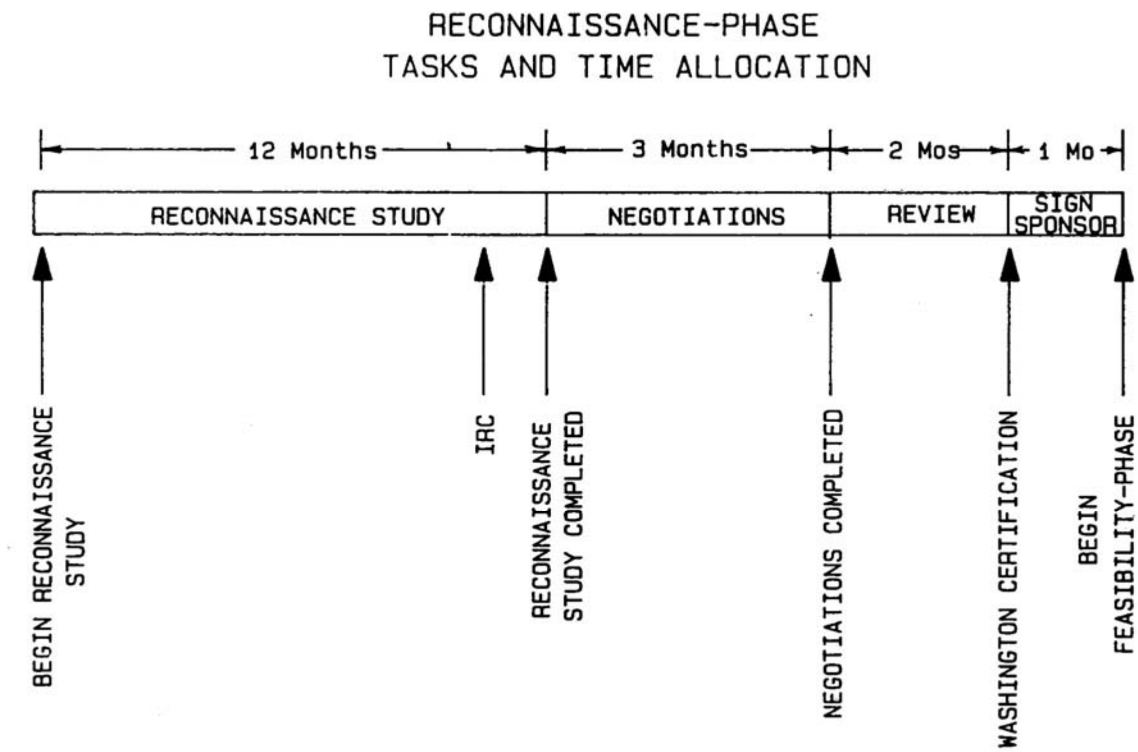
US Army Corps
of Engineers
Hydrologic Engineering Center

Proceedings of a Seminar on

Flood Damage Reduction Reconnaissance-Phase Studies



9 - 11 August 1988
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14. ABSTRACT
A seminar on Flood Damage Reduction Reconnaissance-Phase Studies was held on 9 - 11 August 1988 at Davis, California. The objectives of the seminar were to identify approaches for study conduct; discuss the scope and reliability requirements for technical analyses; and, determine specific guidance and assistance needs for Corps district offices.

15. SUBJECT TERMS
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Proceedings of a Seminar on

Flood Damage Reduction Reconnaissance-Phase Studies

9 - 11 August 1988

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SP-19

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Cont.)

Page No.

FOREWORD

The seminar on reconnaissance-phase flood damage reduction feasibility studies was sponsored by the Hydrologic Engineering Center (HEC). It was held at the HEC, Davis, California, on 9-11 August 1988. The seminar included participants from headquarters, division, and district offices of the Corps of Engineers, the HEC, and a local sponsor representative.

The seminar objectives were to: 1) identify approaches for study conduct; 2) discuss the scope and reliability requirements for technical analyses; and 3) determine specific guidance and assistance needs for Corps district offices.

The seminar included presentations, panel discussions, and a working group session. Experiences were shared and opinions expressed on the conduct of reconnaissance-phase studies. Presentations were made on planning, hydrologic engineering, and economic analysis requirements for reconnaissance-phase studies from the HQUSACE, division, and district perspectives. Panel discussions were conducted for topics covering level-of-detail of technical analyses, plan formulation and evaluation, and division and HQUSACE policy, review, and approval of reconnaissance-phase investigations. Working group sessions by hydrologic engineering, economics, and study management disciplines were held to discuss major items affecting the conduct of the studies.

SUMMARY

Papers and discussions at this seminar focus on the conduct and subsequent processing of the reconnaissance-phase of flood damage reduction feasibility studies. Viewpoints are provided from the district, division, headquarters and local sponsor perspectives. This summary represents a compilation of information presented and discussed in the seminar sessions and informal social periods. The views expressed by the participants in their papers and presented herein in the summaries do not represent the official policy of the Corps of Engineers.

The feasibility study encompasses all activities up to a decision to proceed with design and implementation. The feasibility investigation is a continuous process involving two phases, the reconnaissance-phase and feasibility-phase. The reconnaissance-phase defines the flood related problems, identifies potential solutions and determines whether planning should proceed to the feasibility-phase, i.e. is there a feasible alternative for reducing flood losses for which there is federal interest.

The reconnaissance-phase includes the reconnaissance study, development of the scope-of-study for the feasibility-phase, and cost-share negotiations with the non-federal sponsor. The reconnaissance-phase is initiated with the receipt of funds from HQUSACE.

The reconnaissance study documentation should describe: the flood hazard and flood damage, environmental, social, and institutional flood related problems; summarize the technical analyses performed for existing with plan and without plan conditions; and identify at least one feasible plan for which there is a federal interest. An Issue Resolution Conference (IRC) is mandatory to evaluate the reconnaissance-phase conclusions against the general guidelines for reconnaissance studies. The IRC is normally held near the completion of the draft reconnaissance-phase report. If the reconnaissance study meets the intent of the guidelines, the HQUSACE will then certify the study based on appropriate documentation of the IRC in a Memorandum for Record (MFR). The certification is conditional on the district's submittal of the negotiated feasibility-phase study agreement with the local sponsor.

The level-of-detail for reconnaissance-phase studies will vary with each study as governed by the normal 12-month time frame and funds allocated for the study. The funds may not exceed 25% of the estimated cost to conduct the total feasibility investigation. In unusual circumstances involving extremely complex studies, 18 months may be allocated to conduct the reconnaissance study.

A major aspect of the reconnaissance-phase is to prepare a detailed scope-of-study for the feasibility-phase investigation. The scope-of-study is used to review the feasibility-phase study strategy, for estimating time and costs for the feasibility-phase study, and for determining the local sponsor's feasibility-phase study contributions via negotiations. The preparation of the scope-of-study may begin early in the reconnaissance-phase study, with major updates and modifications normally required at the completion of the reconnaissance study documentation. The hydrologic engineering, economics, cost estimation, geophysical, environmental, and other appropriate disciplines should participate in the development of the scope-of-study.

A significant portion of the presentations and discussions involved study approaches and scope and reliability requirements for the technical analyses. The general consensus was that the reconnaissance study documentation or report should contain a description of: 1) the existing flood problem, 2) formulation of alternatives, 3) evaluation of alternatives and identification of a feasible plan from the federal perspective. The more detailed guidelines for the reconnaissance-phase study approach are defined in the following paragraphs.

1) <u>Define Existing Flood Problem</u>. The ideal reconnaissance-phase technical study will complete the hydrologic engineering and flood damage inundation reduction benefit analyses for the existing without project conditions in the detail needed for the feasibility-phase study. Major changes in problem definition, benefits, identified flood hazard, and other important issues are therefore stabilized early in the project development process. This is possible in some situations, however the lack of available data, the complexity of the study area, and limited time and moneys may dictate that a lesser detailed analysis be performed. The analysis of future conditions will only be performed when it seriously impacts on the feasibility of a plan with federal interest.

2) <u>Plan Formulation</u>. The technical information needed for plan formulation includes the existing with and without plan flood hazard and flood damage conditions. The existing with plan conditions are formulated only to the detail required to determine whether or not a particular plan is likely to be feasible and thus warrant more detailed analysis in the feasibility phase. The hydrologic engineering contributions are the location and size of the measures, elevation-flow- and flow- frequency relationships, and the determination of the operational integrity of the proposals. Flood damage assessments produce the elevation-damage functions and expected annual damage values. The goal is to address the feasibility of a complete set of

alternative measures such as channels, levees, storage projects, flood-proofing, permanent relocation, and flood warning- preparedness programs and to not concentrate on a range of sizes of one or two measures.

3) Plan Evaluation. The objective of the evaluation process is to identify whether or not a plan with federal interest and supported by the non-federal sponsor can be developed. The attractiveness and potential problems (rights-of-way, environmental, geological, institutional) of the implementation and functional operations of each type of measure should be described. A preliminary benefit-cost estimate for each type of measure deemed potentially feasible should then be made.

The appropriate level of detail is one of the primary issues and subjects of interest addressed during the seminar. Opinions were varied, particularly for the hydrologic engineers, and to a lesser degree, economists. Generally both wanted more time and money to perform the reconnaissance-phase study. Both expressed concerns about the use and potential abuse of what they believe will often be less than reliable analysis results. The planning division and HQUSACE representatives emphasized the need for stable and reliable technical analysis results, but stressed that the level of detail for the study is in fact established by the 12 month time frame. The study detail will thus depend on the size, complexity, uniqueness, and availability of data associated with the study area.

The level of detail should subsequently be established by the study manager in negotiation with study team participants. The level of detail does not need to be consistent among the disciplines. In some cases a small additional increment of study cost might significantly increase the validity of the results - taking first floor survey elevations of all structures was one of the examples cited.

The panelists and others discussed means of producing the desired technical products given the limitations of time and funds. They expressed the need to better plan the technical investigations and to use various types and levels of applied methods for analyses. The consensus was for the hydrologic engineer, economist, and other participating technical staff to develop work plans for their respective studies which will form the basis for scheduling and funding the analyses. The plans will subsequently be expanded to more detailed and complete work plans for the feasibility-phase study. Essential elements of the work plans are to: 1) define the objectives of the respective analyses; 2) define the technical analysis study limits; 3) document available technical information; 4) outline analysis strategies; and 5) develop a study schedule and cost estimate.

The primary technical analyses strategies discussed to meet the requirements of reconnaissance-phase studies are: establishing a field presence in the study area, performing desk-top analyses, and performing full-scoped analyses using traditional tools with abbreviated data tailored to the detail defined by the study conditions. The methods are interrelated and provide a means for identifying existing problems/conditions and potential solutions, and detailed analysis needs for the feasibility-phase investigation. The goal is to limit and focus the detailed analysis to important aspects of the study.

An early field presence by the study manager and appropriate technical staff are requisites for a successful reconnaissance study. The field presence involves information gathering, provides valuable insights as to the problems and potential solutions, and lends credibility to the analysis.

Desk-top analyses refers to relatively quick and easy analysis using pencil and paper, hand-held calculator, or simple PC based analysis. The analyses may be for a limited part of the study involving a day or less, or more comprehensive requiring 1-2 weeks. The analyses may be performed any time, but should routinely be conducted after the field trip and prior to application of major computer programs.

The application of traditional hydrologic engineering and flood damage analysis computer programs for existing with and without plan conditions provides analytical capabilities not available with desk-top approaches. The applications range from full- scoped to abbreviated level of analyses. The level of detail of the analysis is dependent upon the study conditions.

Study management is an important aspect of performing a successful reconnaissance-phase investigation. A multi-disciplinary team approach involving capable and experienced personnel is imperative for successful results. It is desirable for the study teams to remain the same throughout both phases to assure consistency of study effort and continuity of involvement with the local sponsor and others.

Within the Corps organizational structure, the study manager is an equal participant of the study team with demonstrated communication and leadership skills. The study manager should also convey a positive attitude, and have a detailed knowledge of the planning process and understanding of the technical analysis procedures and functional aspects of potential projects. It is imperative that the study manager involve the study team in major aspects of the study as early as possible and keep them informed throughout the conduct of the study.

Finally, most seminar participants felt that the districts need to make better estimates of the funds to conduct the feasibility and thus the reconnaissance-phase studies. While the HQUSACE representatives felt that funding of the studies was not a problem, many of the technical representatives felt that they were not receiving sufficient funds to develop the required information to support reasonably stable results.

Overview of the Reconnaissance-Feasibility Study and Planning Process-Program

by James D. Davidson[1] and Wilbert V. Paynes[2]

INTRODUCTION

It can be said that the planning process is like a thermostat, constantly adjusting to the changing emphasis of the nation; and the water resources program functions as a thermometer, increasing or decreasing depending on whether the planning process has adjusted properly and timely. The last significant change in the water resources planning process and program occurred in the 1970s, as a result of the increased focus on the environment. We are now in the midst of yet another major change. With enactment of the Water Resources Development Act of 1986 (WRDA '86) certain changes were mandated, others were permitted, and others are deemed necessary as a result of various other provisions within the Act. The Act required more cost sharing by non-Federal interests and placed statutory time limits and cost sharing requirements on Corps planning. To respond to the challenges of the Act, improvements in the budgetary process have been made to allow continuous funding through the planning and design efforts. This effort with other management inprovements will facilitate a reduction in the Corps project development and implementation process. In response to WRDA '86 changes in the planning process and program have been instituted, which have and will continue to impact significantly on the development of water resources projects. This paper provides an overview of the current planning process and program, and highlight changes that have occurred since enactment of WRDA '86.

CURRENT GUIDANCE

In the planning of water resources projects several major engineering circulars have been developed, subsequent to WRDA '86, which provide guidance on the conduct and management of reconnaissance and feasibility study phases. These circulars are as follows:

EC 1105-2-168, "Procedures for Two Phases Planning"
EC 1105-2-188, "Project Review and Approval Procedures"
EC 1110-2-536, "Project Management System"

1 Deputy Chief Planning Division, Headquarters, U.S. Army Corps of Engineers, Washington D.C.
2 Water Resource Planner, Planning Division, Headquarters, U.S. Army Corps of Engineers, Washington D.C.

Together these circulars create a more effective and efficient management process for developing and implementing water resources projects. The circulars embody the commitment of the Corps to improve its responsiveness to its customers and partners in implementing projects to solve critical water resources problems. The final version of EC 1105-2-168 was issued in September 1987. It defined, among other things, two-phase planning process (reconnaissance and feasibility), purpose of each phase, and general requirements for the feasibility cost sharing agreement (FCSA) between the Corps and the local study sponsor.

EC 1105-2-188, issued in June 1988, is a comprehensive circular providing guidance on project review and approval procedures designed to accelerate the project development and review process in the planning phase. The guidance contained in this circular resulted from recommendations of several task forces formed following passage of the WRDA '86 and efficiency initiatives undertaken to improve the total project development process. The circular describes procedures for early involvement of HQUSACE and ASA(CW) in the planning phase, general evaluation guidelines against which studies will be measured, review procedures for processing reports at the Washington level, and cost estimating and scheduling requirements in the planning phase. Some of the procedures and requirements in EC 1105-2-188 supercede EC 1105-2-168.

EC 1110-2-536, issued in June 1988, provides guidance for the implementation of a life cycle project management system for Civil Works projects specifically authorized with a construction value of over $3 million. The objective of this management system is to provide a stronger project management orientation from the planning phase through project construction. The benefits of life cycle project management will be improved project continuity; accountability for cost, schedule and quality; and effective reconciliation of Corps performance with the concerns and expectations of the non-Federal sponsor. The vehicle by which life cycle project management is being implemented is through the designation of independent and team project managers. In the planning phase the project management system will be identified prior to signing the FCSA and will be instituted at the start of the feasibility study and continue through construction and initial project operation.

PLANNING PROCESS

The goal of the planning process, as is the goal of the total project development process, is that it be accomplished in the most efficient manner as possible. The ideal project development process (inclusive of the planning process) is one where there are no gaps in funding or in study accomplishments, the "no gap implementation model" (Figure 1). Maximum efficiency would

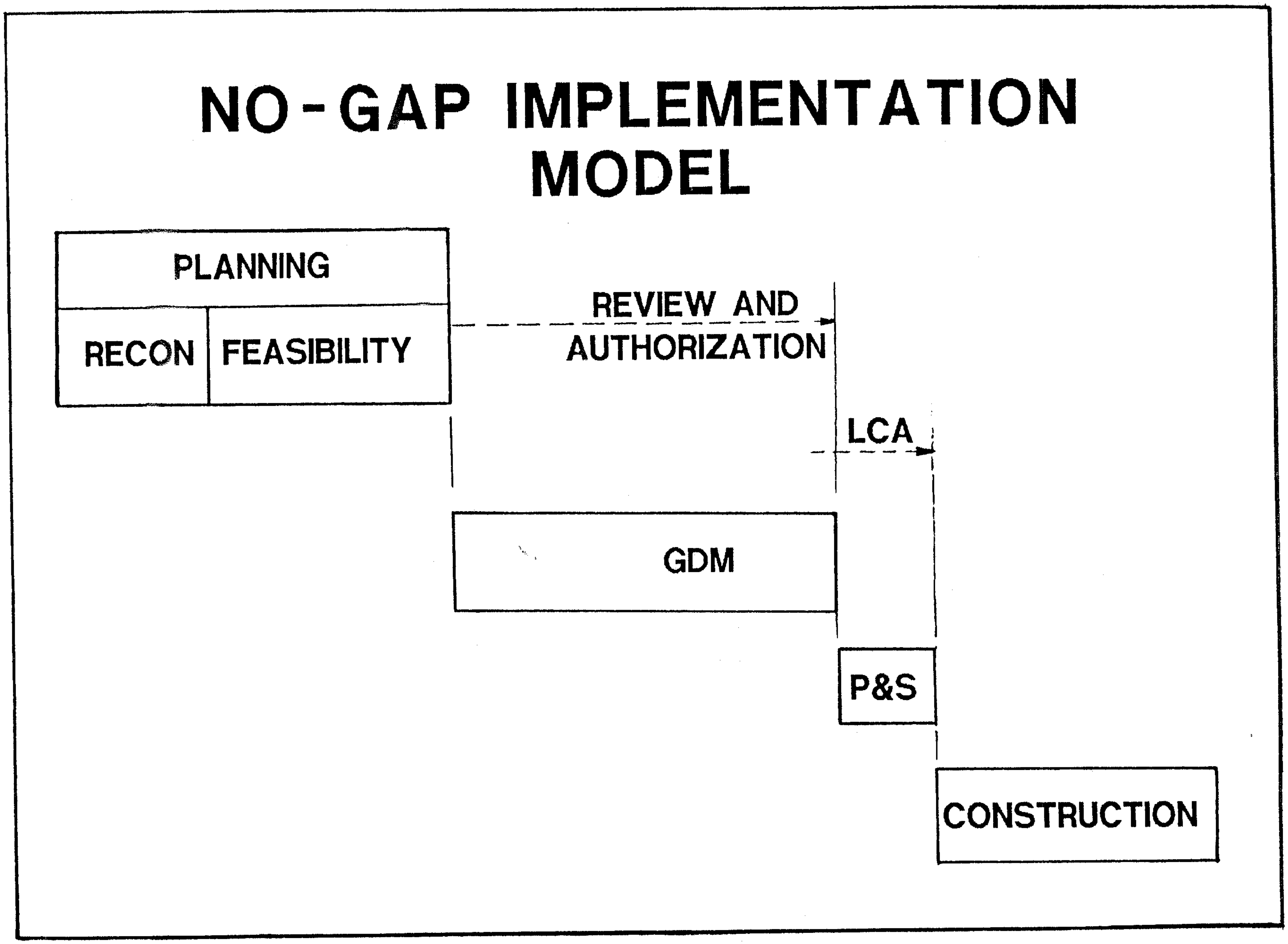

Figure 1 No - Gap Implementation Model

result from an assignment of the completed task (planning, design, and construction) along with full funding (money available when needed) and no constraints (come back when the job is finished). The implementation process slows as constraints are introduced--frequent returns to get approval of the project plan and design; legislation requirements; and funding in less than optimum amounts.

Enactment of the WRDA '86 presented opportunities that have allowed the Corps to move toward the "no gap implementation model." Historically the implementation of Corps water resources projects has taken an average of 21 years. The process was simply too long. As a result of initiatives implemented since WRDA '86 a project development process is now in place that will ready a project for construction in an estimated 8 years. Some of the initiatives implemented were:

1) Early involvement in the planning process by the Office of the Assistant Secretary of the Army for Civil Works (OASA(CW)) and the Headquarters, U. S. Army Corps of Engineers (HQUSACE) to insure early and effective resolution of policy issues;

2) A concurrent and consolidated Washington level review process for the feasibility report;

3) Programming funds to initiate detailed project design (preconstruction engineering and design) upon issuance of the division engineers notice;

4) Permitting local cooperation agreements to be finalized and ready for execution once the project has been selected as a new construction start; and

5) Intensively monitoring costs and schedules through a life cycle project management system in the planning, design and construction phases.

