CHAPTER 1

PROBLEM STATEMENT

One routine task associated with hydraulic design is the delineation of the watersheds and subsequent computation of the watershed characteristics such as drainage area, main channel length, main channel slope, and etc. After this task is completed, the engineer must decide if the watershed should be further subdivided into smaller components, referred to as sub-watershed or sub-basins. The sub-basin parameters are then input into a hydrologic model to develop runoff hydrographs.

The ability of a model to simulate the watershed systems depends on how well the watershed system is described by model input parameters. In a lumped hydrologic model, the watershed is assumed homogeneous with representative parameters. However, the size of the watershed affects the homogeneity assumption, because larger watersheds are more likely to have variable conditions within the watershed. Subdividing a watershed into smaller sub-watersheds would certainly increase the input data preparation effort. In practice, subdividing watershed into smaller components might or might not produce more accurate model results compared to measured, that is observed, streamflow from the watershed. On the other hand, modeling a large watershed as a single lumped model might lead to poor simulation results. Thus, the art of watershed subdivision remains an unsolved problem facing many hydrologists and civil engineers inside and outside TxDOT.

The objective of this research, in response to TxDOT Problem Statement 0-5822, "Subdivision of Watershed for Modeling," is to evaluate the effect of various levels of watershed subdivision on simulated runoff hydrographs.

This thesis presents one of several approaches to watershed subdivision: the iso-characteristic approach, where each sub-watershed has about the same physical characteristic (area, main channel length, etc.) as each other.

Five sets of watersheds in Central Texas with USGS streamflow-gaging stations were selected for this study. Drainage areas for these watersheds ranging from approximately 12.3 to 166 square miles, main channel lengths range from approximately 9 to 48 miles, dimensionless main channel slope are from approximately 0.002 to 0.02. A database of incremental cumulative rainfall values for storms that occurred during the period from 1961 to 1986 were used to input into the HEC-HMS program to construct cumulative rainfall hyetographs for runoff simulation.

There are two components for the hydrological modeling study in this research project. The first component is to estimate the hydrologic response of a watershed as a single basin with no subdivisions. The second component is to analyze the watershed by subdividing it into 2, 3, 5, and 7 sub-basins. These individual sub-basins responses can be combined to generate a composite response for an entire watershed. The model is then run and the results are reviewed and analyzed. The modeled hydrographs are compared with the observed hydrographs to see if the subdivision case can produce a response equivalent to observations any better than the single basin case or in other words, how the response changes as a function of watershed subdivision.

The remainder of this thesis is divided as follows. Chapter 2 is a review of relevant literature regarding to the impact of various levels of watershed subdivision on simulated runoff hydrographs. Chapter 3 describes the method used in this research. The procedure for developing each of the model parameters is also outlined. Model results and discussion are presented in Chapter 4. In Chapter 5, the findings of the study are summarized with the recommendations for further study.