L.B., Shipitalo, M.J. 2007. Watershed Research at the North Appalachian Experimental Watershed at Coshocton, Ohio. In: Rogers, Jerry R., editor. Environmental and Water Resources Milestones in Engineering History. Reston, VA: ASCE/EWRI. p. 127-134. **(NAEW #456)**

Abstract:

The North Appalachian Experimental Watershed (NAEW) at Coshocton, Ohio was established during the mid 1930s as one of the first watershed research locations in the US (other locations included Riesel, TX and Hastings, NE). The mission of the outdoor laboratory facility was to determine the effects of land-management practices on hydrology and erosion, to investigate scaling from small plots to large watersheds, and to determine rates and amounts of runoff from watersheds of varying configuration, shape, cover, topography, land-management practice. Concurrently, techniques to measure and sample runoff were developed including the Coshocton wheel, a flow proportional sampler that is used worldwide. Currently, the infrastructure at the NAEW consists of approximately 1000 acres that includes large lysimeters, small and large experimental watersheds, and a network of rain gauges. The earliest land-management practices investigated included an intensive study on the effects of a corn-wheat-meadow-meadow rotation on the steep experimental watersheds with different soils. These early studies contributed to the development of the no-till concept for farming steep lands to reduce erosion and runoff. No-till has been investigated continuously for 43 years at the NAEW with the current emphasis on effects on soil quality, carbon sequestration, and crop residue removal for biofuel production. The original development of the curve number method included Coshocton data which is used worldwide. After about 1970, water quality was added as an objective to watershed studies. Subsequent experimental watershed studies included investigations of the effects of conservation tillage, herbicide application, nutrients, pasture management, mining and reclamation for coal, and urbanization on hydrology and water quality. Other studies conducted throughout the history of the NAEW include those on rain-gauges, soil carbon, evapotranspiration, precipitation simulation, evaluation of effectives of management practices, ground-water recharge, curve numbers, macropores, hydraulics, watershed modeling, and instrumentation development. Expertise and data at the NAEW are sought after worldwide on these topics. The NAEW continues to have an important impact in the soil and water conservation community.

Morrison, M.A., Bonta, J.V. 2008. Development of Duration-Curve Based Methods for Quantifying Variability and Change in Watershed Hydrology and Water Quality [abstract]. Environmental Protection Agency. **(NAEW #452)**
Only Available Onlinehttp://www.epa.gov/nrmrl/pubs/600r08065/600r08065.pdf

Abstract:

Little is known about effectiveness of land activities to control water quality. The objective was to explore the duration curve (DC) concept for comparing hydrology and water quality data from watersheds. DCs are plots of the percent of time that a given value of a variable (e.g., flow rate) is exceeded. DCs include the flow duration curve (FDC), concentration DCs, and load-rate DCs. DCs take into account natural variability and uncertainty in streamflow watershed response to land activities and precipitation events. Minimum number of samples, averaged streamflow data, and seasonal variation of concentrations were examined. It was found the smallest number of samples needed for relationships between streamflow (Q) and SO4 concentrations (C) (“C-Q relations”) was 25-35. Little is gained with sample numbers larger than about 150-400 samples from the C-Q relations. However, differences between DCs developed from the C-Q data and flow DCs for different sample sizes suggest that 30-100 samples are

adequate. Based on the combined approaches, 50 samples is the suggested minimum number of samples for this study. There is little benefit from using more than about 2% of the 2500 samples collected, a savings in money. An investigation of the use of readily available average daily flow data suggests that midrange and small instantaneous flow rates may be represented by average daily flows which are more readily available data, but errors are more pronounced at larger or smaller flows. An investigation of seasonal variation in NO3-N concentrations and loads showed C-Q equation form changed from a 2-part relation to a linear relation to no relation. An illustration was given on how the DC methodology can be used to quantify the decrease in load rates and the reduction in the percent of time a given load is exceeded (or reduced risk) due to a land-management change. This research project is a collaborative effort between the USEPA and ARS-Coshocton, funded by the USEPA. The research will benefit states and other stakeholders faced with assessing the performance and effectiveness of BMPs within a watershed management framework.