<u>Reconnaissance Phase.</u> The reconnaissance phase results in the first decision document. It forms the basis for initial non-Federal commitment of funds, further commitment of Federal funds, and establishes the management structure, schedule and cost for conduct of the feasibility study. From a HQUSACE perspective there are five milestones in the reconnaissance phase that must be monitored: study initiation; conduct of the mandatory issue resolution conference; certification; execution of the FCSA; and, study completion.

1) <u>Initiation</u>. The reconnaissance phase commences when the Division is ready and requests issuance of appropriated new start funds. This is the first milestone and starts the clock for accomplishing the study in 12 months. The reconnaissance study must be scoped to be accomplished in this time period. To do this may require early discussions with the potential study

sponsor and local and state agencies. Under very unusual circumstances an extension to 18 months may be granted.

2) Issue Resolution Conference (IRC). To insure that the report is consistent with current policies and budgetary priorities a mandatory IRC is required to be held during the reconnaissance phase. The reconnaissance phase IRC is HQUSACE staff first close look at the water resources problem(s) and solution(s) being investigated and serves as a precursor to securing early agency commitment. The IRC is to be held during division review of the reconnaissance report and prior to release of the results to the general public.

The reconnaissance report or other appropriate pre-conference documentation is required to be submitted to HQUSACE at least 15 calendar days prior to the IRC. At the IRC the findings of the reconnaissance study will be evaluated against the general guidelines outlined in Chapter 2 of EC 1105-2-188. At the reconnaissance phase IRC, HQUSACE will indicate whether or not the results can be released to the general public or if there are concerns that must be resolved prior to release. The effectiveness of the conference will depend on the degree of open and thorough discussion of current and potential issues.

3) Certification. Certification procedures for the reconnaissance report in EC 1105-2-68 were revised in EC 1105-2-188. Certification is now based on the outcome of the IRC. Within 15 calendar days of the IRC the conclusions will be documented in a memorandum for record (MFR) to HQUSACE. HQUSACE will endorse the MFR back to the FOA within 15 calendar days, certifying the report and providing project specific guidelines as determined appropriate. If the negotiated draft FCSA was not forwarded along with the FOA's MFR then certification will be contingent on HQUSACE receipt and approval of the agreement and letter of intent to execute the agreement.

When unusual policy or budgetary issues arise, certification may be deferred to allow coordination with the Office of the Assistant Secretary of the Army (Civil Works). In this case an additional 10 calendar days is required to process the MFR and certify the report.

4) Feasibility Cost Sharing Agreement and Scope of Studies. During the negotiation, the potential sponsor should be made aware of the option of including more detailed project planning (PED items) in the feasibility report to reduce uncertainty (the sponsor must be willing to share the additional costs on a 50/50 basis). The FSCA can not be executed until the report is certified.

5) Completion. Following certification, approval of the reconnaissance report and FSCA by the division engineer, the

district engineer and the non-Federal sponsor can then sign the FSCA. Informational copies of the report and signed cost sharing agreement are then to be furnished to HQUSACE when feasibility funds are requested. Feasibility studies that are cost shared do not compete for new start funds but are budgeted as continuing studies.

Feasibility Phase. One of the most important concepts recently incorporated in the feasibility planning process is early Washington level involvement and agency commitment. In the partnership environment in which planning is now being conducted, it is important for the district and the local sponsor to know that when they reach agreement, the project will be supported at the Washington level. Early agency commitment evolves through a well focused issue resolution conference, continuous monitoring, and reporting of major project milestones and activities. Involvement in the feasibility phase by the Washington level is governed by several parameters: it must be timed to occur when the project has been identified with a fair amount of certainty but still early enough in the project development process that issues can be dealt with without undue delay; Division's role in technical peer review, coordination, and oversight must be maintained and strengthened; and delays previously experienced at the Washington level during report review must not be transferred to the field, thus adversely affecting the overall project implementation schedule.

1) Initiation. After all the requirements of the reconnaissance phase are met the District can request funds to initiate the feasibility study when they are ready to begin. Funds will be released within five working days. The clock on the feasibility study commences with the district receipt of appropriated funds.

2) Issue Resolution Conference. The goal of this IRC is to resolve issues prior to the report coming to Washington. To underscore the importance of the IRC, guidance in EC 1105-2-188 states when it is to be held, the guidelines the study will be measured against, specific time requirements for processing an MFR of the meeting, and who will generally be in attendance. Prior to the conference HQUSACE requires that appropriate pre-conference documentation or the draft report be furnished for review. A definition of what constitutes appropriate pre-conference documentation is being developed.

3) Review. The initiative of early agency involvement and commitment compliments the revised procedures for review and processing feasibility reports. Further Washington level review would then consist of a verification that the final report responds to any issues raised at the IRC, any required technical review, and response to State and agency comments. The new procedures are divided into two parts, a review process and a decisionmaking process (Figure 2). The objectives of the new

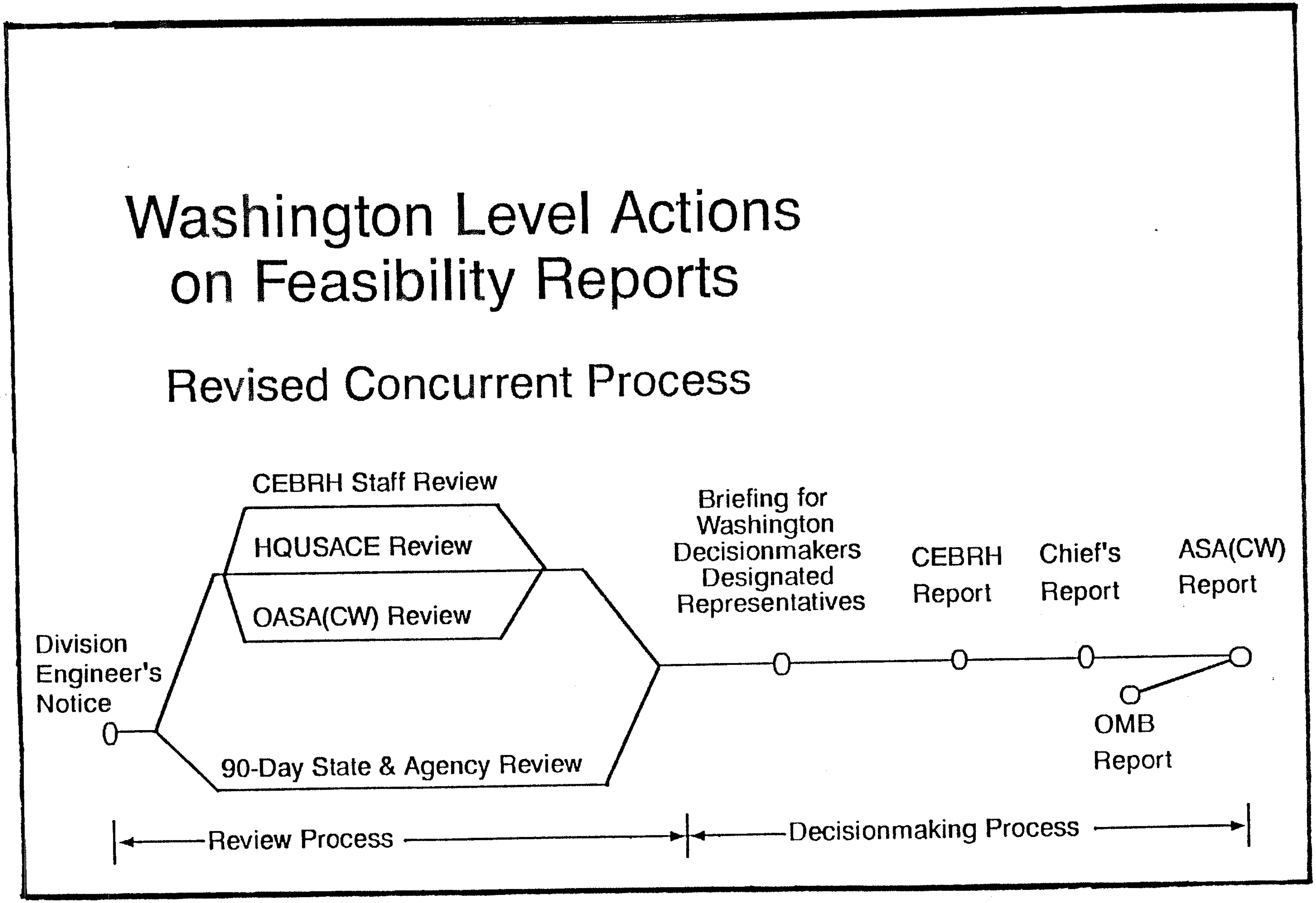

Figure 2 Washington Level Actions on Feasibility Reports

procedures were to (a) reduce the time it takes to get a report to Congress by eliminating review duplication, repetitive requests for data and initiating the 90-day State and agency review earlier; and (b) retain the decisionmaking prerogatives of each echelon (BERH, HQUSACE, and ASA(CW)). The goal is to process reports in 6 months.

CONTENT AND LEVEL OF DETAIL

Reconnaissance Phase. The reconnaissance phase depends heavily on professional judgement due to the limited study time. However, the decision which must be made is a very significant one. Reconnaissance studies must determine whether there is a Federal interest in a solution to the water resource problems of an area and whether planning to develop a project should proceed to the preparation of a feasibility report. Planning is a continuous process and the feasibility study should be a more detailed refinement of the reconnaissance study.

The content and level of detail of reconnaissance reports received in HQUSACE have varied widely. From general discussion of plan concepts to fairly detailed description and cost of alternatives. The reconnaissance phase should focus on identifying the range of concepts and development of at least one alternative with a Federal interest and consistent with current policies and budgetary priorities. The scope of alternative(s) presented in the reconnaissance report to demonstrate the Federal interest should be reasonably close as can be determined to the size project that is expected to result from the feasibility phase. For example, presenting a project in the reconnaissance report that is three or four times smaller than that expected will not provide decisionmakers and the study sponsor clear information on which to base decisions. The most experienced individuals should be involved in the reconnaissance study. This will help to improve our cost estimates and schedule for feasibility studies.

Feasibility Phase. The level of detail and content of feasibility reports prepared under current guidance have been fairly consistent. EC 1105-2-188 now imposes additional requirements in the areas of cost estimating and scheduling. Particular changes in EC 1105-2-188 are: (a) the local sponsor is permitted to expand the level of detail in the feasibility phase in order to better define areas of uncertainty that could possibly affect the scope of the recommended plan; (b) various requirements have been included to improve the quality of alternative plan cost estimates; and, (c) it is now required to have costs and schedules for the detailed engineering and design and construction phases of the project.

During negotiation of the FCSA, the district must discuss with the potential non-Federal sponsor the objectives of the feasibility study, necessary level of detail, cost of studies and scheduling of activities for the feasibility study. If desired and acceptable to the non-Federal sponsor, various project details normally achieved during preconstruction engineering and design (PED), as part of the General Design Memorandum (GDM), could be programmed for accomplishment in the feasibility study to reduce uncertainties in areas such as design and cost. The non-Federal sponsor would have to weigh the benefit of this increased effort against increased feasibility cost, extended schedule and risk associated with committing additional financial resources prior to authorization. The benefits for the sponsor could be elimination of the GDM and better information on which to base financing.

The project cost estimates presented to Congress are now defined as baseline estimates. The cost estimate contained in the feasibility report is generally the one presented to Congress for authorization unless modified while awaiting authorization. Section 902 of WRDA '86 limits the increase in costs to 20 percent, after adjustments for inflation for projects authorized in the Act. It is from the baseline estimate that any subsequent increase will be measured. The 20 percent limit combined with non-Federal cost-sharing mandates complete and accurate project cost estimates so prudent financial and budgetary decisions can be made by both the Federal Government and the non-Federal sponsor. The following will be done to improve cost estimate.

1) Include cost estimators on the study team.

2) Plan and formulate projects in such a way that constructability and operability are assured.

3) Identify and thoroughly discuss uncertainty associated with items in the cost estimate.

4) Insure that the reconnaissance and feasibility phase alternative plan cost estimates are prepared by or reviewed by the cost engineering element in the district and the chief of that unit signs the estimate.

STUDY MANAGEMENT

Reconnaissance Phase. The study management structure in the reconnaissance phase as described in EC 1105-5-188 is essentially unchanged with the implementation of life cycle project management (described in EC 1110-2-536). The requirement to establish a multi-disciplinary study management team with a lead study manager and establisment of an Executive Committee is still in place. There are two new requirements in the reconnaissance phase: (a) the composition of the study management team must insure that increased emphasis will be given throughout the planning phase to cost estimating, scheduling, real estate requirements, constructability and project operability; and, (b) in transmitting the reconnaissance report to the division commander the district commander will indicate whether the feasibility study will be managed by a life cycle project manager (LCPM) or be managed by a team project management (TPM) system. The FCSA when executed will formalize the feasibility management structure.

Feasibility Phase. The responsibility of the study manager has not changed with the institution of life cycle project management, regardless of which management system is selected for the feasibility phase. The study manager is still responsible for scheduling and managing the resources required for the preparation of the feasibility report and, with the representative of the non-Federal sponsor, share the responsibility for coordinating the activities of the study management team. The LCPM monitors the activities of the study management team to ensure that the activities are on schedule and within budget.

The team project management concept involves management by a team of functional managers, consisting of a study manager, engineering manager, real estate manager and a construction manager. The primary management responsibility will shift as a project progresses through planning, design and construction. Each of the functional mangers will be responsible for monitoring the costs, schedules and milestone acheivement for project development activities in his function. One functional manager will be designated as team leader; usually the functional manager having primary activity at that project stage. The study manager will be the team leader during the feasibility phase.

A series of reports have been developed to assist the LCPM/TPM in monitoring and forecasting the project activities. These reports are presented in EC 1110-2-536. These report should be carefully reviewed, some are required to be submitted to HQUSACE, while others are for the use within the district. The first set of reports will be recieved in HQUSACE near the end of August.

Program Management

With the institution of project management, statutory limits on study time and budgetary constraints, it is extremely important to more tightly manage the program. Primary responsibility for that management is with the division. Overall responsibility, of course, rests with HQUSACE. Planning Division, HQUSACE, is developing management and reporting parameters and tools to accomplish necessary oversight of the program.

HYDROLOGIC AND HYDRAULIC ANALYSIS FOR LAS VEGAS WASH AND TRIBUTARIES, NEVADA

BY JOSEPH B. EVELYN[1]

Introduction

Purpose. This paper was prepared as part of the August 1988 Seminar on Flood Damage Reduction for Reconnaissance Phase Studies held at the Hydrologic Engineering Center. Although the emphasis of the seminar is on reconnaissance phase studies, the hydrologic and hydraulic analysis performed in support of both the reconnaissance and feasibility phase studies for Las Vegas Wash and Tributaries, Nevada, will be presented and compared. In that the scope and level of detail of technical studies during a reconnaissance phase is an important issue, the Las Vegas Wash and Tributaries case study will illustrate the differences that can arise during subsequent more detailed technical analyses.

Scope. The presentation begins with a general description of the physical aspects of the study area along with the meteorologic and runoff characteristics of the region. Since the availability of precipitation and runoff records is an important factor in the conduct of subsequent phases of study, it is addressed next. Hydrologic and hydraulic analysis for the reconnaissance phase study is then presented, followed by a description of the feasibility phase analysis. The hydrologic analysis is treated in somewhat more detail than the hydraulic analysis because of the significant changes which occurred during the feasibility phase that influenced the scope and direction of subsequent study activities. A summary and conclusion compares the results of the two phases of analysis and presents some of the impacts of changes in the hydrology and hydraulics on the feasibility study and ongoing floodplain management activities in the Las Vegas area.

General Description of the Drainage Area

Physiography and Topography. The Las Vegas basin is located in Clark County, the southernmost county in Nevada. The region is characterized by well-defined mountain ranges running generally north-south with broad alluvial valleys between the ranges (see Figure 1). Las Vegas, North Las Vegas, Henderson, and Nellis Air Force Base are located within the valley portion of the drainage basin. The Las Vegas Wash basin is approximately 30 miles wide (east-west direction) and 50 miles in length (north-south direction) with 1,590 square miles of drainage area at its mouth at Lake Mead, a man-made lake created by Hoover Dam. The mountains surrounding the basin are generally rugged and steep with an average upper elevation of 5,000 feet above mean sea level. The maximum elevation in the area is 11,900 feet at Charleston Peak in the Spring Mountains about 30 miles west of Las Vegas. Elevations in the valley portions of the drainage area range from about 1,220 to 2,700 feet. Las Vegas Wash, a typical ephemeral desert stream, originates in the mountain ranges in the northwest part of the drainage area and flows generally southeast for about 45 miles to Lake Mead. Numerous ephemeral and generally

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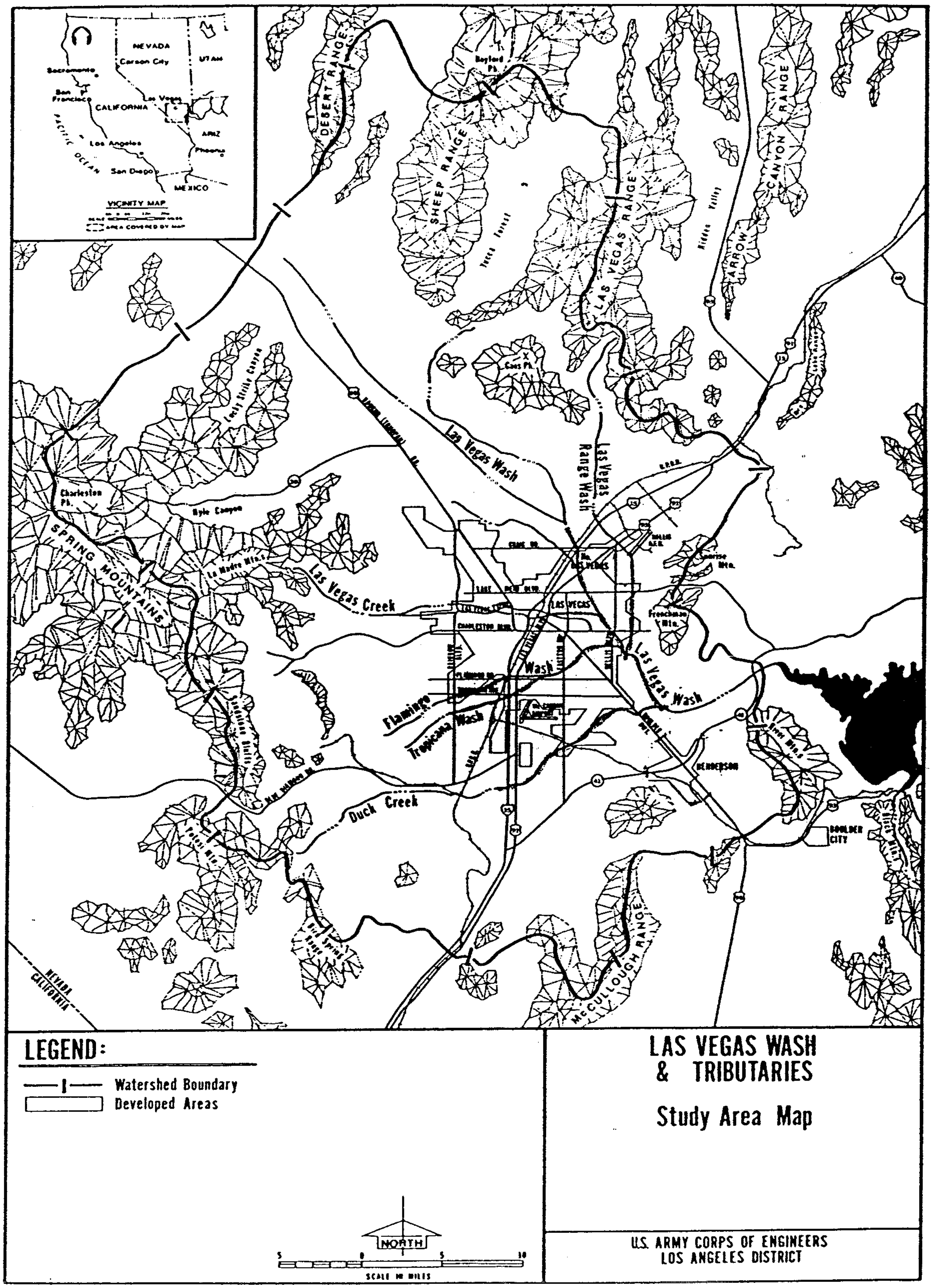
NEVADA
UTAH
Carson City
Sacramento
San Francisco
CALIFORNIA
Las Vegas
ARIZ
Los Angeles
Phoenix
San Diego
MEXICO
PACIFIC OCEAN
VICINITY MAP
DESERT RANGE
SHEEP RANGE
LAS VEGAS RANGE
ARROW CANYON RANGE
SPRING MOUNTAINS
Charleston Pk.
Kyle Canyon
Las Vegas Wash
Las Vegas Range Wash
Las Vegas Creek
LAS VEGAS
Wash
Flamingo
Tropicana Wash
Duck Creek
HENDERSON
BOULDER CITY
McCULLOUGH RANGE
NEVADA
CALIFORNIA
LEGEND:
Watershed Boundary
Developed Areas
NORTH
SCALE IN MILES
LAS VEGAS WASH
& TRIBUTARIES
Study Area Map
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

FIGURE 1

unnamed tributaries join the main stream. The principal tributaries that run through the Las Vegas Valley are Las Vegas Creek, Tropicana Wash, Flamingo Wash, Range Wash, Pittman Wash, and Duck Creek. The gradient of Las Vegas Wash is about 45 feet per mile at the upper end of Las Vegas Valley, about 25 feet per mile in the vicinity of Las Vegas and about 45 feet per mile near the lower end. The gradient of the tributaries in their upper reaches near the mountains is typically 200-400 feet per mile and decreases gradually as these streams approach Las Vegas Wash in the valley.

