STREAM BANK STABILIZATION MANUAL

for

THE CITIES OF:

PLANO
GARLAND
McKINNEY
ALLEN

by

HALFF ASSOCIATES, INC.

in conjunction with

WEST Consultants, Inc.

The seal appearing on this document was authorized
by Walter E. Skipwith, PE #48752 on 6/28/98

June 1998
AVO 15914

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES IN APPENDIX A

EXECUTIVE SUMMARY

Manual Purpose. This Stream Bank Stabilization Manual is intended to assist in the analysis, planning, design, and construction of stream bank erosion control measures. The goal of the manual is to provide procedures and design guidance for mitigation of severe erosion problems to reduce the potential for damage to public and private property and the environment. Generally speaking, the manual addresses streams in the White Rock Creek, Rowlett Creek, Wilson Creek or the East Fork of the Trinity River watersheds located in Plano, Allen, McKinney or Garland. The measures described in the manual are intended to be permanent. The procedures can be applied to problems related to existing development or incorporated into the planning process in developing watersheds. Ideally, the procedures presented here will be refined and applied city-wide in the form of watershed-based studies. This will enable a better understanding of bank stability and other stream features with the goal of developing permanent, economical solutions. This manual is not intended to provide, replace or supplement existing guidelines or regulations for construction site erosion control in any of the four communities.

Stream Bank Erosion And Failure. In **Chapter I**, the varied and complex causes of stream bank erosion are discussed. Bank failures can be massive and sudden or occur gradually over long periods of time. Of all the factors contributing to stream bank erosion in the project area, urbanization probably is the most important. Studies have shown that urbanization accelerates erosion and channels tend to roughly double their area over time as the stream attempts to reach a new state of relative stability. Therefore, it is important to establish some sort of stream bank stabilization program for newly developing areas so controls and/or mitigation of future problems can be achieved before homeowners or public facilities incur damage from stream bank failures due to erosion.

Stream Bank Protection and Erosion Damage Mitigation Measures. The manual presents structural and nonstructural methods of stream bank erosion mitigation for stream reaches in existing neighborhoods and for areas that are undergoing development pressures. **Chapter II** introduces the various methods and provides general guidance as to the applicability of each method. **Chapter IV** provides more specific design criteria and details. Of all the stream bank erosion mitigation methods examined in the manual, the establishment of an erosion hazard zone, or setback, offers the best solution for developing areas. A setback is a strip of land that separates one type of land use from another, usually for protection or aesthetic purposes. The resulting area, also referred to as a buffer, is established based on key physical or environmental features of streams and their adjoining flood plains. When used as an erosion control tool, setbacks protect adjoining developed land uses from damage due to stream bank slope failures, slides and settlement. Another effective flood plain management tool available to stream corridor planners today is the preservation of natural streams and flood plains. Preserving these areas as open space and greenbelt accomplishes the multiple goals of flood control, water quality enhancement, recreation and often economic development. Stream bank erosion can still be a problem particularly if the watershed is undergoing urbanizing influences. Therefore, erosion

hazard assessment and stabilization measures or tools such as setbacks will be needed, even along those streams whose channels remain undisturbed directly by development.

Selecting Protection For Stream Banks. The manual recommends a design frequency of the 2-year flood peak discharge for evaluation of typical erosion and stream bank stability problems. Design engineers should confirm this design criteria with the City Engineer of the community in which they are working.

Stream Evaluation. All streams should be physically inspected by a multidiscipline team of engineers and scientists in reaches affected by proposed development. Based on the field visit and best available maps, assessments can be made of such channel features as sinuosity, channel shape (depth, width, etc.) and vegetation. This assessment will assist the designer in the determination of the causes of stream erosion and the selection of appropriate stream bank stabilization method(s), if necessary.

Stream Hydraulic Analysis. Detailed stream hydraulic analysis is needed to provide an accurate portrayal of channel velocity and tractive force and to correctly assess stream bank erosion problems in the study reach. The hydrologic analysis should be based on discharges reflecting a fully urbanized watershed. Guidelines for hydrologic and hydraulic analysis are found in **Chapter III**.

Setback Determination. Setbacks for the purpose of erosion damage mitigation shall also be established. This setback shall be permanently established by plat or recorded instrument. The erosion setback shall be required of all projects in which natural streams are to be preserved or where variations in the design recommendations of this manual are desired by the developer or land owner. The guidelines for establishing setback limits are found in **Chapter III**.

Erodibility Index. An erodibility index shall be computed as described in **Chapter III** for each potential erosion and stream bank stabilization problem area within the proposed project limits. Problem sites include areas of high velocity (greater than 5 feet per second), outside banks of meanders, steep banks (greater than 3:1) and areas designated by the city as erosion-prone. The erodibility index shall be a function of urbanization, stream velocities, sinuosity, and channel bank material. The procedure is as follows:

- Watersheds that have been or have the potential to be impacted by urbanization shall be weighted by a factor of 2.
- The degree of sinuosity or meandering of the subject stream shall be assessed and assigned a factor ranging from 1 for relatively straight streams to 3 for streams with pronounced meanders.
- The effect of channel bank soils on erosion potential is quantified based on a rating ranging from 1 for rock to 4 for sands and silts.
- Channel velocity, and indirectly, tractive force is included in the erodibility index as a range from one (velocity less than 5 ft/sec) to three(more than 8 ft/sec).
- To compute the Erodibility Index, sum the individual indices for channel velocity, sinuosity and bank materials.
- Multiply this total by the urbanization factor.

The resulting erodibility index will range from 3 to 20. Areas with stream bank erodibilty indices of 3 to 8 should exhibit mild erosion, 8-12 moderate erosion and 12-20 would indicate severe erosion potential. If the project contains any sites with an erodibilty index of 8 or greater, the applicant should develop a stream bank stability plan for submittal to and approval by the city engineering staff prior to platting as a part of the project design.

Summary of Procedures for Stream Bank Stabilization. All projects that involve streams to remain all or in part in their natural state or that have drainage basins larger than 130 acres shall be evaluated for stream bank stability problems according to the procedures outlined in this manual. A summary of those procedures is shown below. An important part of the initial stream assessment is a determination of the causes of the stream bank stability problems.