Bonta, J.V. 2008. Drop-box Weir for Measuring Flow Rates Under Extreme Flow Conditions. Journal of Soil and Water Conservation. 63(4):134A. **(NAEW #451)**

Abstract:

Sediment and large rocks often are transported in runoff during extreme events. The sediment can deposit in a runoff-measuring structure and give erroneous readings. The drop-box weir (DBW) is one of only a few flow-measuring devices capable of measuring sediment-laden flows. Recent studies have extended its utility from large watersheds to small plots and watersheds. Furthermore, recent hydraulic studies have guided adaptation of the Coshocton wheel, a proportional sampler, for use with the configuration of the DBW used on runoff plots. This article presents a short history of the development of the DBW and it use with the Coshocton wheel on runoff plots in a study of application of manure on frozen soil. It also lists other studies where the DBW has been used.

Bonta, J.V., 2008. Bonta-Rao method for estimating peak flows and frequencies from small agricultural watersheds. In: Singh, V.P., editor. Hydrology and Hydraulics. Highlands Ranch, CO: Water Resources Publications. p.647-668. **(NAEW #450)**

Abstract:

A summary of a promising method for estimating peak runoff rates and return periods from small agricultural watersheds is presented. Precipitation and runoff data were analyzed in a systematic method using the CREAMS watershed model. Dimensionless Huff curves were used with the model to synthesize the frequency distributuion of peak runoff rates from an experimental watershed at Coshocton, Ohio. The frequency distributions of synthesized and observed peak flows were found to agree with each other when the return periods of causal precipitation and simulated peak flows were in agreement. This observation occurred at an optimal antecedent soil water. A sensitivity study of model inputs showed that the method is insensitive to some uncertain inputs. Although the method has several desirable features for practical application, it should be investigated further on other watersheds and using different models. This work led to a stochastic storm generator. The steps outlining the application of the method are presented, along with suggestions for further research.

Harmel, R.D., J.V. Bonta, and C.W. Richardson. 2007. The original USDA-ARS experimental watersheds in Texas and Ohio: Contributions from the past and visions for the future. Transactions of the ASABE 50(5):1669-1675. **(NAEW #445)**

Abstract:

The USDA Soil Conservation Service (USDA‐SCS) realized the importance of understanding hydrologic processes on agricultural fields and watersheds in the mid‐1930s. Based on this realization, the research program of the Hydrologic Division of SCS established three experimental watersheds across the U.S. to analyze the impact of landuse practices on soil erosion, flood events, water resources, and the agricultural economy. Two of the original watersheds remain in operation today within the USDA Agricultural Research Service (USDA‐ARS): the Blacklands Experimental Watershed (now the Grassland, Soil and Water Research Laboratory) near Riesel, Texas, and the North Appalachian Experimental Watershed near Coshocton, Ohio. These original watersheds were designed for collection of hydrologic data on small watersheds and evaluation of hydrologic and soil loss response as influenced by various agricultural land management practices. A major contribution of these experimental watersheds is the quantification of soil loss reduction under conservation management, which has led to a drastic reduction in soil loss from cultivated agriculture in the 20th century. Riesel watershed studies produced the scientific basis for several watershed models that are now used worldwide to manage water quality and also facilitated fundamental analysis of the agronomic and environmental effects of tillage, fertilizer, and pesticide alternatives. Coshocton watershed studies led to the development of no‐till and pasture management practices to control runoff, erosion, and chemical loss and were instrumental in understanding water quality and hydrologic effects of soil macropores and mining and reclamation activities. The long‐term hydrologic records at each site have also improved understanding and management of water resources in their respective geographic regions. Because of their historical and future value, the USDA‐ARS has a unique responsibility to maintain these long‐term experimental watersheds, which are vital for addressing emerging research needs to meet future water availability, environmental quality, and food and fiber demands.