Soils. The materials that make up the alluvial fans at the base of the mountains are generally well graded gravels, sand, silt, and caliche, with coarser materials predominating. Caliche beds are extensive and very hard. Near the mountains, the materials are especially coarse and angular. The central floor of the valley consists of unconsolidated alluvial materials and dense lacustrine silts and clays.

Vegetation. Most of the high mountain areas are covered with moderately dense brush and some trees. Brush and small trees also occur in the higher ravines and along some of the watercourses at lower elevations. Vegetation is sparse in the valley areas, typical of the Mojave Desert region, and consists predominately of varieties of yucca, cactus, mesquite, creosote bush, tamarisk, and sagebrush. Because of the lack of water, only a very minor portion of the study area is devoted to agriculture.

Climate. The climate of Las Vegas and vicinity is arid, with hot summers and relatively mild winters. Precipitation results from mild general storms in winter and occasional heavy thunderstorms in summer; spring and fall are the driest seasons. Average daily minimum/maximum winter temperatures (degrees Fahrenheit) range from approximately 33/56 in the City of Las Vegas and surrounding valley areas to about 17/35 in the mountains. Average minimum/maximum summer temperatures range from approximately 76/105 in the valley areas to 55/80 in the higher mountains. The prevailing winds, which are from the southwest, are generally light. Mean seasonal precipitation in Las Vegas and vicinity ranges from about 4 inches in the southeastern portions of Clark County to more than 20 inches atop Charleston Peak in the Spring Mountains.

Land Use. The Las Vegas valley area is currently undergoing intensive urbanization. Coordination with city and county planning departments was undertaken to establish a growth boundary upon which hydrologic analysis and flood control planning could be based. The future condition (year 2055) development boundary was projected to be the effective topographic limits of construction. That is, future condition development will be essentially "rim to rim" (the entire valley area will be developed).

Runoff Characteristics. None of the watercourses in the Las Vegas area flow perennially from natural runoff. There is continuous flow on lower Las Vegas Wash due to discharge from sewage treatment plants. Generally, runoff occurs only during and immediately following the heavier precipitation because climatic and drainage area characteristics are not conducive to continuous runoff. Significant runoff occurs in the summer months (May through October) as a result of summer local storms and to a lesser degree, general storms. Stream channels are distinct and well defined in the mountain ranges, but upon reaching the valley transition they become braided and poorly defined channels. These channels carry the bulk of large floodflows in their wide flat overbanks, except in some urban areas where manmade channels have been constructed.

Existing Structures. Existing structures affecting runoff in the area include several new detention structures on tributaries upstream from the currently urbanized valley area and scattered channel improvements on washes within the urbanized area. Generally, channels in the developed valley area consist of the open space left for washes as development takes place adjacent to the wash. Until recently, no systematic engineering approach had been applied to defining the flood control and drainage needs of the study area. Highway embankments and bridges create significant obstructions to, or alterations of, natural flow patterns.

Precipitation and Runoff

Precipitation Records. Precipitation records are available for 19 gages in and near the Las Vegas Wash drainage area, 11 of which are currently operating. The only recording gage records within the Las Vegas Wash drainage area are for the Las Vegas WB AP (McCarran Airport) gage (recording from 1949 to present) and the Las Vegas gage (recording from 1939 through 1943). The longest record in the study area is for the Las Vegas WB AP gage which has 56 years of record.

Streamflow Records. Streamflow records are available for 19 gages in the Las Vegas Wash drainage area, six of which are recording type gages. The U.S. Geological Survey (USGS) established the stream gage system in the mid-to-late 1960's. The longest record available is the Las Vegas Wash near Henderson gage, which has 30 years of record (1957 to 1987).

Storms and Floods of Record. Nearly all of the major flood events in Las Vegas and vicinity have resulted from heavy local summer thunderstorms. There are five intense historical thunderstorms in southern Nevada for which there are sufficient total-storm precipitation data to prepare isohyetal analyses; 13 June 1955, 21 August 1957, 3 July 1975, 10 August 1981 (Moapa Valley), and 10 August 1983. Four of these occurred in the immediate vicinity of Las Vegas, and one occurred in the Moapa Valley, about 45 miles northeast of Las Vegas. In all but one of these five events, there are sufficient data from recording rain gages and aviation weather observations in or near the storm to construct a meaningful time distribution of the precipitation near the storm center(s). Not much is known about storms and flood events in southern Nevada prior to 1945 because occurrences went virtually undetected and unreported in the very sparsely populated desert of that era.

Reconnaissance Phase Hydrologic Analysis

General. The reconnaissance study for Las Vegas Wash and Tributaries was initiated in September 1984. In support of the study, hydrologic analysis was necessary to provide discharge frequency results (10-year through 500-year), standard project flood, and at detention facilities the probable maximum flood and sediment accumulation during project life. These hydrologic products were required for both present and future conditions and for several alternatives consisting of combinations of detention basins, channelization, and diversion of runoff to adjacent tributaries. The time frame available for hydrologic analysis was 3 months (November 1984 to January 1985). Given the limited resources in terms of time and funds available, maximum utilization of prior hydrologic studies in the area was essential. The most current and comprehensive hydrologic analysis available in the area was the work performed by James M. Montgomery Engineers (JMM) for the on-going Preliminary Las Vegas Valley Flood Insurance Study (FIS).

JMM Preliminary FIS Hydrology. JMM utilized the Soil Conservation Service (SCS) TR-20 computer program to perform rainfall-runoff computations to derive flood hydrographs of desired return period. The SCS dimensionless unit hydrograph was used to develop unit hydrographs for each subarea based on area size and time of concentration. Rainfall losses due to infiltration, surface storage and other factors were determined in TR-20 using the SCS curve number method. The precipitation input to the model was based on an assumed typical critical storm event for Las Vegas Valley consisting of a local thunderstorm with an effective duration of 3 hours and an areal extent of about 200 square miles. Total point precipitation storm depths for 3-hour events with 10-, 50-, and 100-year return periods were computed from information presented in National Oceanic and Atmospheric Administration (NOAA) Atlas 2, Precipitation - Frequency Atlas of the Western United States, Nevada. An evaluation of storm events in the region led to adoption of a rainfall time distribution characterized by an intense burst of rainfall having 60 percent of the total storm precipitation occurring in 25 percent of the total storm duration. The storm depth-area relationships were based on "Hydro 40, Depth-Area Ratios in the Semi-Arid United States" by NOAA. A total of nine different storms centerings (each 200 square miles) were performed within the 1,518 square mile JMM study area in order to generate discharge frequency values at all locations. Calibration of the rainfall-runoff model was limited to a verification that the unit hydrograph and loss rate procedures were able to give a fair reproduction of the floods resulting from the July 1975 storm at four locations in Las Vegas. Calibration of the rainfall-runoff procedure to regional flood frequency relationships based on analysis of streamgage records was not attempted. Hence, the question remained as to whether the adopted rainfall-runoff procedure generated discharge frequency results consistent with the actual flood frequency experience of the region.

Adopted Reconnaissance Phase Hydrology.

(1) Present Condition Without Project. Preliminary results of the JMM study were adopted directly with some adjustment based on contributing area assumptions for present without project conditions. Plotting the 10-, 50-, and 100-year peak discharges and extrapolating the curve, the 500-year peak discharge was estimated and also assumed to be the standard project flood (SPF). Probable maximum flood peak discharges were assumed to have magnitudes four times the SPF peak discharges.

(2) Future Condition Without Project. Urbanized areas under present or future conditions were assumed to have a 40 percent imperviousness. Future condition without project discharge frequency values were developed by adjusting the present condition discharge frequency values upwards by using a set of relationships derived in a Corps study for San Luis Obispo County in coastal southern California.

(3) Future Condition - Detention Basin Alternative.

(a) Detention basins which provide 100- or 500-year flood control protection were proposed for Duck Creek, Tropicana Wash, and Las Vegas Wash. Hydrographs of 100- and 500-year floods at the sites were obtained directly from JMM and used to calculate the required flood storage volumes. An adjustment was made to increase the size of the hydrographs to account for a storm event having a duration of 6 hours versus 3 hours used in the JMM analysis.

(b) Sediment yields at the detention sites were estimated using an average annual rate of sediment production of 0.25 acre-feet per square mile per year. This rate was used in the 1959 Corps Survey Report for Las Vegas Wash and Tributaries.

(c) Discharge frequency analysis downstream from detention basins was accomplished by adding detention basin peak outflow to peak runoff from the uncontrolled downstream runoff, thereby yielding a conservatively high result.

(4) Future Condition Channelization Alternative. JMM's TR-20 stream system model assumed channel capacities which were adequate to convey runoff without significant ponding or overbank flow. Since this assumption in effect represents the hydrologic effect of an improved channel condition, the estimated future condition without project discharge frequency values were considered adequate for channel design.

Reconnaissance Phase Hydraulic Analysis

General. Hydraulic support was required in the form of overflow areas for 10-year through 500-year discharges values as well as hydraulic designs for flood control alternatives. Hydraulic analysis was scheduled for completion in 4 months (November 1984 to February 1985).

Overflow Analysis. Water surface profiles and overflow delineations for Duck Creek, Tropicana Wash, Flamingo Wash, and lower Las Vegas Wash were extracted from the 1979 SCS Flood Hazard Study for Las Vegas Wash and Tributaries. For Upper Las Vegas Wash and Las Vegas Creek, the early results of the JMM Preliminary FIS work were used. The SCS Flood Hazard study was accomplished using the SCS WSP-2 backwater program and 1 inch equals 500 foot scale maps (5-foot contour intervals) for 10-, 50-, 100-, and 500-year overflows. The JMM Preliminary FIS was accomplished using the HEC-2 computer program. For the reconnaissance study, each stream was field checked to identify cross section changes due to channel or bridge modifications. Rating curves were developed at significant obstructions that were not originally accounted for. Also, channel cross section rating curves were extended to enable water surface profiles determinations for higher discharges. The backwater computer models were not rerun. Instead, the existing water surface profiles were used and overflow delineations were adjusted for the channel modifications observed in field reconnaissance. Depths in channels were determined using normal depth calculations, and depths at culverts were determined using inlet control nomographs.

Hydraulic Design. Hydraulic design was not performed on the detention basin outlet works or spillways. Design engineers costed out detention basins based on hydrologic requirements of storage space, release capabilities, and spillway capacity of comparable facilities designed for other projects. Channel design data based on normal depth was developed in terms of families of curves for specific reaches for various revetment types to permit design engineers to select the most cost effective design. Channel design information consisted of:

(1) Channel design curves for discharge versus flow depths for various channel sizes and revetment.
(2) Profiles of each proposed channel showing existing invert, design invert, and existing bank.
(3) Typical cross-sections of channel improvements and training (diversion) levees.
(4) Plan view drawing showing location and alinement of proposed improvements.

Conclusion of Reconnaissance Phase

Results of Reconnaissance Phase Study. Economically viable flood control measures were identified on several study streams (Los Angeles District 1986). The most promising were the 500-year and 100-year detention basins on Tropicana Wash with its associated training levees to convey flows from Las Vegas Creek, Flamingo Wash, Tropicana Wash, and Blue Diamond Wash into the Tropicana Detention Basin. This plan would provide a high level of flood protection to the western portion of the Las Vegas Valley. Channelization of Las Vegas Creek along Washington Street in the City of Las Vegas to handle the 100-year or 50-year flood was also found economically justified. Local protection measures consisting of short reaches of improved channel and/or bridge and culvert modifications were found economically justified on Duck Creek, Tropicana Wash, and Flamingo Wash. With respect to the non-structural approach, two measures were recommended for all washes in the Las Vegas area: (1) securing flood insurance for structures at risk, and (2) implementation of a comprehensive flood warning system. In addition, individual building enclosure and floodproofing, as well as floodwall construction options were found very favorable for specific locations on Flamingo Wash, Topicana Wash, Las Vegas Creek, and Duck Creek areas.

Recommendation. The Los Angeles District (LAD) recommended that the study proceed into the feasibility phase because economically viable flood control alternatives had been identified and the Clark County Board of Commissioners indicated their support of the study and their willingness to cost share in a feasibility study. The South Pacific Division (SPD) gave approval to proceed with feasibility studies on Flamingo Wash, Tropicana Wash, Las Vegas Creek, and Duck Creek. SPD maintained that there was insufficient basis for further study on Las Vegas Wash, Las Vegas Range Wash and Henderson area washes.

Feasibility Phase Hydrologic Analysis

General. Moving into the feasibility phase brought with it additional time and funding resources to enable investigation of the fundamental hydrologic relationships, rainfall-runoff and discharge frequency, upon which all flood control studies are based. Funding resources were somewhat limited, however, in part due to the complications of having a cost sharing local partner. At about the time the feasibility study began, the State of Nevada had mandated that each county develop a "Master Plan" for flood control planning purposes. In that the Clark County Regional Flood Control District (CCRFCD) had not been formally constituted at this time, the County contracted with JMM to develop the "Master Plan" for approximately $1 million. Naturally the County was interested in maximum in-kind services credit for the portions of the feasibility study addressed by the JMM master plan effort. This turn of events complicated the hydrologic analysis because it required us to adopt some of the methodology emanating from the master plan work, even though we were unfamiliar with some of the methods. There was a similar influence on the hydraulics, design, and plan formulation areas of the feasibility study. In fact, a small task force within the District composed of the Chiefs of Design, Hydrology and Hydraulics, and Water Resource Branches was formed in an attempt to find a way to accomplish the feasibility study within the $2.1 million total study cost which included in-kind services.

Synthesis of Standard Project Flood (SPF).

(1) Standard Project Storm (SPS). After a thorough evaluation of all historical storm information in southern Nevada, the Valley of Fire center of the 10 August 1981 Moapa Valley storm was selected as the basis for depth-area-duration relationships for SPS, in the vicinity of Las Vegas.

(2) Determination of Rainfall-Runoff Relationships. The runoff model utilized for the feasibility study was developed by JMM for the "Master Plan" Study and consists of a combination of the Soil Conservation Service (SCS) dimensionless unit hydrograph for use in unurbanized areas and kinematic wave runoff models for urbanized areas. Because of the availability of a stream system model and model parameter data, the local sponsor's interest in using the SCS/kinematic wave model in future studies, and assumed savings in time and cost, it was decided that LAD would use the SCS/kinematic wave model after verifying it produced reasonable results. The verification process consisted of first performing reconstitutions of observed storm and flood events using the computer program HEC-1 to derive best-fit unit hydrographs and rainfall loss rates. Two recorded or estimated flood hydrographs and 10 measured or estimated peak discharges for three storm events in the Las Vegas area were reconstituted. Secondly, LAD enlisted HEC to independently check the application of the kinematic wave runoff model developed by JMM. HEC suggested that two overland flow planes, one pervious and one impervious, be used instead of just one overland composite flow plane for each subarea, as had been used by JMM, where there is development or proposed development. HEC's recommended adjustments were made by LAD to the JMM kinematic wave model. Finally the SCS/kinematic wave rainfall-runoff procedure was compared to the LAD S-graph procedure by computing hydrographs using both procedures for selected subareas to verify that resulting hydrographs were in reasonable agreement. This verification was accomplished for both urbanized and unurbanized subarea samples. LAD experience in adjusting S-graph parameters to model urbanized watershed conditions enabled this comparison.

(3) Flood Routing. Flood routing through both natural and improved main channels or through SCS subareas was performed using the Muskingum method. Reservoir routing was accomplished by use of the modified Puls routing procedure. Routing through kinematic wave subareas where there were no defined channels was accomplished by using the kinematic wave routing method.

(4) Stream System Analysis. Rainfall-runoff computations of flood hydrographs were accomplished by use of HEC-1 applied to the comprehensive stream system composed of over 100 subareas. A unit time period of 5 minutes was required to adequately define the runoff hydrograph, particularly for kinematic wave subareas.

Discharge Frequency Analysis. A calibrated rainfall-runoff frequency model was developed as the appropriate discharge frequency methodology to derive n-year flood hydrographs at ungaged locations for various land uses and flood control alternatives.

(1) Precipitation Frequency Analysis.

(a) In order to determine n-year peak discharges (for n = 10-, 50-, and 100-year) on various watersheds in and around Las Vegas, a determination of n-year storm rainfall was undertaken. The precipitation frequency analysis included an evaluation of information from NOAA and local engineering firm reports, as well as analytical point precipitation-frequency analyses by LAD. LAD adopted point frequency precipitation values consistent with the 1985 Black and Veatch Report which, for example, calls for increases of 43 percent and 23 percent respectively, to NOAA Atlas 2 point precipitation values for 100-year and 10-year, 3-hour duration values.

(b) Each return period storm was of 6-hour duration with the same time distribution as SPS and depth-area relationships based on the Valley of Fire center of the 10 August 1981 Moapa Valley storm (corraborated by NWS Hydro 40).

(2) Regional Peak Discharge Frequency Analyses Used in Model Calibration.

(a) Regional discharge frequency relationships described below were used to calibrate an S-graph rainfall/runoff model developed for selected gaged watersheds in the study area. The S-graph model was then used to verify the SCS/kinematic wave runoff model. The derivation of these regional frequency relationships was based on an analysis of gages located throughout the California-Nevada desert in areas hydrologically similar to the Las Vegas Valley, because the gages located within Las Vegas Valley alone did not have records of sufficient length to derive the regional relationships for the study. The adopted regional relationships were a regional skew, a standard deviation versus drainage area curve, and a 100-year peak discharge versus drainage area curve.

(b) All stream gage records in the California-Nevada desert area surrounding the Las Vegas area were retrieved from the USGS WATSTORE database. The initial retrieval was refined and reduced to 41 gages on the basis of a record length of more than 10 years, suitability for analytical analysis (more than 75 percent nonzero flows), absence of known regulation in the watershed, and absence of significant snowmelt runoff.

(c) The remaining gages were then analyzed utilizing the HEC computer program Flood Flow Frequency Analysis. After preliminary analysis of the results, additional gages were dropped from further consideration in the study because these gages had a significant number of very low flows which unduly biased the gage statistics. Table 1 presents the statistical characteristics for the remaining gages which encompass drainage area sizes ranging from 1.13 to 3090 square miles.

(d) A regional skew coefficient of zero was determined from a weighted average (by years of record) of the computed station skew coefficients for those gages having 15 or more years of record shown in table 1. A least squares regression analysis was performed relating log (standard deviation/area) to log (area).

(e) A mean flood discharge (M) versus drainage area relationship was developed, but because of the wide scatter of the plotted points, a 100-year peak discharge versus drainage area relationship was developed and adopted. From this relationship and the equation;

$$LOG\ Q = M+KS$$

values for the mean (M) were computed for the desired areas using the value of K for zero skew at the 100-year return period. This technique yielded results that matched gage frequency curves of both large and small areas more closely than relating the log (mean) to area.

(f) Figure 2, is a frequency plot showing the computed individual gage frequency curve compared with the regional frequency curve, derived using the relationships discussed, for Flamingo Wash at Las Vegas (DA = 86 mi^2). The regional curve compares reasonably well with the individual gage curve, indicating the adequacy of the regional relationships. Expected probability adjustments were made to the regionally derived frequency curves using an N (number of years of record) of 20 years.

(g) Calibrations of the LAD S-graph rainfall-runoff model to the regional discharge frequency relationships were performed to make adjustments to model parameters to assure that the n-year precipitation used resulted in n-year flow rates. The calibrated S-graph model was then used to verify the SCS/kinematic wave model at selected locations.

Table 1. Computed Frequency Statistics for Peak Flow, California, Nevada, and Arizona Desert Basins.

