Case Teaching Notes

for

"Losing the Farm: How Changes in Land Surface Affect Storm Runoff"

by

Edwin H. Price
Department of Physical and Life Sciences
Nevada State College, Henderson, NV

Introduction / Background

In this interrupted-format case study, students examine hydrologic properties of a real farm property in north Georgia and discuss characteristics of the land surface that affect how much storm precipitation would run off the property into a stream. The farm land surface was greatly modified for a new use, a high-density residential subdivision. Students examine the significance of these changes with respect to runoff and predict the consequences downstream. While constructing the residential development, there were some unfortunate events, both human-caused and natural, that significantly affected the runoff characteristics of the property, causing damage to the property, neighboring structures, and the downstream environment.

In this case, students compute storm-runoff volumes utilizing the most commonly used method for calculating runoff, a method derived by the Soil Conservation Service in 1973. While the calculations involve mostly plugging various parameters into algebraic equations, the emphasis of this case is on understanding how various soil characteristics, coupled with various land surface uses, can dramatically affect the amount of runoff from a single rain event. This calculation concerns only total runoff volume, not the rate of runoff nor the timing of peak discharge.

The case was developed for use in an introductory environmental hydrology course as part of an environmental science program. Because the case involves a determination of soil characteristics from the narrative and because of the significant soil erosion, this case could be incorporated into a soil science course.

Students should have a good understanding of the hydrologic cycle and its components, particularly infiltration. Students also should have some understanding of soil properties that affect infiltration.

Objectives

- Using analytical reasoning, evaluate the changing hydrologic characteristics of a natural setting upon which to base computations.
- Learn how various soil characteristics, coupled with different land uses, determine the volume of precipitation that will run off of a property in a single, typical storm event.
- Learn that, when natural drainage characteristics are modified for a new land use, runoff must be controlled and discharges minimized by designing structures to prevent detrimental effects on adjacent areas.
- Learn that exceptional storm precipitation events must be planned for in the design of runoff control structures.

Classroom Management

This case is presented using the interrupted case method. Because my hydrology classes are small (8–15 students), students work on the various sections of the case independently in class.

To start the case, I present paper copies of Part I, which students read in class. At this point, there has not been any discussion of how to calculate runoff volume. Part I presents the physical conditions of the site and students begin asking themselves questions about which site characteristics might be related to runoff. We then discuss the site characteristics in class. The reading of Part I and answering Question 1 about site conditions takes approximately 10 minutes.

After reading Part I and discussing the site with Question 2, students will have an interest in figuring out how the various characteristics are used in a computation of runoff. This is where the SCS runoff volume estimation method is presented as students now have a problem of interest to solve and can understand how various characteristics affect infiltration and excess precipitation which runs off. A discussion of the SCS runoff volume estimation method is included in the case as an addendum, a handout for students' use. Review of the SCS method

takes about 10 minutes. An arithmetic calculator is needed in class for the calculations.

Before moving to the next part of the interrupted case, students compare and discuss their computations of runoff in Question 3. Computations will be different depending on student interpretations of the soil group present.

Parts II through VI are done one at a time in class. These go faster because students are now familiar with the calculation method and are becoming aware of how different parameters affect runoff. Calculation and discussions of Parts II through VI take about 30 minutes total class time.

Discussion times vary, but the case can be presented and discussed in approximately 50–60 minutes.

Legal Notes: "Something Must Be Wrong Here"

This case study was designed for students to consider environmental/hydrologic concepts and not necessarily regulations. However, any development must follow regulations designed to protect the environment. Such is the case with the residential development, Legacy Cove. Students will quickly realize that "something must be wrong here" and will begin questioning legal issues concerning erosion and sedimentation from the property.

The State of Georgia is the National Pollutant Discharge Elimination System (NDPES) Permitting Authority for all regulated discharges in Georgia, under the Amendments to U.S. Clean Water Act of 1972. According to a spokesperson with the Georgia Environmental Protection Division (EPD), Mountain District, the construction project became "out of compliance" with erosion and sedimentation requirements in 2007. A "consent order" to resolve the issues was written. The immediate problem was water quality from sediment in the downstream creek. Every time it rained there was a separate violation because muddy water was discharging from the sediment-filled catch basin.

The developer worked with the EPD, but no resolution was reached. Further erosion and sedimentation mitigation efforts were required, but the developer did not comply. It is thought that finances were the main contributing factor. Meanwhile, erosion and muddy water discharge increased because of the epic flood.

The EPD issued an Administrative Order, a legal order requiring compliance. The developer did not appeal so the Administrative Order became legally binding. The builder did not comply with the Administrative Order from the EPD so the issue was turned over to the Georgia Attorney General to take the case to Georgia's Superior Court. Because of a backlog of cases, the Attorney General's office did not readily take the developer to court.

Meanwhile, the developer's lending bank foreclosed and repossessed the property, and thus became responsible for the legal liabilities. The bank immediately hired engineering and environmental consultants to rapidly stabilize the site so they could satisfy the EPD requirements and so they could put the property on the market. As of summer of 2012, sediment discharge has been controlled and the property is for sale.

Answer Key

Answers to the questions posed in the case study are provided in a separate answer key to the case. Those answers are password-protected. To access the answers for this case, go to **the key**. You will be prompted for a username and password. If you have not yet registered with us, you can see whether you are eligible for an account by reviewing our **password policy and then apply online** or write to **answerkey@sciencecases.org**.

References

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Acknowledgements: This case was published with additional support from the National Science Foundation under CCLI Award #0341279. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.