Blanco-Canqui, H., R. Lal, W.M. Post, R.C. Izaurralde, and M.J. Shipitalo. 2007. Soil hydraulic properties influenced by corn stover removal from no-till corn in Ohio. Soil & Tillage Research 92:144-155. **(NAEW #438)**

Abstract:

Corn (Zea mays L.) stover removal for biofuel production and other uses may alter soil hydraulic properties, but site-specific information needed to determine the threshold levels of removal for the U.S. Corn Belt region is limited. This study quantified impacts of systematic removal of corn stover on soil hydraulic parameters after 1 year of stover management under no-till (NT) systems. These measurements were made on three soils in Ohio including Rayne silt loam (fine-loamy, mixed, active, mesic Typic Hapludult) at Coshocton, Hoytville clay loam (fine, illitic, mesic Mollic Epiaqualfs) at Hoytville, and Celina silt loam (fine, mixed, active, mesic Aquic Hapludalfs) at South

Charleston. Interrelationships among soil properties and saturated hydraulic conductivity (Ksat) predictions were also assessed. Earthworm middens, Ksat, bulk density (rb), soil water retention (SWR), pore-size distribution, and air permeability (ka) were determined for six stover treatments. Stover treatments consisted of removing 0 (T100), 25 (T75), 50 (T50), 75 (T25), 100 (T0) and adding 100 (T200)% of corn stover corresponding to 0, 1.25, 2.50, 3.75, 5.00, and 10.00 Mg ha1 of stover, respectively. Stover removal reduced the number of middens, Ksat, SWR, and ka, and increased rb at all sites ($P < 0.01$). Compared to normal stover treatment (T100), complete stover removal (T0) reduced earthworm middens 6-fold at Coshocton and about 14-fold at Hoytville and Charleston. Geometric mean Ksat decreased from 3.1 to 0.1 mm h1 at Coshocton, 4.2to 0.3 mm h1 at Hoytville, and 4.2 to 0.6 mm h1 at Charleston while soil rb increased about 12% in the 0–10-cm depth at Coshocton and Hoytville from T100 to T0. The SWR for T0 was about 70% of that for T100 and 58% of that for T200 at 0 to 6 kPa suctions across sites. The log ka for T200, T100, and T75 significantly exceeded that under T50, T25, and T0 at Coshocton and Charleston. Differences in the number of middens, rb, SWR, Ksat, and ka between T100 and T200 were not generally significant although the T200 retained slightly more water for the 0 to 100 kPa at Charleston and had higher ka at Hoytville compared to T100. Measured parameters were strongly correlated, and ka was a strong Ksat predictor. Stover harvesting induces rapid changes in soil hydraulic properties and earthworm activity, but further monitoring is needed to ascertain the threshold levels of stover removal for soil-specific conditions.

Hauser, V.L., D.M. Gimon, J.V. Bonta, T.A. Howell, R.W. Malone, and J.R. Williams. 2005. Models for hydrologic design of evapotranspiration landfill covers. Environmental Science & Technology 39(18):7226-7233. **(NAEW #421)**

Abstract:

The technology used in landfill covers is changing, and an alternative cover called the evapotranspiration (ET) landfill cover is coming into use. Important design requirements are prescribed by federal rules and regulations for conventional landfill covers but not for ET landfill covers. There is no accepted hydrologic model for ET landfill cover design. This paper describes ET cover requirements, design issues, and assesses the accuracy of the EPIC and HELP hydrologic models when used for hydrologic design of ET covers. We tested the models against high quality field measurements available from lysimeters maintained by the Agricultural Research Service of the U.S. Department of Agriculture at Coshocton, Ohio and Bushland, Texas. The HELP model produced substantial errors in estimates of hydrologic variables. The EPIC model estimated ET and deep percolation with errors less than 7 percent and 5 percent, respectively, and accurately matched extreme events with an error of less than two percent of precipitation. The EPIC model is suitable for use in hydrologic design of ET landfill covers.