Designation	USGS Gauge #	Location	Drainage Area (Sq. mi.)	Log Std. Dev.	Log Mean	N Years	# of O's	Computed Skew
8	9419675	Flamingo Wash @ Las Vegas	86	0.6571	2.4709	19	3	-0.0276
9	9419677	Flamingo Wash @ Maryland Pkwy	106	0.7614	2.4811	17	0	-0.1732
10	9419678	Flamingo Wash nr. mouth	117	0.7388	2.5386	16	0	-0.1366
13	9419650	Las Vegas Wash @ N. Las Vegas	693	0.7661	2.4325	20	1	0.1456
24 +	9428800	Tyson Wash Tr. Nr. Quarzite	13.7	0.4594	2.5130	14	0	-0.5393
25 +	9423900	Sacto Wash Tr Nr Topc	14.7	1.0463	1.5833	14	2	-0.6400
26 +	9423820	Sacto Wash nr. Yucca, AZ	787	0.4967	3.3342	12	2	-0.4713
31	10255885	San Felipe Crk Nr. Wstmrelnd	1693	0.6027	3.4799	22	0	0.5293
32	10254050	Salt Crk nr Mecca, Ca	269	0.6320	2.5203	22	0	0.0466
34	10252550	Caruthers Cr nr Ivanpah, Ca	1.13	0.9900	1.4791	19	0	-0.2659
35	10251220	Amargosa R @ Tecopa	3090	0.6801	2.4001	21	0	0.1677
37	10251271	Amargosa R Tr #1 nr Johnnie	2.21	1.0266	1.1143	16	3	-0.6578
38	10264900	Salt Wells Cr nr Westend, Ca	61.6	0.7537	1.6106	15	3	-0.3804
39	10264878	Ninemile Cr nr Brown, Ca	10.4	0.8589	1.2837	15	0	-0.0195

+ No regional skew input.

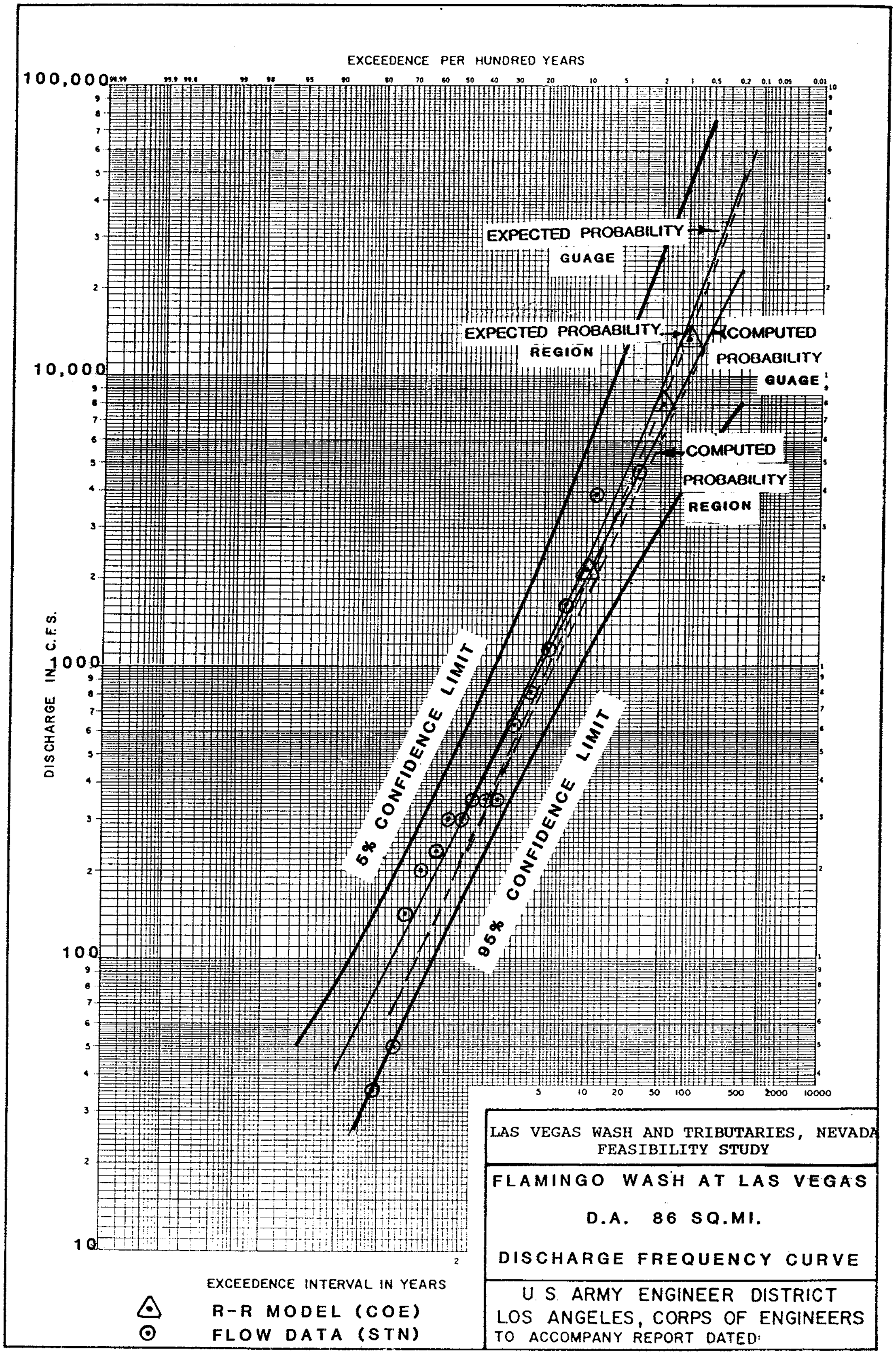
EXCEEDENCE PER HUNDRED YEARS
100,000
10,000
1000
100
10
DISCHARGE IN C.F.S.
EXPECTED PROBABILITY
GUAGE
EXPECTED PROBABILITY
REGION
COMPUTED
PROBABILITY
GUAGE
COMPUTED
PROBABILITY
REGION
5% CONFIDENCE LIMIT
95% CONFIDENCE LIMIT
EXCEEDENCE INTERVAL IN YEARS
R-R MODEL (COE)
FLOW DATA (STN)
LAS VEGAS WASH AND TRIBUTARIES, NEVADA
FEASIBILITY STUDY
FLAMINGO WASH AT LAS VEGAS
D.A. 86 SQ.MI.
DISCHARGE FREQUENCY CURVE
U S ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

FIGURE 2

(h) The determination of peak discharge frequency values for (n = 10-, 50-, and 100-year) for present and future without project conditions at selected concentration points were derived in an analagous manner to SPF computations using stream system analysis.

Feasibility Phase Hydraulic Analysis

Overflow Analysis. Feasibility level overflow analysis is being accomplished by updating existing FIS HEC-2 backwater models on Las Vegas watercourses and running the models with the higher discharges determined from the hydrologic analysis. The higher discharges created a need to expand cross section widths and to more carefully evaluate breakouts of flow from the main channels in the valley areas. Topography consists of 1984 (4 foot contours) FIS mapping supplemented by 1974 FIS mapping (5 foot contours) plus USGS quad maps. Where the hydraulic analysis indicated significant deviations from the hydrologic rainfall-runoff model assumptions, the hydrologic model was modified and rerun to generate appropriate discharge values.

Hydraulic Design. The initial effort will consist of a reevaluation of the reconnaissance effort in order to ascertain whether the current scope of the feasibility study is adequate. The higher feasibility level discharge frequency values are to be used in conjunction with feasibility overflow areas and feasibility economic analysis to upgrade the reconnaissance estimates of flood damage potential. At this point, the reconnaissance phase hydraulic design curves and design cost estimating methodology will be used to redefine the scope of the federal interest in flood control facilities. More detailed feasibility hydraulic design efforts will then follow.

Summary and Conclusions

Comparison of Reconnaissance and Feasibility Results. The feasibility phase discharge frequency analysis resulted in a marked increase in the magnitude of peak discharge values for a given return period than estimated during the reconnaissance phase. Table 2 presents a comparison of reconnaissance versus feasibility discharge frequency values for present conditions without project at selected locations. Naturally, the extent of overflow areas increased commensurately.

Summary. The hydrologic and hydraulic analysis for both reconnaissance and feasibility phase studies for Las Vegas Wash and Tributaries, Nevada has been presented. During the reconnaissance phase, maximum utilization was made of prior studies in order to quantify existing and future flood damage potential, and evaluate alternative flood hazard reduction measures in the short time frames and minimal funding available at this phase. In the feasibility phase, additional time and funding resources permitted hydrologic and hydraulic analysis consistent with Corps guidance requirements, but not without accommodation of the needs and requirements of the local cost sharing sponsor. The feasibility hydrologic analysis resulted in large changes in the discharge frequency relationships for the Las Vegas region. The implications of the change in hydrologic results is still being wrestled with in terms of the reliability and accuracy of the reconnaissance study conclusions, as well as the direction and scope of the on-going feasibility study. As of May 1988 FEMA had decided to adopt the methodology and conclusions of the Corps'

Table 2. Selected Present Condition Without Project Discharge Frequency Values.

Location	Drainage Area (Sq. mi.)	Return Period (Years)	Peak Discharge (cfs)	
			Reconnaissance[1]	Feasibility[2]
Tropicana Wash @ I-15	12.3	500	6,740	22,000 (11,200)
		100	3,940	6,900 (4,800)
		50	3,080	3,800 (3,000)
		10	1,390	700 (600)
E. Range Wash @ Carey Avenue	60	500	3,880	25,000 (14,000)
		100	2,430	8,400 (5,600)
		50	1,900	5,000 (3,500)
		10	700	1,100 (950)
Flamingo Wash @ Decatus Boulevard	96.5	500	9,720	35,000 (16,000)
		100	5,440	10,000 (7,800)
		50	4,010	6,000 (4,500)
		10	1,460	1,350 (1,100)
Duck Creek @ Boulder Highway	226	500	17,700	60,000 (33,000)
		100	9,700	18,500 (11,500)
		50	7,190	9,800 (7,000)
		10	2,810	1,900 (1,700)
Las Vegas Wash @ U.P.R.R.	733	500	10,000	82,000 (39,000)
		100	7,700	23,000 (14,500)
		50	6,470	12,000 (8,500)
		10	3,620	2,200 (1,900)

1. Source of discharges (JMM 1986) FIS hydrology adjusted by LAD.
2. Feasibility Study discharges are adjusted for expected probability. The numbers in parenthesis are computed probability discharges. Source of discharges (Los Angeles District 1988)

feasibility phase hydrologic analysis as the basis for the flood insurance program in the area. This decision means a redo of a nearly completed FIS that was scheduled for release for public review in Feburary 1988.

Conclusions. Based on LAD's experience with the Las Vegas study among others, several ideas with regard to the Corps' current flood control study program are worth surfacing.

(1) When adopting hydrologic and hydraulic work by Architect-Engineer firms or other agencies, one must recognize that significant changes in the technical results can occur following more detailed Corps analyses.

(2) Hydrologic analysis is the first technical activity on any flood control study. Given the ripple effect on the entire study process, reconnaissance through design phases, the hydrologic analysis should be addressed in as much detail as practical at the earliest possible opportunity in the overall study process.

(3) With the advent of cost sharing, Corps technical elements must be prepared to use or adopt methodology that may be unfamiliar in order to meet the needs of local sponsors.

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RECONNAISSANCE STUDIES
A HYDROLOGIC ENGINEER'S PERSPECTIVE

by Edward W. Sizemore, P.E. [1]

Introduction

The two primary purposes of a reconnaissance phase study are to determine if there is federal interest and, if so, the scope and cost of the feasibility phase studies. The time and funds available to conduct reconnaissance phase studies are limited. Policy concerning the scope, reliability, confidence, and management of the technical analysis, which serves as the foundation for scoping and estimating the cost of the feasibility report, should be clearly established.

The management of studies using a "study team" concept has been promoted within the Corps for several years. Experience shows the success of this concept depends greatly on the personality of the study manager. This year the Corps is implementing the "project management" concept for Civil Works studies utilizing independent life cycle and team project managers. Thought must be given to how this new concept will change the way the Corps does business. Other areas of interest in the management of reconnaissance studies concern the functional responsibilities and interaction between organizational elements. They are apparently not consistent between Districts or even within a District. Experiences and opinions concerning the involvement of hydrologic engineering staffs in reconnaissance studies are discussed in this paper including forces at play today which require an even greater involvement of the hydrologic engineers earlier in the reconnaissance phase. Recent experience in seven reconnaissance studies in the Omaha District is discussed as well as the results of a survey of hydrologic engineers throughout the Corps.

Recent Experience in the Omaha District

Greeley, Colorado - Cache La Poudre River. This was a Section 205 study to determine the magnitude of the flood problem at Greeley and to determine if the design proposed by the city was economically feasible. The City of Greeley requested the Corps to initiate the study based on an alternative proposed by the city. Concurrently, the State of Colorado identified changes and hydrologic developments in the basin that occurred subsequent to a previous Corps hydrologic studies for a Flood Insurance Report, and requested the hydrology to be updated. Because of concerns expressed by the State, the Cache La Poudre River hydrology was scheduled to be updated as part of the Section 205 reconnaissance study for Greeley. The city's design was used as the basis for the Corps reconnaissance study. Initially, Planning allocated $8,000 (of the $50,000 total recon funds) to Engineering for the hydrologic study.

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Engineering responded with a requirement for $15,000. Planning subsequently allocated $10,000 for the study. The hydrologic engineering staff prepared a stand alone hydrologic analysis and submitted it to the engineering staff at the Missouri River Division for review. After incorporation of Missouri River Division's comments, the hydrology report was provided to the Planning Division and the State of Colorado. The final cost of the hydrologic studies was $14,481. Concurrently, the Planning Division completed the draft reconnaissance report utilizing the old hydrology and submitted it to the Division. The final reconnaissance report will incorporate the new hydrology.

Twin Bridges, Montana - Beaverhead River. This was a Section 205 study to extend and/or raise an existing spoil bank levee along the right bank of the Beaverhead River to protect the town of Twin Bridges. Because of a limit on study funds, no other alternatives were investigated. The hydrologic engineers were tasked to conduct an interior drainage analysis and open flow hydraulic calculations to define the existing flooding potential and to develop the alternative. Determination of the existing level of protection was also requested. The Planning Division had completed a draft Initial Appraisal Report and requested the Engineering Division to review it's scope and cost estimates for the Reconnaissance and Detail Project Studies. Engineering requested that $18,000 and $4,500 be allotted for engineering in the reconnaissance and detailed project studies, respectively. The total study costs requested by the District were $90,000 and $75,000 for the reconnaissance and detailed project studies, respectively. These requests were rejected by the Missouri River Division because they exceeded the limits established by the policy that the total study cost should be less than 20% of the estimated construction cost and that the reconnaissance study costs had to be less than 1/3 of the detailed project study costs. This resulted in, among other things, the shifting of mapping from the reconnaissance phase to the detail project phase.

Howells, Nebraska - Maple Creek. This was a Section 205 study to evaluate flood protection measures for City of Howells, Nebraska including channels, raising existing levees, and replacement of bridges. Hydrologic Engineering's involvement was to update the design hydrology, develop water surface profiles for various schemes of levee improvements and combinations of channel and levee improvements, and develop cost estimates for various alternatives. An Initial Appraisal Study was conducted by Planning Division with support from the Hydrologic Engineering staff. The initial cost estimates for engineering studies in the Reconnaissance and Feasibility phases were again reduced to meet the policies discussed in the paragraph above. Mapping was again taken out of the reconnaissance phase. Interaction between the team members was good. Scheduling delays were experienced mainly due to the fact that the project had differing priorities in each staff element. Thus, one staff was delayed while awaiting another staff's input.

Arvada, Colorado - Van Bibber Creek and Ralston-Leyden Creek. These general investigations consisted of reviewing reports prepared by a consulting engineer for the local Urban Drainage and Flood Control District. The plans proposed flood prevention measures to provide a combination of 10 and 100 year levels of protection along Van Bibber Creek and Ralston-Leyden Creek. The plans consist of channelization, drop structures, improved bridges and culverts, and riprap protection. Existing and proposed detention dams were also studied. Engineering Division was tasked to review the consultant's report and to provide cost estimates for work needed to be done in the feasibility phase. Review comments received from the Missouri River Division highlighted a need to require that the Engineering Division "chop" on all report submitted to higher authority.

Grand Island, Nebraska - Wood River. This was a general investigation of providing flood protection to Grand Island from Wood River overflows. Alternatives included diversions, channel improvements, levees and bridge replacements. Hydrologic Engineering's involvement was limited to the diversion alternative. All other work done by Planning Division utilizing hydrologic information from previous studies. No new hydrology was developed. The initial scope and plan of study was developed by the Planning Division in coordination with the local interests. The range of alternatives to be investigated was limited by how much money the local sponsor was willing to cost share on the project. Engineering Division's other involvement during the reconnaissance phase was input to the cost estimate for the feasibility phase. The local sponsor also influenced the number of alternatives and level of detail to be investigated in the feasibility study in order to hold down their costs. Engineering Division's limited involvement in the reconnaissance phase made the preparation of cost estimates for the feasibility phase more difficult due to lack of familiarity with the project.

Malta, Montana - Milk River. This was a Section 14 study to investigate providing emergency streambank protection for sewer and waterlines in the City of Malta. Hydrologic Engineering's involvement was a site visit and development of alternative solutions. Since this was a Section 14 project, it was handled differently than the other projects discussed in this paper. Basically the reconnaissance phase was expanded to be a Detailed Project Study. An Initial Summary Report was first prepared which provided a summary of the problem, site conditions, history of the location, and a most likely solution including a cost estimate. The scope of detailed project phase was to investigate several alternatives and recommended a selected plan. Planning Division managed the study and Engineering provided technical input. A total of $8,000 was available to do the Initial Summary and Detailed Project Studies. It was divided $5,500 for Planning and $2,500 for Engineering. With the limited funds allocated to engineering, reliability and level of detail were not major considerations in the scope.

Survey of experience throughout the Corps

Background. In February 1988 a survey was conducted among the 132 attendees of Hydraulics and Hydrology (H&H) Conference. A questionnaire was utilized to assess the current level of involvement of the Hydrologic Engineering staff in H&H studies during the various phases of project development. The questionnaire asked the respondents to indicate on a scale of 1 to 5 their current and desired levels of involvement in various scoping factors during the planning/design phases.

In general, those who returned the questionnaire feel they do not currently have enough involvement in the scoping factors of the studies on which they work. In 151 of 240 questions, the Hydrologic Engineers indicated that their level of involvement should be increased. There were no areas in which the survey showed the level of involvement of the Hydrologic Engineers should be reduced. Tables 1 to 3 show the composite results for questions pertinent to this paper for Continuing Authorities, General Investigation, and Dam Safety Assurance projects. On the tables, the number on the left indicates the current level of involvement and the number on the right indicates the desired level of involvement. The scale used was as follows:

1: No Involvement.

2: Some Involvement, if requested.

3: Always involved, approval outside of the H&H element.

4: Always involved and H&H element must concur in approval.

5: Prepared and approved within the H&H element.

Continuing Authorities. (Table 1) Hydrologic Engineers would like more involvement in determining level of detail and establishing schedules, especially for the reconnaissance and feasibility studies where they feel their concurrence should be mandatory. They feel that they should always be involved in the allocation and review of hydrologic work done by others. Their involvement in preparing cost estimates and selecting the recommended plan are satisfactory.

General Investigations. (Table 2) For the General Investigation Studies there is a desire for more involvement in almost all the categories. The Hydrologic Engineers feel they should always be involved in the scoping factors, not just upon request. They also feel their concurrence should be mandatory in developing the plan of study for the feasibility study, determining the level of detail for the initial appraisal and reconnaissance studies, reviewing the hydrologic engineering done by other in-house elements and contractors, allocating work to contractors, establishing schedules and cost estimates, and in selecting the recommended plan.

TABLE 1

CONTINUING AUTHORITIES

SCOPING FACTOR	PLANNING/DESIGN STAGE		
	Initial Appraisal	Recon Study	Feasibility Study
1. Developing the plan of study.	3/3	3/4	3/3
2. Determining the level of detail.	2/3	3/4	3/4
3. Allocating the work between the Engineering Div and other in-house elements.	2/3	2/3	2/3
4. Reviewing the work done by other in-house elements.	2/3	2/3	NA
5. Allocating the work between Corps and non-Corps elements (contracts).	2/3	3/3	2/3
6. Reviewing of the work done by non-Corps elements. (contracts).	3/4	4/4	NA
7. Allocating the work between Corps and non-Corps elements (Locals)	2/3	2/3	3/3
8. Reviewing of the work done by non-Corps elements. (Locals)	2/3	2/3	NA
9. Establishing LCA provisions to preserve the function of the plan.	NA	2/3	NA
10. Developing the schedule.	3/4	3/4	3/4
11. Preparing the cost estimate.	4/4	4/4	4/4
12. Selecting the recommended plan.	4/4	4/4	NA

TABLE 2

GENERAL INVESTIGATION

SCOPING FACTOR	PLANNING/DESIGN STAGE		
	Initial Appraisal	Recon Study	Feasibility Study
1. Developing the plan of study.	2/3	2/3	2/4
2. Determining the level of detail.	2/4	2/4	2/3
3. Allocating the work between the Engineering Div and other in-house elements.	2/3	2/3	NA
4. Reviewing the work done by other in-house elements.	2/4	2/4	2/4
5. Allocating the work between Corps and non-Corps elements (contracts).	2/4	2/4	2/4
6. Reviewing of the work done by non-Corps elements. (contracts).	3/4	3/4	NA
7. Allocating the work between Corps and non-Corps elements (L.C.A.'s)	2/3	3/3	3/3
8. Reviewing of the work done by non-Corps elements. (L.C.A.'s)	2/3	2/3	NA
9. Establishing LCA provisions to preserve thr function of the plan.	NA	2/3	NA
10. Developing the schedule.	2/3	2/4	2/4
11. Preparing the cost estimate.	3/4	3/4	2/4
12. Selecting the recommended plan.	3/4	3/4	NA

TABLE 3

DAM SAFETY ASSURANCE

SCOPING FACTOR	PLANNING/DESIGN STAGE Recon Study
1. Developing the plan of study.	2/3
2. Determining the level of detail.	2/3
3. Allocating the work between the Engineering Div and other in-house elements.	1/2
4. Reviewing the work done by other in-house elements.	2/2
5. Allocating the work between Corps and non-Corps elements (contracts).	1/2
6. Reviewing of the work done by non-Corps elements. (contracts).	2/2
7. Developing the schedule.	2/2
8. Preparing the cost estimate.	2/2
9. Selecting the recommended plan.	3/3

Dam Safety Assurance Studies. (Table 3) Hydrologic Engineers want to be more involved in the Dam Safety Assurance reconnaissance studies. They indicated that they are currently involved only by request or not involved at all in most scoping factors. They feel they should always be involved in the developing the plan of study, determining the level of detail, and in the selecting the recommended plan.

Forces at Play

Water Resources Development Act of 1986 (WRDA). The way the Corps plans, designs, and constructs Civil Works projects changed with the passage of Water Resources Development Act (WRDA) of 1986. "Partnership" is now a key word in the development of Civil Works projects. Local sponsors have now become paying partners and have brought to the Civil Works process expectations of reducing the time it takes to get projects underway, being treated more as equals, and having a say in the level of protection the standards used, and the selection of the plan. They want credit for work they have done or can do, since they feel it is generally easier to get things done than to raise money.

Initiative '88. Along with the WRDA, Initiative '88 is changing the way the Corps is doing business. Seamless funding of planning and design is now to be a reality. This along with concurrent Washington level review should greatly expedite the planning and design process. The requirements for better cost estimates and mandatory issue resolution conferences should improve the quality of the product and delivery of it on time and within budget. To facilitate this, project management concepts are now being implemented for the Civil Works program. The focus is changing from management of "fiscal" schedules to management of "physical" schedules. Milestones are to established to create a planning, design, and construction schedule that is to be intensively managed.

Engineering Practices. Engineering practices of the Corps are being challenged. Engineering elements must become involved earlier in the planning process. Design assumptions and requirements must be clearly presented and explained to the local sponsors at the start. The Corps must in some ways think like an Architect-Engineer explaining a proposal to a client. Engineering expertise and judgment must be applied early in the planning and design process, when information upon which to make decisions is limited, to improve reliability and credibility. This is especially true for cost estimates. The engineering staff must learn to make rough and timely estimates as well as detailed ones. For the Initial Appraisal phase, engineers should have at their finger tips historical data on completed projects compiled in such a way that it can be utilized to make rough cost estimates of the proposed flood prevention measures. The involvement of the local sponsors as partners in engineering decisions should lead to a better product. Old Corps' parochialisms will be subject to review and change. Key areas of discussion will be level of protection and selection of the design flood. The Corps must be ready to explain the consequences of events greater than the chosen level of protection and to be firm on life safety issues. The changing of design criteria should remain the prerogative of the engineering staff and should not be done just to make a project affordable.

Scoping of Reconnaissance Studies

Level of Involvement of Engineering Staff. Level of involvement should not be equated to level of detail. If the level of detail or the amount and quality of information collected are decreased, then more reliability must be put on engineering judgment. If all that is affordable is a rough and timely analysis, then to maintain a reasonable level of reliability and credibility, such studies should be made by those individuals with the greatest experience and judgment.

Time and Cost of Reconnaissance Studies. Guidance dictates that 12-18 months is all the time available for conducting a reconnaissance study and that the cost should not exceed 1/3 of the cost of the feasibility study or 5% of the estimated construction cost. Given these constraints, the only variables left are the scope, the division of responsibilities, and the allocation of the funds.

Maximum Cost Based on the Viable Estimated Construction Cost. To arrive at how much money could be allocated to the reconnaissance phase, the Corps and local sponsor should agree on what is the maximum viable estimated construction cost. This will require the expertise and judgment of many elements, i.e. Planning, Engineering, Legal, Real Estate, Financial, and Political. Viable means that the Corps can support it within it's budgetary and engineering guidance and that the local sponsor can afford and support it. The establishment of the maximum viable estimated construction cost should be a key task in the initial appraisal which would provide the basis to estimate the maximum funds that could be budgeted for the reconnaissance and feasibility phases.

Scoping to Achieve the Objectives. Now focus must be put on what is needed to accomplish the objectives of the reconnaissance study which are:

1) The definition of problems and opportunities; and identification of potential solutions;

2) A determination of whether or not there is a Federal interest in proceeding to the feasibility phase, based on a preliminary appraisal of costs, benefits, and environmental impacts of potential alternative solutions;

3) The selection and recommendation of the most likely alternative for detailed engineering and design;

4) An estimate of costs and schedule to carry out the feasibility phase; and

5) An assessment of the level of support and willingness of the local sponsor to share the cost of the feasibility phase.

Uniform Level of Detail and Involvement. The level of detail to accomplish the above should be consistent throughout the Corps and between disciplines, e.g. detailed economics should not be based on rough hydraulics. All team members should have an equal level of involvement in the scoping process, the division of responsibilities, and the allocation of the study resources (dollars). Each study is unique in it's geographical location, available data, complexity, and number of possible alternatives. The team should develop a scope of work and cost estimate to complete a reconnaissance study within the time available which will accomplish the objectives above. The costs should be equal to or less than the maximum cost targets established based on the viable estimated construction cost. Fixed formulas for allocation of the study resources (dollars) should not be used.

Summary and Conclusions

Involvement of the Engineering Staff.

1) Past History Experiences of the past show a reluctance by some study managers to ask the help of the engineering staff unless absolutely necessary. Initial appraisals were generally conducted by the planning staff with engineering sometimes asked to provide cost estimates for tasks to be performed during the reconnaissance and feasibility phases. The study managers felt, usually with good reason, that the engineering staff was too expensive and wanted to do more detailed studies than were required. However, when the District's engineering staff wasn't properly involved in the reconnaissance phase studies it usually lead to problems when the report was reviewed by the engineering staff at the Division Office.

The Hydrologic Engineers wanted to develop reliable Hydrology in the reconnaissance phase which would not have to be changed later. Likewise, the Hydraulic Engineers wanted good mapping and cross sections to use to develop flood profiles and flood inundation maps that would not have to be substantially revised later subjecting them to criticism. A basic problem was highlighted, the failure of the engineering specialist to understand the purposes of each iterative phase in the planning and design process. Another concern that surfaced was the breaking of functional lines by study managers who made engineering decisions themselves and failed to utilize the judgment and experience of the engineering specialists.

2) Today and Tomorrow Today's environment consists of "partnerships", limited resources, and high level program oversight. Teamwork is not just desirable, it is mandatory. The reliability of reconnaissance studies must depend on more professional judgment and less data and analysis. All the team members must understand the study objectives and level of detail required to achieve them. Functional responsibilities must be understood and strictly observed. Each team member must be involved in the scoping of the studies. Equivalent levels of detail, commensurate with the study objectives, must be maintained. The team must be aware of the "physical milestones" to be met in the planning and design process. The phrase "quality product, on time, and within budget" must be understood and committed to by all the participants including the reviewers at the Division Office.

Scoping of Reconnaissance Studies

1) From the Local Sponsor's Perspective The local sponsors usually have an idea of what they think would be the solution to their flood problem and they desire the maximum Federal contribution and the minimum local costs to implement that solution. They would like the reconnaissance studies to focus on their alternative and to do what is necessary to establish a Federal interest in proceeding to the feasibility phase. It is to their advantage to have detailed studies conducted during the reconnaissance phase since they would not be cost shared. They would like to see funds spent on more detailed investigations of their alternative in lieu of spending them looking at a greater number of alternatives. Their focus is getting something in place quickly at a minimum and affordable cost to them.

2) From the Corps Perspective The Corps should scope the reconnaissance studies to achieve two primary objectives: 1) to determine if there is a Federal interest in proceeding and, if so, 2) to define the scope of studies required in the feasibility phase including a detailed cost estimate and schedule to accomplish them. Federal interest is based on a preliminary appraisal of costs, benefits, and environmental impacts of potential alternative solutions. There must be at least one potential solution which appears to meet Corps criteria of safety, function, performance, engineering soundness, and economy.

The reconnaissance studies should scoped so as to be accomplished at a cost not to exceed five percent of the estimated construction cost and within a 12 to 18 month time frame.

Management of Reconnaissance Studies

1) Interdisciplinary Study Team Recent guidance recommends that reconnaissance studies conducted by the Corps should be managed utilizing an interdisciplinary team approach. The team should be composed of specialist under the leadership of a project manager. The team should also include representatives from the local sponsor. The study team should contain at least one representative from each of the major functional elements. Since the reconnaissance phase is 100% Federally funded and the local sponsor receives no credit or reimbursement for its involvement during this phase, the management should be mostly performed by Corps personnel. During the reconnaissance phase, as a voluntary effort, the local sponsor should help assemble the study team, scope of work, and cost-sharing agreement for the feasibility phase.

2) Executive Committee Recent guidance also recommends that an Executive Committee should be informally established during the reconnaissance phase. This committee should be typically composed of the District Engineer, the District Chief of Planning and people of commensurate decision-making authority from the local sponsor. The guidance also recommends that a technical advisor from local sponsor be included. It is also very important that a technical advisor from the Corps also be included. Usually this should be the Engineering Division's Chief of the Hydrologic Engineering Branch.

3) Project Manager In general, the team should establish the study objectives, divide responsibilities, and allocate the study resources (dollars). All team members should participate in the decision-making process. The project manager should lead the team to produce a quality reconnaissance report, on time, and within budget. The project manager should be the team's spokesperson and manager of the team's expenditures and obligations. The project manager should be responsible for preparation of budgets, schedules, and coordination of work. One of the most important responsibilities of the project manager should be to insure that the team members are involved in and subsequently "buy into" the study objectives and scope. Each member must understand their role as it relates to accomplishment of the reconnaissance studies.

4) Division of Responsibilities Division of responsibilities should be along functional lines, e.g. Hydrology should be done in Engineering and Economics in Planning. Under today's "FTE" constraints, the Corps cannot afford duplication of functions among organizational elements. For example, Hydraulic studies are the functional responsibility of the Engineering Division. Therefore, the Planning Division should not have any staff allocated to doing hydraulic studies. All hydraulic calculations should be tasked to the Hydraulic Section within the Engineering Division. The Corps must consolidate it's technical specialists not only because of the limited FTEs available, but to foster professional interaction between the experienced and recently educated. The Corps has a mission to do and must develop and maintain the technical staff to accomplish it.

5) Allocation of Resources Each team member should prepare proposals of scope and cost for work to be accomplished in their functional areas. The team should review all the proposals in terms of what is required to meet the study objectives and for consistency in the level of detail. A consensus on the scope of work for each functional element should be reached. The scope of work for each functional (organizational) element should be specific as to level of detail, expected product, and schedule for completion. The scopes should be reviewed by the various chains of command in the District and by the stovepipe reviewers at the Division Office. Any significant disagreements involving level of detail, budgets, or schedules, should be resolved through negotiations. The end products must produce balanced study conclusions and be accomplished within the overall study's budget and schedule.

ABSTRACT

HYDROLOGIC ENGINEERING FOR RECONNAISSANCE STUDIES

Much the same considerations and thought processes are involved when establishing an appropriate scope and level of detail for reconnaissance study hydrologic engineering analysis as is required when designing a hydrologic analysis for any type of study. Designing the hydrologic/hydraulic analysis should proceed in a systematic manner from identification of study goals to examining the physical setting and basic data to estimating the resources required. Close coordination is required between all interested parties throughout this process. Doing a good study design is not easy and may consume substantial resources for complex studies. However, a good study plan that is well coordinated will more than pay for itseelf by reducing the amount of lost effort later on in the study.

A hydrologic/hydraulic analysis should be designed to proceed from a low level of detail covering a large area and/or a large number of alternatives to greater refinement for selected alternatives. The analysis should be planned so that the refinement can be accomplished, insofar as possible, using the same basic approaches and procedures throughout. Such a process will maintain maximum continuity with a minimum of lost effort for a minimum cost. Generally speaking, it seems logical to keep all the technical analysis (hydrological and economic for example) at about the same level of detail and confidence. Refining only one part of a study cannot improve the overall study very much. "A chain is only as strong as its weakest link".

To design an analysis it is first necesary to have a clear understanding of the study objectives. When conducting feasibility studies, the Corps has in the past focused almost entirely on the single objective of identifying and selecting the national economic development (NED) plan. In our single minded pursuit of economic efficiency we, the Corps, have generally ignored other relevant and important considerations such as safety, function, and performance. A blind adherence to the NED philosophy is not good rational planning. The fact is that NED is an academic theoretical concept that will never be even approximated in the real world, except by a rare accident. A balanced approach to planning is needed which is based on a clear comprehensive view as to what a feasibility study entails. Risk assessment needs to be incorporated in the plan formulation process to consider safety/functional issues and inform local interest.

Technical people cannot be divorced from the planning process. As a minimum the first line supervisor of the people who will be doing the real work must be involved in the negotiations that establish the level of detail for procedures, analysis, and the study. It is not possible for technical people and technical considerations to be removed from and not interact in the plan formulation process. In the process of conducting a technical analysis many decisions must be made that are normally considered technical but in fact are driven by and are actually formulation decisions. For example, when a

hydrologic engineer picks an "n" value this is formulation because it implies a decision that the floodplain will be preserved or developed in a particular way. When a unit hydrograph coefficient is chosen, this implies a particular development of the watershed. These interrelationships between technical and formulation decisions need to be thoroughly explained in feasibility reports to provide an understanding of how the project is supposed to function and what it will and will not accomplish.

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FLOOD DAMAGE ANALYSIS - GRANDVIEW HEIGHTS CASE STUDY

By Jim Twohig[1/]; Willard Hunter[2/]; and Vic Reck[3/]

August 1988

INTRODUCTION

Study Area. Situated in west central Ohio, the City of Grandview Heights is located in Franklin County, Ohio, on the Scioto and Olentangy Rivers. It is surrounded by the larger City of Columbus except on its west side where the small village of Marble Cliff is located. A map of the study area and the entire Scioto River Basin is included as Plate 1. A more detailed local area map is included as Plate 2.

Grandview Heights had a 1980 population of 7,420 over 1.3 square miles. The city has experienced little population growth since 1940. Population density is about twice the density of the City of Columbus (3,000 persons), and 22 times that of the State of Ohio.

Residential dwellings, and various types of manufacturing, warehouse operations, and utility facilities make up most of the floodplain development within the City of Grandview Heights. About 549 structures would receive damages during a 100-year frequency flood. Approximately 75 percent of the structures are residential. Because of a good business atmosphere in the city few commercial structures in the floodplain are vacant, and those that become vacant are reoccupied by other operations in a short period of time. Little land is available within the city for future growth and expansion.

Background.

(1) The Flooding Problem. Floods in the area are not limited to any specific time of the year, although winter and spring floods are more frequent than summer floods. Summer-type floods produce isolated tributary flooding without affecting adjacent areas. Floods on the Scioto River are of moderate duration, seldom remaining above flood stage more than four days. Flooding along the Olentangy River is not a significant problem because upstream protection is afforded by the Corps Delaware Lake project.

The flood of March 1913 was the greatest flood of record on the Scioto River. Precipitation over that portion of the Scioto River Basin north of

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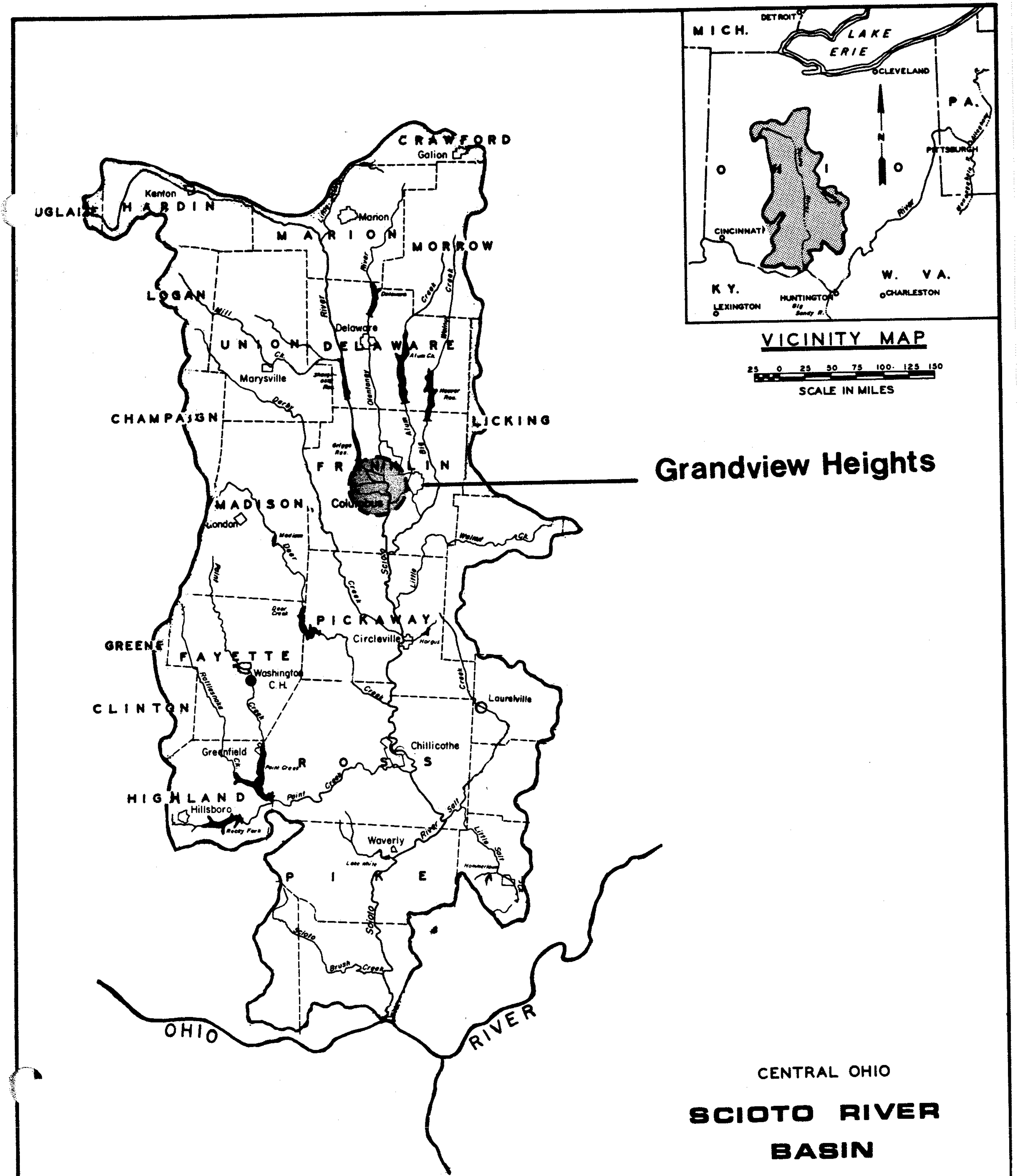
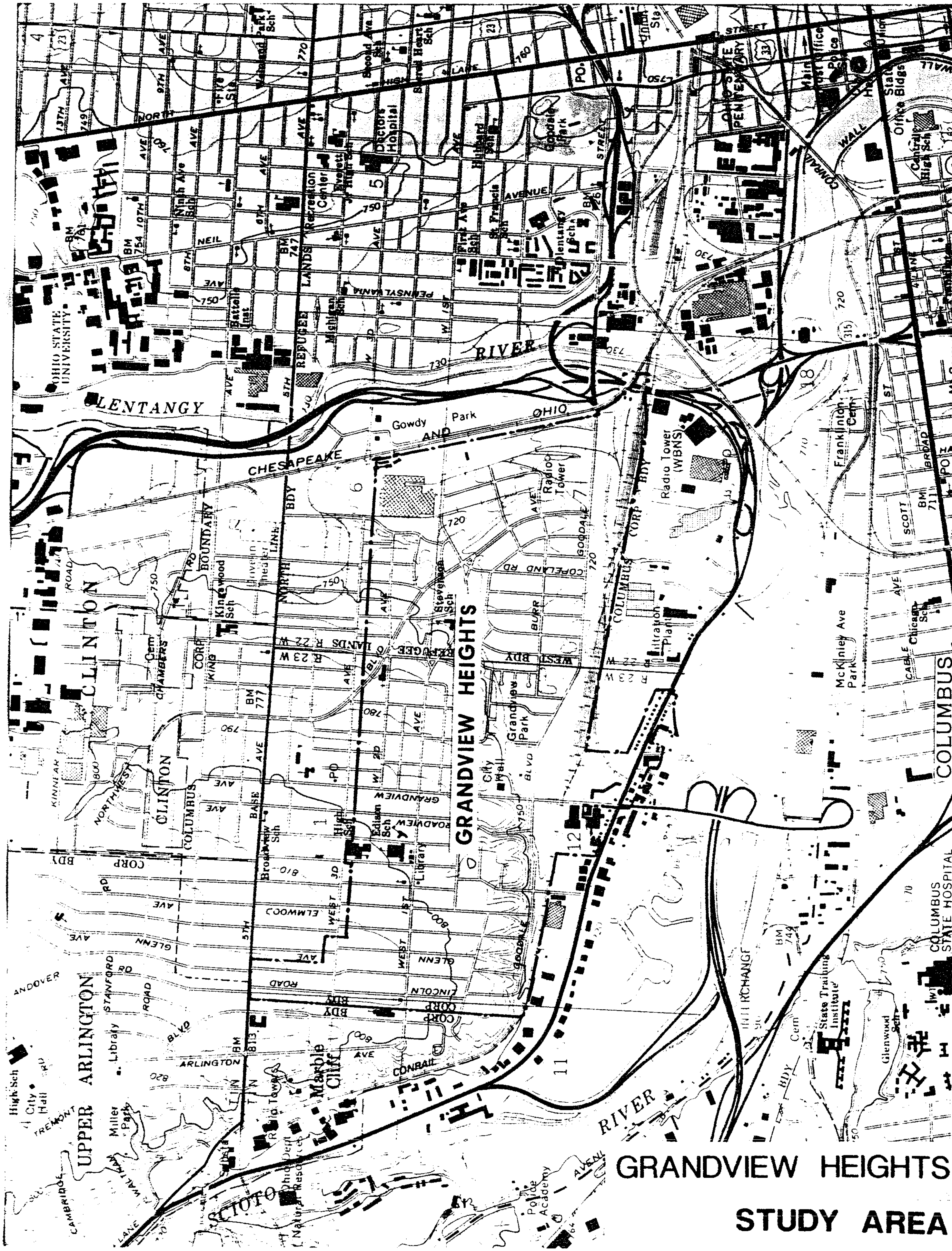


CENTRAL OHIO

SCIOTO RIVER BASIN

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT CORPS OF ENGINEERS
HUNTINGTON W. VA.

PLATE 1



GRANDVIEW HEIGHTS

STUDY AREA

PLATE 2

Grandview Heights averaged more than 9 inches. Major damages resulted not only in Grandview Heights, but also throughout the entire Scioto River Basin.

A major flood also occurred in January 1937. However, the second most severe flood of record at Grandview Heights occurred in January 1959. The river remained above damage stage for seven days. The impact of the storm on the area would have been much more devestating had it not been for the Delaware Lake project.

(2) The Study. Since major flooding has not occurred in the area since 1959, local residents were not aware of the severity of the potential problem until completion of the Flood Insurance Study for the City in 1980. Soon afterward floodplain restrictions heighted the local concern for the flood problem. In May 1983 the City of Grandview Heights, Ohio requested the Corps to initiate studies to determine the feasibility of providing additional flood protection to the City. The Reconnaissance Study was initiated in May 1986 and completed in September 1987.

The study was conducted under authority previously provided by a Resolution of the Committee on Public Works of the House of Representatives, adopted 14 July 1970, for the Central Ohio Water Development Region.

The study results indicated that Grandview Heights has a serious flood problem along the Scioto River. Although there have been no significant floods in the recent past, the potential exists for devastating floods with catastrophic damage and possible loss of lives. The study showed that a floodwall/levee project could be developed that would provide 100-year frequency protection and be economically and environmentally sound. The city was provided the recon report for their review in April 1988.

The city was made aware in June 1988 that the Corps has reached the point in the study where the execution of a Feasibility Cost Sharing Agreement (FSCA) was required to proceed with feasibility level studies. The city requested an extension of time to further discuss their position on cost sharing the feasibility study. The extension was granted. Discussions with the city are continuing at this time.

(3) Purpose and Intent of Paper. The purpose and intent of this paper is to highlight the study process and findings with particular emphasis on the flood damage analysis utilized during the study.

PROBLEM IDENTIFICATION

Available Data. The following information was available for use in the recon study.

(1) Mapping - 1"=200', 5' contour intervals

(2) Aerial Photographs (1976)

(3) Base Hydrology and Hydraulics Data - Franklin County Flood Insurance Study completed in 1980.

(4) Geological Explorations - No geologic borings have been performed at the study site. However, a number of borings were made in 1983 at the West Columbus LPP site located south of Grandview Heights directly across the Scioto River. The presence of some pervious sandy gravels (GW) indicated a possible need for underseepage control and slope stability requirements.

Base Hydrology and Hydraulics Studies. Water surface profiles were developed using data obtained from the Franklin County Flood Insurance Study. Profiles were computed for the 1-, 2-, 5-, 10-, 20-, 50-, 100-, 200-, 500-year frequency floods and the Standard Project Flood on the Scioto River. All profiles were developed using the HEC-2 program. The starting water surface elevation for each profile was taken from an existing rating curve for the Columbus U.S.G.S. gage, Columbus, Ohio. A slope-area normal depth computation was used on the Olentangy River with backwater from the Scioto River superimposed. A weighted roughness coefficient was computed for a typical cross-section within reaches of similar channel characteristics for the main channel as determined by field inspection and aerial photographs. The "n" values used for the channel area ranged from .030 to .045 and the "n" values used for the overbank areas ranged from .05 to .08.

The coefficients of contraction and expansion used were 0.10 and 0.30 respectively in the natural channel and .30-.50 respectively at bridge locations within the study reach.

The water surface profiles from the Columbus gage to the Dublin gage were established using 174 cross sections. Cross section data for the study reach were obtained photogrammetrically from aerial photographs taken in April 1976. The cross sections were located at close intervals immediately upstream and downstream of bridge and dams in order to compute the effects of these structures. It was assumed in the analysis that the bridge openings would remain unobstructed from debris. Within the Grandview Heights study limits, there are seven major structures across the Scioto, and twelve across the Olentangy. All bridge and dam data were obtained by field survey between May-November 1976 and October 1986.

Flood Damage Analysis. To determine the magnitude of potential damage from flooding, a survey was made of all structures that would be affected by flooding up to the 500-year frequency. The survey was conducted by District personnel in 1986. Damages were classified by residential, commercial, industrial, and a number of other categories. Potential damages at various levels were determined in the field and related to first-floor levels for each structure. These data were related to frequency profiles to determine flood damages for various frequencies and average annual damages.

There are approximately 549 structures which would receive damage during a 100-year frequency flood. Total damages at this level for structures, transportation facilities, and emergency costs are estimated to be $72,763,000. Table 1 shows damages and structures affected by the 100-year frequency and the average annual damages by category.

The following paragraphs discuss the methodology used to determine the flood damages for each of the categories shown in Table 1 having significant damages.

TABLE 1

100-Year Damages, Structures Affected and Average Annual Flood Damages at Grandview Heights (October 1986 Dollars)

Category	100-Year Damages	Structures Affected	Average Annual Damages (Rounded $1,000's)
Residential	$ 2,430,000	425	$ 121,000
Commercial	42,166,000	106	1,661,000
Industrial	338,000	2	17,000
Business Losses	11,608,000	-	277,000
Municipal Damages			132,000
Structures	2,625,000	16	110,000
Transportation		NA	11,000
Storm & Sanitary Sewers & Water Distribution		NA	7,000
Traffic Lights		NA	1,000
Rubbish Containers		NA	2,000
Swimming Pool Electrical System		NA	1,000
Emergency Costs	1,479,000	-	50,000
Sub Total	$60,636,000	549	$2,258,000
Contingency	12,127,000		452,000
TOTAL	$72,763,000	549	$2,710,000

(1) Residential. First floor elevations for all residential structures located in the study area floodplain within the limits of the 500-year frequency event were established using field survey methods to extend from known elevations. The location of each structure was recorded by assignment of river miles to nearest tenth using available mapping with stream miles denoted. Each structure was recorded in accordance with structure classes (i.e., Class II, single story with basement) which correspond to representative depth-damage curves. Based on the data collected for each structure and a knowledge of area real estate prices, structure values were estimated.

A computer program was used to correlate the flood damage survey data and flood frequency profile data to determine flood damages for various frequency levels for each residence and average annual damages for residential categories. The program made use of representative depth-damage curves for various structure types previously developed by Huntington District staff using door to door surveys and inspection of damage areas.

For projecting future flood damages it was assumed that the ratio of structure damage to content damage would be the same as the ratio of structural value to content value at any given point in time. Therefore, the structural damage and content damage/content value relationship was estimated to remain constant through time.

Table 2 summarizes the data that were collected for each residential structure and the method of determination.

The flood damage computation program used to estimate residential damages interpolates between cross-sections lying upstream and downstream of a building, and applies the resulting ratio to the flood elevation between the two cross-sections. An example of this process is shown in Table 3.

TABLE 2

Residential Data

Data Item	Method of Determination	Remarks
First Floor Elevation	Actual field survey	Accurate to 0.1 ft.
Type	Visual inspection (Exterior only)	Housing Type 1 = Single story 2 = Single story with basement 3 = Multi-story 4 = Multi-story with basement 5 = Split level 6 = Mobile home
Value	Visual inspection (Exterior only)	Structure values determined based on knowledge of real estate prices obtained from local sources.
Location	Measurement using available mapping	Referenced to nearest stream station.
Basement Option	Inspection	Used to eliminate basement damages for structures beyond limits of low level flooding.

TABLE 3

Method for Calculating Flood Heights

XSECT	Flood Height	Reach Distance
2	710.00	2,000
3	715.00	2,500

The structure has a reach location of Station 23+00.
Stream cross-sections are available for Stations 20+00 and 25+00.

Step 1: Calculates the reach distance interval for the two cross-sections.
2500 - 2000 = 500

Step 2: Calculate the distance from the structure to Station 20+00 (the nearest downstream section).
2300 - 2000 = 300

Step 3: Determine the interpolation ratio.
300/500 = .6

Step 4: Calculate the difference in flood heights between the two cross-sections.
715.00 - 710.00 = 5.00 ft.

Step 5: Uses the ratio to find the increase in flood height from Station 20+00 to the structure.
.6 x 5.00 ft. = 3.00 ft.

Step 6: Add the increase to the flood height at Station 20+00.
710.00 + 3.00 = 713.00 ft.

The flood height at the structure is 713.00 feet.

The residential program computes both structure damage and content damage. Damage to contents is a function of estimated content value and depth of flooding. Each of the six housing types previously displayed (Table 2) has unique characteristics which produce a different degree of damage to two structures of different types event though the depth of flooding may be the same. For example, a single story house without a basement has 100 percent of its structural value above the first floor, while a single story house with a basement has a portion of its value below first floor. Therefore, a flood 0.5 foot above first floor produces a smaller degree of damage for a house with no basement than for a house with a basement.

Damage as a percent of value for each house type at various depths have been determined for the Huntington District in a field survey conducted in 1975-1976 and compiled as a depth/percent-damage table and updated periodically. This data is subdivided by house type and by value range of the house. Thus when the house type, value and depth of flooding are known, damage to the structure can be obtained.

Determining the damage to contents is accomplished with the aid of field surveys. A sample survey of houses in the study area was made to determine the value of contents of several houses of each type. This figure is then used to determine the value of contents as a percentage of structure value. The contents percentage can be applied to any house of that type in the study area to determine the total contents values for a particular house. The contents value is multiplied by a percent-damaged figure obtained from the depth/percent damage value for contents at a given flood height. As determined in the field survey, content values were estimated at 50 percent of structural value. All computations were performed by the computer program.

The total damage to each structure caused by a flood of a given magnitude can be determined by adding the structure damages and content damages. The total damages for each flood are calculated by simply adding the damages by that flood to each structure.

(2) Commercial and Industrial. There were approximately 150 nonresidential properties located in the floodplain study area. The greatest amount of commercial and industrial structures in the study area (about 60 percent) consisted of warehouse facilities which serve as distribution, storage, and transit facilities. In addition there are several large manufacturing firms. The remainder of the establishments consists of various types of small businesses and offices. The age of the buildings ranged from newly constructed structures to some 50 or more years old. Nearly all of the buildings appear to be maintained in good condition.

Interviews ranging from five to ten minutes in length were conducted with the owners or managers of each of the major establishments. The primary goal of the interviews was to determine the approximate current value of the contents (inventory and equipment); to identify potential flood damages to the contents at various levels of flooding (1', 3' and 5', and 7'); to evaluate the business losses at various levels of flooding; and to establish the number of employees and number of workers that would be affected at various levels of flooding. The owners or managers contacted were asked to estimate the above values, based on their experience with the companies operations.

Approximately 85 percent of the commercial and industrial properties were interviewed. In estimating content values of offices and small businesses, several of these establishments were visited, noting the approximate size and the type of contents within. Content values of other similar offices or businesses were then prorated on this basis. Land values were not considered in the analysis.

(a) Structure Values. Structure values were estimated utilizing the Marshall-Swift Commercial Estimator Program. This program calculates the replacement value of each structure (less depreciation). Field data were compiled on a field work sheet and entered into the program. The major data items required for the program included the occupancy number, class of structure, zip code, cost rank, total floor area, perimeter or shape of building, number of stories and height, effective age, and heating and cooling methods, and whether the structure has elevators or sprinklers. The following paragraphs discuss the major value determining factors included in the program.

*Occupancy Number - Indicates the type of building (office, warehouse, etc.). Since structures vary in cost depending on how they are designed or used, the occupancy number influenced the replacement cost of the building. For instance, if a building is made up of a warehouse (70%) and offices (30%), the occupancy can be split as such by entering the appropriate codes.

*Class - Designates the construction of the building. Most of the structures in the floodplain utilize reinforced concrete bearing walls, wood or steel frame walls, or metal frame walls.

*Zip Code - Determines the region and climate, and the local multiplier to be used for generating the cost report.

*Cost Rank (Quality) - The type of buildings constructed to meet the building code requirements for a specific class. For example, low ranked structures tend to be very plain buildings which conform to minimum building requirements.

*Total Floor Area - The square feet on all floors.

*Perimeter - The linear feet of the structure at grade level; and shape is the configuration of the structure (square or L-shaped).

*Number of Stories - The count of floors above the first floor. Height is the number of feet of each story.

*Effective Age of a property is its actual age as compared with other properties performing like functions. It is the actual age, minus the age which has been subtracted for face lifting, removing functional inadequacies, etc. For example, a warehouse with an actual age of 30 years has a building life of 55 years. Due to face lifting or structural modifications the building now has a remaining life of 40 years. Therefore the effective age of the structure is 15 years (55 years minus 40 years). Once the effective age of the building is entered the program automatically calculates the amount of physical and functional depreciation. The calculation is also based on the occupancy, class, and cost rank.

(b) Structural Damage. The large number of warehouses support a diversified industry that includes kitchen and furniture products, electrical components, bank security systems, printing companies, a large grocery chain, beverage distributors, several large utility companies, and others. The buildings appear to be of similar type construction. Most of the buildings are large 1-story structures about 15 to 20 feet high, constructed of brick or concrete block with concrete floors. There are only a few structures that have basements. Each of the structures have dock facilities for loading or unloading goods and most of the buildings have offices. The extent and condition of the office space was dependent upon the operations of the company.

Damages to many structures were estimated based upon experience, judgement, knowledge obtained from field survey, and value data. Estimates of damage to others were derived from generalized depth-damage relationships for different types of structures supplied by Mobile District personnel.

(c) Content Damage. All content damage estimates were based on personal interviews with occupants of business and industrial properties. In some instances company officials could not estimate the value of or damage to equipment. In several instances correlation of damages to depth of flooding could be obtained from interviews. For these cases, value-depth-damage relationships were estimated based upon information obtained from other flood control studies.

Business losses were developed by estimating the inventory/sales ratio for major establishments that would seriously be affected by flooding. Inventory estimates were based upon the survey interviews. In these interviews, owners, or managers of establishments provided values of damageable contents that would be directly affected by severe flooding. In most interviews the owner/manager divided the value of contents into inventory (or salesable product), or equipment.

Because business loss is a function of the amount of downtime that a business may experience, depth of flooding was correlated with downtime. Estimated business interruption, in days, based on water depth, is as follows:

1 foot .... 2 days
2 feet .... 5 days
6 feet .... 15 days

A curve was applied to all business establishments determined to potentially experience business lossess if flooding should occur.

According to Survey of Current Business terminology, the inventory/sales ratios for a given year were derived by dividing the weighted average of seasonally adjusted inventories by the monthly average of unadjusted sales for that year. The inventory/sales ratios were based on the annual ratios for 1986, as published in the Survey of Current Business, May 1987. The following business inventory/sales ratios were considered in this analysis.

Manufacturing, total	1.69
Durable goods industries	2.10
Nondurable goods industries	1.23
Retail trade	1.53
Durable goods stores	2.01
Nondurable goods stores	1.22
Merchant wholesalers, total	1.27
Durable goods establishments	1.73
Nondurable goods establishments	.85

Application of these ratios resulted in estimated sales. By applying the estimated downtime to average daily sales, the amount of business loss per frequency flood was calculated.

Lost wages were estimated on the basis of average weekly payroll earnings by industry in Franklin County for 1985. The wage loss per employee affected times the duration of flooding yielded total wage losses.

Cleanup costs were estimated on a square foot basis, the type of structure, and the depth of flooding. These costs were estimated to range from $.10 to $1.00 per square foot, with lower costs assigned to warehouses and industrial facilities, and higher costs applied to predominately smaller buildings, as offices and business establishments.

(3) Municipal Damages. Municipal facilities include damage to the storm sewer system, sanitary sewer system, water distribution system, transportation facilities and other miscellaneous municipal facilities. It was determined that the bulk of the flood damages to the storm, water and sewer facilities would result from general cleanup of the systems, such as cleaning and hosing out inlets, and removing rocks and sediment. This mostly involves labor costs, together with minor equipment costs, utilizing trucks and backhoes. Based on this, the cost estimate is geared toward supplying those labor and small equipment costs.

The portion of the storm sewer system within the 100-year floodplain consisted of about one-half of the developed sewer system in the city. There were about 202 inlets and manholes and about 30,000 feet of piping and culvert. Costs were estimated based upon information obtained from local officials and District staff.

About one-third of the total sanitary system was located within the 100-year floodplain including about 130 manholes and 30,000 feet of pipe. Cleanup costs, which appear to be the only claimable damages, were estimated as a percentage of the storm sewer costs, for the various flood levels. Damages were estimated to be 60 percent of the estimated storm sewer costs.

Within the 100-year floodplain, the water distribution system consisted of about 60 hydrants, 65 valves, and 21,000 LF of pipe. It was determined that the sealed lime and soda system employed at the treatment plant would sustain minimal damage in the event of flooding and the water system would continue to operate, providing water to city residents, or businesses.

Therefore the major costs would involve labor costs and cleanup costs, to clean or blow lines that may be contaminated. An estimate of 60 percent of the storm sewer damages was used (see Table 4).

TABLE 4

Storm and Sanitary Sewers, and Water Distribution Damages (by Frequency)

Frequency	Storm Sewer System	Sanitary Sewer System	Water Distribution System	Total
20-Year	$40,000	$24,000	$24,000	$ 88,000
50-Year	50,000	30,000	30,000	110,000
100-Year	125,000	75,000	75,000	275,000
500-Year	150,000	90,000	90,000	330,000

Transportation damages include damages to streets and railroads. Data on the length of streets and railroad tracks inundated at various levels of flooding was determined by directly measuring the length of linear feet on a map of Grandview Heights that showed the inundation outline for various frequency floods. This data was used in computing per mile damage estimates. The per mile damage estimates previously developed in prior district studies were updated to reflect current price levels. The updated values for street damages were $5,000 per mile for depths of up to one foot. This includes only cleanup. For depths of one to three feet the value was $10,000 per mile. This includes cleanup, minor curb replacement and gutter replacement. The value for depths greater than three feet was $60,000 per mile, which includes cleanup, tearing up street, curb and gutter replacement, and repaving. The updated value for railroad inundation was $50,000 per mile.

(4) Emergency Costs. This category covers expenses for protection of life, health, and property; evacuation, transition and reoccupation; emergency and mass care; emergency preparedness; and administrative costs. Costs are dependent upon warning time, duration and the number of properties affected. In Grandview Heights the warning time was determined to be sufficient only to move important household contents to higher levels, off the floor, or to second floor levels. Flooding along the Scioto River is characterized by relatively rapid rise and fall of water, therefore the duration is expected to last only a few days. From other studies, related emergency costs were estimated at two to three percent of the total physical damages incurred. Emergency costs in the study were estimated to be about 2.5 percent of the total physical damages.

ALTERNATIVE SOLUTIONS.

Potential solutions were identified and screened for effectiveness. Those solutions which appeared to be effective were combined to form alternative plans of development. Measures which had been identified are described briefly in the following paragraphs.

Floodplain Regulation and Flood Insurance. Because extensive modern development already exists on the floodplain, zoning was not considered a reasonable alternative for near-term flood damage reduction for Grandview Heights when used alone. The City is now participating in the National Flood Insurance Program, and more stringent floodplain regulations would be neither acceptible or effective.

Temporary Floodplain Evacuation. Although an improved flood warning and emergency evacuation system would reduce flood damages to some extent, residual damage potential would remain high. The extent of commercial/industrial development is not conducive to mass evacuation of building contents.

Permanent Floodplain Evacuation and Floodproofing. Relocation of residential and commercial/industrial developments to floodsafe sites was not considered to be locally acceptable or cost-effective. Analysis of flood-proofing and raising structure concluded that such measures would not be economically feasible.

Channel Modification. Channel enlargement and channel straightening along both the Scioto and Olentangy Rivers were found to be economically infeasible because of the locations of several bridges and development adjacent to the river. The existing slope of the Scioto River is 1.7 feet per mile, and it is not practicable to increase it beyond the existing grade. The amount of deepening required to obtain the desired flood height reductions would have to extend along an unreasonably long reach of channel. Widening sufficiently to contain floodflows is not practicable because of bridges and development adjacent to the stream.

Floodwalls and Levees. Preliminary reviews concluded that floodwalls and levees exhibited potential cost effectiveness for the study area. Therefore, additional evaluation was considered advisable.

Reservoirs. As noted previously, Grandview Heights presently receives flood protection from the Corps' Delaware Lake project, located on the Olentangy River. In 1962, an additional reservoir project was authorized on Mill Creek, a tributary of the Scioto River above Grandview Heights. However, the State of Ohio withdrew support for the project, which led to its deauthorization in 1981.

Two water supply lakes located on the Scioto River upstream of Grandview Heights are operated by the City of Columbus. Extensive development along the shores of these lakes would restrict the addition of any flood control capability.

In addition, Ohio's citizens have become increasingly concerned over the loss of free-flowing streams, scenic and recreational rivers, and changes in the environment would result from the construction of large reservoirs.

Based on these land-use and environmental factors, the construction of large reservoirs in this region primarily for urban flood protection has not been publicly acceptable, so this alternative was eliminated from further study.

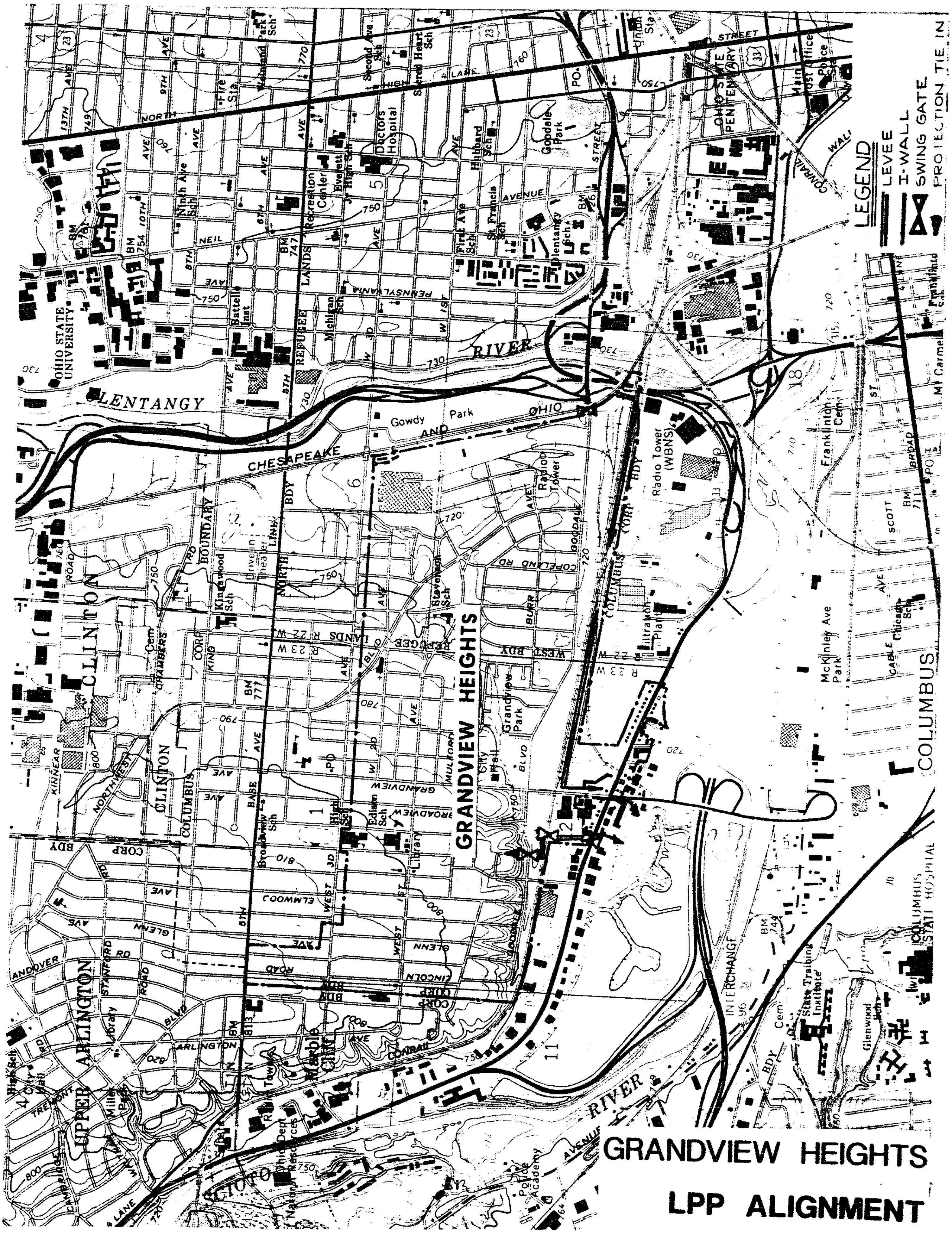
THE SELECTED PLAN.

The alternative selected during the recon study consists of a floodwall/levee project that incorporates a portion of an existing railroad embankment along the Scioto River. Table 5 provides a summary of the selected plan and Plate 3 depicts the project alignment.

TABLE 5

Grandview Heights Project Summary
(October 1986 Prices in $1,000)

Project Features	6,500' levee (Avg. Height - 6') 1,500' I-wall (Avg. Height - 4') 4 Gate Closures 1 Pump Station
Level of Protection	SPF
Initial Investment Cost	$13,500.0
Federal Cost	$10,125.0
Non-Federal Cost	
LERR	$ 1,000.0
Cash	$ 2,375.0
Total	$ 3,375.0
Average Annual Cost	$ 1,344.0
Average Annual Benefits	$ 2,710.0
Net Benefits	$ 1,366.0
B/C Ratio	2:0



GRANDVIEW HEIGHTS

LPP ALIGNMENT

PLATE 3

FEASIBILITY STUDY REQUIREMENTS.

The total cost of the feasibility studies is currently estimated to be $410,000. The study would require approximately 23 months from receipt of funding, for completion.

Engineering Studies. These studies provide the basis for estimating damage reduction, project costs and effects and identifying construction details. The following will be undertaken:

(1) Surveying and Mapping. Surveying and mapping of study area including transportation and utilities systems developed in sufficient detail to design and layout project, to obtain additional stream cross-sections for hydraulic studies (photogrammetric techniques supplemented by field surveys) for hydraulic studies and to conduct relocations and real estate assessments. Based on the plan selected in the recon studies the mapping scale will be one inch equals 200 feet with 2-foot contour intervals.

(2) H&H Studies. Those studies include updating meteorological and climatological information, determination and documentation of streamflow and interior runoff data, provide hydraulic design for pump station sizing and development of existing condition flood frequency profiles and flood inundation limits.

(3) Geotechnical Studies. Studies include borings to determine suitability of support for a floodwall/levee system and the determination by laboratory testing the nature of materials to be excavated and borrowed.

(4) Design, Layout, Relocations, and Cost Estimates. Studies would include refinement of a baseline alignment, determination of quantity estimates, development of detailed costs for the floodwall/levee and pumping requirements, and the development of land/access requirements including borrow and disposal areas and relocation cost estimates.

Environmental Studies. These studies will include documentation of the existing environmental conditions, evaluation of the effects of the proposed project on the environment, cultural investigations and a description of the recreation situation and potential, and development of any required mitigation measures.

Economic Studies. These studies may include updating of the flood damage survey depending upon the time lapse between the recon and the feasibility study. A detailed benefit/cost analysis will also be required for the alternatives considered in the feasibility study. Commercial damage estimates would have to be reviewed in more detail. Location and intensification benefit studies would also be required.

SUMMARY AND CONCLUSIONS.

The reconnaissance studies were conducted during a twelve month period between May 1986 and September 1987 at a total study cost of $191,000. Of that amount approximately $40,000 or 20 percent of the total study cost were expended for the flood damage survey and other economic studies.

Extensive flood damage survey investigations were required for this recon study due to the types of floodplain development prevalent in the study area. Extensive commercial/industrial improvements as found in the Grandview Heights area warranted more economic flood damage detail than is typically required for a recon scope study.

The H&H investigations for the recon study were rather simple because of the availability of good mapping (1"=200', 5' contours) and the Franklin County Flood Insurance Study. While no geotechnical explorations were undertaken, recent boring data for the opposite side of the Scioto River were available from the Corps prior studies at the West Columbus project. This type of information, which is usually unaffordable at the recon level, added confidence to the recon scope design work for the project.

Large floods have not occurred in the study area in recent history. Therefore, local residents and city officials do not feel a "sense of urgency" about obtaining flood protection. The actual risk of damage for the city is much greater than is locally perceived. This is partially attributable to the fact that a substantial amount of the commercial and industrial facilities developed after the last major flood in the study area.

Local concerns also have been voiced by those in the local area who understand the need for, and endorse, flood protection about the requirements for feasibility studies. These people believe that the Corps should proceed directly from the recon study to detailed engineering, design, and construction.

Flood Damage Analysis Reconnaissance Phase Studies

by Paul D. Soyke[1]

The Rock Island District currently has 5 Reconnaissance Studies underway which could lead to cost-shared Feasibility Reports. We are also completing 2 cost-shared Feasibility Reports.

Table 1

CURRENT RECONNAISSANCE STUDIES

Clive, IA	Section 205
Des Moines, IA	Section 205
South Fork Sangamon River, IL	GI
Cedar Falls, IA	Section 205
IL-MI Canal, IL	Section 205

CURRENT COST-SHARED DPR OR FEASIBILITY REPORT

Tama, IA	DPR
East Peoria, IL	DPR

These studies range from a small localized flood problem to a larger urban area to a river basin. The studies range in cost from $60,000 to $194,000. The Rock Island District, as can be seen in Table 1, is heavily involved in small projects. One of the primary reasons for this is the fact that the states of Illinois and Iowa have the highest number of small communities in the country, relative to their size. They also have a relatively high percentage of land in flood plains. This creates some problems for the District that are different than those of Districts that may have a few large Feasibility Studies.

The problems for the economist in attempting to provide information for a Reconnaissance Report is related to the amount of information available and the time and effort involved in performing the work. With a time limit of 12 months for a Reconnaissance Report, the work can be as simple

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as using recent topographic maps to identify properties in a small flood plain or as complex as looking at 50 miles of stream where the type and magnitude of damage is virtually unknown and only 10-foot USGS maps are available. It should be obvious that there will be considerable differences; either in the time and cost or in the quality of the final product.

This brings up a key question. Is it fair to ask a local sponsor to share the cost for a study where the reliability of the data is in doubt? Does this also encourage us to feel a commitment and to assure that a project proposed in the Reconnaissance Report is carried through to construction. I am sure that the corporate answer is "no". However, that may not be true of the individuals involved in the study.

The key to most damage analysis is the hydraulic data. Most of the uncertainty in our analysis comes from that data. If the hydraulic data is based on rule of thumb or 10-foot contour cross sections, the annual damages can be within a very wide range. It has been said that the potential sponsor can understand the risk he takes. Yet, is it fair to complete reconnaissance reports that results in one sponsor taking a substantially greater risk than another? We must consider the fact that most communities view <u>us</u> as the experts. We are supposed to have all of the hydraulic information. After all, we are generally assumed as the Government agency that collects it. They feel that we should be able to give them accurate information. Where is our credibility if we present them with recommendations conditioned by statements that there is substantial risk that we are wrong? How long will our credibility last if we have very many positive reconnaissance reports that result in negative feasibility recommendations?

Is scheduling a 12-month schedule for Reconnaissance Studies reasonable? I believe it can be. However, that is conditioned on having fewer constraints on the work force. With a limited number of staff and a considerable amount of unscheduled work, it can be difficult to meet that constraint. The Economic & Social Analysis Branch in Rock Island is presently working on 7 studies that require cost-sharing. In addition there are many other studies of various types that are going on at the same time. The staff in Rock Island beside my self, are 2 Economists, 1 Social Science Analyst, 1 Economic Assistant, a Clerk/Typist, and 2 vacancies. Trying to schedule 50 projects and also meet 12 month time constraints is difficult under the best circumstances. At least 25 percent of our work effort during the year is unscheduled. In

1988, only one-half of our work, measured in dollars, was scheduled by November. By May, there was an excess of work. The other problem with scheduling is that there is no way to estimate the effort or the amount of time required to respond to comments. In the Reconnaissance Phase, we must make many assumptions and use a considerable amount of judgment. Too often reviewers do not believe our assumptions or trust our judgment. This results in comments that may require a significant amount of work for a response. The new regulations attempt to minimize this problem by deferring some of the response to the Feasibility Phase and by involving BERH and OCE early. However, this may still cause problems in cost-sharing or resolving the issue at the sponsor's expense. There have also been problems in the past when reviewers change. A satisfactory resolution of comments in one phase has not always resolved the issue. A new reviewer may have had a different opinion on the issue.

For most of our studies, we must wait until most of the hydraulic data is available before we start our work. The exceptions are for work on the Mississippi and Illinois Rivers where profiles are already available. The majority of our work, however, is on small streams, many of them ungaged, where we have little information. Therefore, our schedules must be based on when we can expect to get flood profiles. If this takes a considerable amount of time, then obviously it could be late in the schedule before the economics work can begin. Hydraulic work must often wait for cross sections from the Survey Branch. Everyone along the line is trying to juggle their schedules. The tighter the schedules and the fewer people we have, the less flexibility we have. It would seldom make a significant difference if we commit to a 12-month schedule, but cannot start the work for 6 months or if we started work immediately but took 18 months to complete it. The end result is that the study would take 18 months from the time of request to the completion. I believe that the latter course offers us better flexibility and may be preferable from the sponsors' viewpoint.

Coordination

Cost-sharing requires more coordination than in the past. Prior to cost-sharing, coordination was more informal and was more flexible. The sponsor was only concerned about the final product. Now the sponsor is also concerned about the cost. The sponsor is also more concerned about the benefits than previously. If they are paying 50 percent of the study cost and 25 percent of the construction cost, the sponsor would like to know why the local benefits don't receive more attention; although a partial explanation can be given to the sponsor's satisfaction, a complete explanation is difficult. For example: if the local area has excess labor, why must they meet the national criteria in order to include the employment benefits in the analysis? This point is valid, even from a national perspective if those local benefits do not exceed the local share. Explaining this only as policy is not the proper way to work with a 50 percent partner. Table 2 is an example of how the local benefits might be considered.

Table 2

Example of Local Unemployment Benefits

Total Cost	$7,000,000
Construction Cost	5,000,000
Labor Cost	3,000,000
Unemployment Benefits	$ 300,000
Non-Federal Annual Cost	
25% of Total	$ 175,000
LERR	200,000
Limit of Unemployment Benefits	$ 200,000

These are total unemployment benefits based on the labor cost. They are limited to the local cost-share since the area does not qualify for National Unemployment Benefits.

The costs also create problems when they seem excessive to the sponsor. Sponsors are generally willing to accept more risk than Corps' regulations or policies allow.

There seems to be a trend to at least review standards to determine if they are based on supportable criteria. The Risk Research Program can be a basis for this analysis. It is important that we in the field can explain why we must maintain some of the standards that we have. It is also important to be able to negotiate standards that may not be critical, especially when it could mean the difference between justifying project or not.

The issue of standards and guidelines seems to be changing from a policy issue, but not necessarily in the actual review process. Reviewers inject a great deal of their personal opinion into the comments. Economic comments need to be limited to the technical adequacy of the analysis and to assure that the evaluation is in accordance with the Principles and Guidelines. Where assumptions are made, the reasons obviously need to be stated, but the economist involved is generally the person most familiar with the local conditions. That person should have obtained information from the local sponsor and other sources familiar with the area. He or she is in the best position to make assumptions. This is not to say that assumptions should not be challenged; but that the challenge should be made to assure that the assumption was rational and based on the best available information. It should not be challenged based solely on personal opinion, especially by someone who may have no personal knowledge of the study area.

Comments and challenges cost money. In the Feasibility Phase, 50 percent of this money is paid for by someone not directly in the review and comment process. If the sponsors' attendance at the review conference results in any direct impact will remains to be seen. We in the District firmly believe that our analysis and assumptions are the best that can be made under the existing conditions. When these have been coordinated with the sponsor, it is extremely difficult to defend the project delays and extra costs to that local sponsor.

Given the conditions today for sponsor involvement and cost-sharing, there is a real need to have the review process change to a more cooperative procedure. The Division reviewers need to ask the questions necessary to be a support to the District. This will not only improve our image to the publics we serve, but also reduce costs and time in the evaluation process. This discussion has not been an attempt to blame the economic reviewers for delays and costs. However, the economic evaluation by its nature is more subject to criticism than most other parts of the evaluation. There are more assumptions and more policy issues involved than in other aspects of the study. Cost-sharing of studies makes these conditions more obvious than in the past. It is my hope that by more open discussion of these issues, we can improve our process, our image, our costs, our productivity, and especially our credibility.

Interaction

Interaction has always been a critical issue. Cost-sharing only causes minor changes from an economic perspective. The interaction between the various Corps elements relates to scheduling and costs. The interaction between the Corps and the local sponsor changes somewhat with cost-sharing. Better interaction can only improve what we do. Interaction takes place in several ways. In Rock Island, and I'm sure in many Districts, Team Planning is the norm. However, this does not take the place or duplicate the day-to-day interaction that occurs between the economist and others involved in the study. The economists' interaction is most often with Hydraulics and then with the project designer. Better interaction with the hydrologist will allow us to better explain our methods, assumptions, and benefits to the sponsor. It will reduce costs, shorten schedules, and reduce review questions. This interaction is difficult because of several conditions. First is the process itself. The economist needs to wait for the initial survey and hydraulics data in order to start work. By the time we finish our field work and start the analysis, it is usually so far along in the study process that any revisions that often are the result of interaction are difficult to make. Interaction becomes much more critical in accomplishing the sensitivity analysis. It is at this point that interaction with the hydraulogist is important. We as economists may have little idea how sensitive or uncertain the hydraulic analysis is to various assumptions that were made. Until we know more about the sensitivity and the assumptions, we cannot be certain how sensitive the economic analysis is to the hydraulic data. In the Rock Island District, we try to interact with the hydrologist as soon as possible. When we receive this data, we review it and discuss it with them. If we are to use this data, it must make sense to us. Especially with the constraints we are working with, I do not believe that we can always assume that the hydrologist had the same informaiton we have. We ask questions such as: Is there enough water in the stream to fill this area to the depth you show on the profile? How does the information relate to historic flooding? Why is the profile at this frequency so much different than that at another frequency? This not only gives us information that can be useful in developing economic data in the field. If there are uncertainties or if the analysis is sensitive to certain assumptions we can better determine how this might impact the economic analysis.

Our next interaction is with the project engineer and with the study team. We need to know what possible solutions there are. What is our understanding of the problem? Are there any constraints in this phase of the study? Cost-sharing has not changed this but makes it more important to clarify the issues early. These issues must be discussed and agreed upon by the sponsor fairly early in the first phase of the study. However, it is important that we encourage the sponsor to leave his options open. It is not in his interest to limit the alternatives too soon. There are many cases where the benefits can change considerably between alternatives that may not always be obvious initially.

Although the project manager is generally the principle contact with the local sponsor, the economist can have considerable contact as well. Most of the time though, the majority of the contact is with the direct beneficiaries rather than with the sponsor. Cost-sharing has made any problems this causes somewhat more sensitive than in the past. If the sponsor has ideas that are in conflict with the flood plain residents, there is a potential for problems. It is important that the economist be neutral in his discussions with local residents. This does not mean that any problems or conflicts are ignored. The interaction between the economist and the residents are critical to understanding the problem and gathering data. It only means that we should not take sides in a controversy. We are now financial partners with the sponsor and, at least officially, the sponsor represents the community. This takes us away from what was frequently the Corps role previously - that of an arbitrator of public opinion. Let me cite one example. We are presently doing a study of a relatively small portion of a large urban area. The city cited flood problems in their request. That was true. However, upon investigation of damages, the real problem seems to be a lack of interior drainage facilities. The city understands the problem, but appears to have ignored it. The local businesses blame the city for being insensitive to their needs. Our problem then is to sort out which damages occur solely because of rainfall and which occur because the high water floods the area or causes the culverts to be closed.

That issue is even more important in the Rock Island District than in some other Districts. We have an Economic and Social Analysis Branch that is responsible not only for the economic evaluation, but also for social and institutional analysis. It is far easier for the economist to stay out of a local controversy than for the sociologist.

Cost-sharing has not significantly changed how the interaction process works. It has, however, made it potentially more sensitive and much more important.

Summary

From an economist's perspective, the efforts for Reconnaissance Studies have not changed. However, the reliability of the analysis may change significantly. This is dependent on the information available and the amount of time allowed to complete the study. With limited information and time, sponsors will be required to absorb more of the risk and cost during the Feasibility Phase.

Scheduling of work is probably the major problem facing us. Even though the 12-month time frame may be realistic when considering a single study, it may not be in the overall program. Each specialty must coordinate his study efforts not only with the other specialties, but also with other studies. Any unscheduled work and emergencies that arise can easily cause changes that impact other branches and studies.

The economist must be sensitive to the uncertainties of the analysis. Prior to the cost-sharing, any uncertainties could be taken care of during the feasibility phase. This can still be done, but a greater risk to our credibility. In the Rock Island District, the easy projects seem to have been built. The remaining studies have complications or problems associated with them which increases the uncertainties and creates problems in equity between different sponsors. A large urban area may have sufficient information to allow the damage evaluation to proceed early and efficiently. A smaller community may require additional data collection and result in an analysis that has a wide range of assumptions built in. The urban area is more likely to be able to afford the risk than is a small community, but the risk is usually greater in the small community. This raises some equity issues. It may also mean that in some cases, studies may not be done in small areas that have a need but cannot afford the risk involved in financing the feasibility study.

I believe that the economic analysis is the most important part of the Reconnaissance Study. The potential damage and benefits should be the best that can be done. The economics in a Feasibility Report should then be limited to formulating the most appropriate plan and finishing any details that need to be completed. By doing this, we have assured that each sponsor is treated fairly and that even if a project turns out to be infeasible, the community will have information on which to make informal decisions. This not only benefits the community, but also the nation. If the community proceeds with a plan to reduce flood damage then NED benefits are realized.

In summary, the Rock Island District is heavily involved with small projects and will probably remain this way into the foreseeable future. This results in some problems in performing with the current constraints we have. However, we are confident that the job can be done. The impacts of cost-sharing on our program will eventually result in a better program and a more complete analysis of the total economic impacts. I hope that we, the Corps, will be open to the suggestions and concerns of the sponsors in our future guidance.

LEVEL OF DETAIL IN RECONNAISSANCE REPORTS

by Brad Fowler [1]

Planning Philosophy 101. Yet another useless prologue.

What is a reconnaissance study supposed to DO? The purpose of the reconnaissance study is to determine whether there shall be a feasibility study or not. This purpose is simple and primary. The famous four tasks of a recon are derivative. They define how you will know what the answer to the question is: they are not the purpose.

1) How many angels....? The above distinction is not merely nice. The way planners think about the recon's purpose can affect their approach to the recon "problem." Looking beyond the relevant decision can weaken its quality by diverting attention from it.

   For example, we often hear the advice: "work smart and develop information in the recon which will be used in the feasibility" or "don't waste resources on stuff that will have to be done over in feasibility." Here's our view. The recon is a decision document: work useful for a different decision should not be undertaken.

   For example, we also hear: "local preferences should guide the formulation of alternatives." While local preferences are obviously quite important, the way the question is posed can be equally so. Looking beyond the relevant decision, to specific local preferences, can significantly influence the cost and difficulty of the recon. For recon purposes what is entirely unacceptable to the sponsor may be more important than what is preferred.

[1] Economist, HQUSACE, CECW-PD

2) <u>The Four Horsemen</u>. The four paraphrased recon tasks- done in support of the Go/No Go feasibility decision- are:

   a) What ails this place and what can be done about it (problems and opportunities)?

   b) Is there some economically justified project that the Feds would support?

   c) What, exactly, is going to be accomplished in the feasibility study, if there is to be one? How long will it take and how much will it cost (scope of study)?

   d) Are the locals interested in buying into a feasibility study, that is buying into c)?

<u>Who is first among equals</u>? Whether or not there will be a feasibility study depends on the answers to the above questions. If there is to be a feasibility, each answer must be correct. Therefore, each question is equally important. Each question is not equally costly or difficult to answer however.

1) For study conduct generally, and particularly for the economics portion, finding potential for an economically justified project is paramountly important. This practically goes without saying yet it is easy to slip out of the mind, perhaps especially out of those minds which must necessarily have broader concerns (read study managers and up).

2) Economists should understand and convey to study managers that finding a feasible project is <u>sine qua non</u>. Other tasks mean little without it. In practice this could mean that finding a potential project would consume the great majority of study funds. The justification for this is that it best supports the relevant decision, whether to go forward or not.

3) Economists should understand as well that finding a feasible project is not all, and may not even be mainly, economics. This is true at least in so far as use of recon study funds is concerned. The reason is that the standards of documentation establishing the likelihood of a feasible project are minimum standards (read "good enough"), and there is no virtue in exceeding the standard. Once planners are reasonably confident that a feasible project can be devised, they should devote remaining resources to the second most important recon task.

Who is second among equals? From our economics perspective, and from planning's we would hope, second in importance is the advance planning done to prepare for the feasibility study. Advance planning doesn't mean accomplishing feasibility tasks; it means thinking a lot about them. The advance planning is the scope of studies.

1) What is a scope of studies? The scope is the plan for the feasibility study. Opinions vary on the appropriate scope of the scope. We have seen scopes of study which range from a simple list of major functional tasks with a one sentence description for each task (e.g., Economics. Complete surveys and evaluate plans, including NED plan.), to twenty plus pagers where each functional component is broken down into such detail that virtually every step in the data collection and analysis is laid out (e.g., how pages of field data are to be numbered). We think an appropriate scope of the scope lies in between.

2) Why is the scope of studies important?

   a) The scope is a work agreement between the Corps and the sponsor. It's part of a contract and subject to the usual contractual difficulties in modifying once executed. If costs change significantly, the Executive Committee must approve, meaning the District Engineer and the sponsor's representative. Good practice dictates that the contract should be modified only when the reasonably unforeseeable occurs. Not noticed or not anticipated is not the same thing as reasonably unforeseeable. Preparing the scope is where you look and think ahead.

   b) The scope is the the record of the understanding each party has regarding what it and the other will accomplish. It is also the record of the totality of efforts (tasks) required to accomplish the feasibility study.

   c) The scope is the place to identify, or at least acknowledge the possibility of, and propose approaches to handling problem areas or uncertainties in the conduct of the feasibility study. This applies not only to areas in which costs are uncertain, but also, and especially to analytical or methods questions, data gaps, etc. Often enough feasibility studies require analyses and evaluations which depart from the traditional and well-worked. The scope is the place to identify these. Sponsor understanding requires this.

d) A credible Certification process requires this information as well. Certifiers must be able to tell that what will be done is in accord with policy and procedures. Frequently also, anticipated potential problems develop into less critical actual problems later. Two effects: (1) being aware of the problem, the planner is also alert to potential solutions that might not have been noticed otherwise; (2) a "heads up" can have a crisis defusing effect.

e) Few have recently expressed envy of the Corps' cost estimating record. Both the Army and the Corps are concerned. Initiatives have been initiated. The general goal is more reliable cost estimates earlier.

For reconnaissance reports this means that feasibility study cost estimates should improve. It does not mean that reconnnaissance studies should devote extra resources to improving project cost estimates. Clearly sponsors need some idea of what potential projects are likely to cost, but in reconnaissance reports project costs may be approximate, perhaps augmented by sensitivities. Feasibility study cost estimates should be pretty good however. The scope of studies is the main documentation for the feasiblity study cost estimate.

3) <u>What is the appropriate scope of the scope</u>? In our view the scope of studies should be work item or task oriented. Every task should at least be listed, and a cost estimated. If the task is routine this is sufficient. For example: survey X residential structures; cost $Y. If the task is not routine, a listing and cost is not sufficient. For example, if the task is to survey 20X structures, which will necessitate a sampling procedure, and of which some are commercial establishments, which will necessitate special contents surveys, then each subtask should be discussed and costed.

Potential problem areas, evaluation challenges and unusually high or low estimated task costs should be discussed in the scope.

The scope should be in enough detail regarding tasks and costs, and clear enough regarding the study process so that the sponsor and reviewers obtain a good understanding of proposed study conduct and expected results. This is true whether or not the sponsor is making in kind contributions. In other words the scope of studies should be transparent in itself, or if it cannot be so in reasonably compact form, it should provoke questions which through discussion lead to transparency.

But who shall you rob to pay Paul. Anyone you can, including Peter if necessary. Since finding out if there is a feasible project with a Federal interest dominates all else, this means that planners with eyes on the relevant decision must sometimes make sacrifices. Planners should be most reluctant to skimp on the scope of studies, however. It should be the last recon task to be sacrificed. In most cases no sacrifices will be necessary as long as the reconnaissance study is geared to the reconnaissance decision. (1) feasibility tasks should not be done in recons. (2) the "good enough" standard of proof applies to recons. Sponsors, at this point, buy into feasibility studies, not projects.

Bolts and Nuts. Nissan Sentra performance on a Yugo budget.

Uncertainty. In doing constrained time and budget reconnaissance studies uncertainty is the name of the game. This game's been around, but the Corps' never been a serious player. Dealing with it is now necessary. "If not us, who; if not now, when." In the game of uncertainty scoring occurs when uncertainty is reduced the most with the least resources. Below are some strategies for getting information that should be "good enough" for reconnaissance reports. First however, the following, since there are frequently different points of view concerning the appropriate allocation of study money.

Never fall for this one - the Classic Study Manager's Feint. The economists want additional money for some purpose, and the study manager says he can't justify more study money for economics "refinement" when the hydrology is only accurate to plus or minus 20 percent. Sounds good, has certainly worked in the past, and continues to, despite the fact that it is faulty reasoning. The hydrology-foundations-design-environmental-economics-etc. plus or minus X percent accuracy is irrelevant. What's relevant is how much progress (additional uncertainty reducing information) can be made by using the "contended" study money in various ways. That is, the improvement in the final answer should drive the allocation of study funds, not any pre-existing level of accurracy.

Note that this is a general principle, and does not prove the case for any particular use of study money. It could be, for example, that the money spent for hydrology most improves the quality of the final answer.

Strategy One - Concentrate on the existing condition. For many if not most studies the existing condition is key. It is observable and relatively certain. Conditions without the project are not likely to change much until well into the project's period of analysis, by which time their importance is lessened due to discounting. In practice concentrating on the existing condition means:

1) Get the facts right. For urban this is structures, elevations, and values (reasonably accurate and conceptually correct), etc. For agricultural projects it is crops, yields, costs and income.

2) Don't spend a lot of resources trying to forecast the future. No one does it well.

3) Show a BCR based on existing conditions. In our view a well documented existing condition BCR of 0.9 with reasonable arguments for enough future benefits for feasibility is superior to a weakly documented overall BCR well in excess of 1.0. For policy and budgetary reasons, it is particularly important to show an existing condition BCR for agricultural flood control projects.

Strategy Two - Sample. Sampling is in general an efficient way to collect data. Sample when study funds are not sufficient for a complete survey, or if funds must be conserved so that the scope of studies gets it's required attention. Sampling is great, but it must be thought about a bit before it is done, so that results will be representative. If you need assistance consult CECW-PD.

For example, a flood plain is occupied mainly by a tract house subdivision. There are relatively great differences in elevation but not so great differences in structure values. To conserve study money survey elevations but sample values.

Strategy Three - Think about the probable realtionships among study variables before you know what they actually are. In other words don't approach a recon in the same way you would a feasibility. In a feasibility study eveything that needs to be done usually gets done, at least eventually. There won't be time or money enough to do everything you want to in many recons, or to recover from surprises. Only the most important stuff will get done, and somebody needs to know what that is. Thinking about the likely relationships among variables, and talking with other study team menbers, particularly the hydrologists, can help identify the important stuff.

1) List all variables which are important in the economic analysis: numbers of structures, type of same, density of strucutres, elevations, values, height of water surface, crop types, etc. Draw pictures of relationships between variables, based on previous experience, or preferably, existing project specific knowledge or data. This can assist in thinking about what is going to be important to spend study money on.

   For example, from existing quad sheets plot the numbers of structures vs elevation. A jump in the number of structures at a given elevation(s) may indicate where survey resources should go.

   For example, do a plot between value (if data is handy) and elevation.

2) Talk to the hydrologists. They may be able to help you, based on their previous experience, to narrow your focus and thereby increase efficiency of study fund use.

   For example, if the hydrologists expect flood profiles to be close together, this tells you that elevation accurracy will be more than usually important. You may therefore want improved elevation imformation, which could be obtained via a sampling procedure.

3) Identify critical uncertainties and focus on these.

   For example, in what appears to be a straightforward urban flood study your experience and intuition tell you that the BCR will likely be marginal because of the size and age of structures, and the income of residents. In this case structure and content values will be critically important. Consider a sample of structure and content values to supplement your usual methods.

   For example, in a flood control study the floodplain is large with many structures. Concentrate the structure elevation and value survey (or sample) where the most damages will occur, by risk zone or geographic area or both.

<u>Strategy Four</u> - <u>Fill in non critical areas with cheap data</u>. Cheap data is data that already exists, or that others will provide to you. Sources are other Corps reports and backup data, FEMA, SCS and ASCS, argument by analogy, etc.

For example, the Agricultural Stabilization and Conservation Service flies and photographs all agricultural land annually. This data could potentially largely replace some agricultural surveys in recons.

If project justification depends on this cheap data, it will of course need to be shown to be not only good data, but relevant. Sampling can sometimes be used to supplement, support or modify cheap data.

Strategy Five - Analyze the easiest or cheapest alternative that will give a Go or No Go indication. No NED plan is required in reconnaissance reports, and other guidance is not specific on the number or range of alternatives that must be formulated and evaluated. All that is necessary is that at least one alternative be justified, have a Federal interest and have sponsor interest sufficient that it will share feasibility costs. Therefore we conclude that the alternative easiest or cheapest to analyze is a strong candidate for the bulk of study attention.

For example, a town wants flood protection. They have said they don't want to lose their view of the river, so they prefer channel work. If a levee is signifantly easier or cheaper to formulate and evaluate why not concentrate on it in the recon.

Preferences expressed absent knowledge of relative costs and benefits are likely not strongly held and should not overly influence analysis of alternatives in reconnaissance reports.

Establishing an alternative that will be less costly to analyze cannot be done by economists alone. It requires consultation with and the cooperation of the hydrologists.

Strategy Six - Avoid Fortune-telling. Concentrate on existing conditions and, if appropriate, future conditions without the project. If you really think future with project conditions will be significantly different and that the project will not be feasible without future benefits, keep in mind that the P & G set upper bounds on intensification and location benefits. These can be no more than the damage avoided with the intensification (location) but without the project. Acknowledged as such, however, these relatively easily calculated upper bounds can themselves be used as an approximation of the benefits.

Strategy Six(a) - Avoid using direct land price comparisons for benefit estimates. This is tricky. If it weren't so the Corps would have been doing it all along, instead of using damages avoided calculations. Such comparisons will probably be OK for some sensitivities and in non-critical areas.

Strategy Seven - Be candid. Be candid about what you know and the degree of confidence you know it. Be especially forthright about the unknowns. There is no hard and fast burden of proof for reconnaissance reports. Show the reviewers and sponsor that you understand the shortcomings of the data and analysis, are aware of the tentative or preliminary nature of the results, and that you can still articulate an argument for doing a feasibility study.

Summary and Conclusions.

This paper addresses our view of the nature of the reconnaissance decision, what should be done in support of that, and techniques or strategies that can assist in obtaining data and anlyses which provide a "good enough" foundation for that decision. Still, no definitive guidance on the appropriate level of detail is provided, and some may find that unsatisfactory.

We doubt, however, that effective general specifications or rules are possible at this point. Varying degrees of uncertainty and the particular "uniquenesses" of each study situation make hard and fast degree of detail guidance quite difficult to define. Note that we are not saying that what kinds of things to do or how to do them are special problems, but only that how much of them to do remains so. We will speculate, though, that the problem of how much to do is largely self-correcting. More knowledge of and experience doing the what and how questions will in themselves help answer the how much question.

Recommendations resulting from feasibility and reconnaissance studies vary in the degrees they utilize and depend on information provided by Corps functional elements. Recons are unusual in that they are driven, essentially, by the economics and the hydrology-hydraulics. This bare fact, in itself, does not prove that communication between economics and H & H is necessary or even desirable. The "hand off" approach has worked for some studies in the past.

We don't think "hand off" will work for recons in the future. As we indicated at several points in the body of the paper, communication between hydrology and economics is essential to efficient formulation and evaluation. Formulation is part art to begin with: formulation with an eye towards an efficient study process, one that gets answers good enough to make good decisions about feasibility studies requires collaborative art.

Little was said above about documentation _per se_. Documentation is the principal means by which official communication among Districts, higher authorities, OASA and sponsors takes place, and must necessarily be the major information base for decision making. The importance of a good written "record of decision" - which each recon report is- can hardly be overestimated, particularly as the level of decision making is elevated.

In our opinion strong potential for additional communications problems among the interested parties exists. It can be reduced by reconnaissance reports which are unambiguous and complete in laying out the processes by which recommendations result. The data, analyses and evaluations themselves may not always be as complete, or as clear and unambiguous in their interpretations or implications as we would prefer. This is expected. A sustainable reconnaissance process, one with more flexible analysis requirements, requires however that the ingredients and recipe which result in the pudding (recommendation) be out on the table for all to see.

Analytical Methods and Tools for Reconnaissance-Phase Studies

by Darryl W. Davis and Michael W. Burnham [1]

Introduction

Reconnaissance-phase feasibility studies are required to determine if a feasible solution to an identified problem exists and whether there is a federal interest. The study must also identify a local sponsor. The studies are abbreviated full-scoped planning investigations that address the relevant technical, financial, and institutional issues. A first-cut plan formulation and evaluation will be performed. Engineering and economic analysis provides the basis for preliminary plan development and cost-benefit analysis. The studies will normally be for existing conditions with and without proposed plans of improvement.

This paper describes study strategies and methods and identifies and discusses the application of traditional analysis tools for hydrologic engineering and flood damage/benefit analysis to reconnaissance-phase investigations. The paper encourages careful technical study management and presents three interrelated activities for performing the technical analyses. The activities involve: 1) establishing a field presence in the study area, 2) the use of desk-top analysis methods, and 3) the application of presently available analytical tools to perform the hydrologic engineering and flood damage analyses. The latter emphasizes selected Hydrologic Engineering Center (HEC) developed computer programs and associated analysis methods. The paper concludes with some reflections on issues involving use of sophisticated computer programs with abbreviated data and the dilemma in which the Corps technical professional finds himself in these studies.

Technical Information Needs

Overview

Technical information is required to support the planning tasks of problem definition, plan formulation, and plan evaluation. The specific information needed and commensurate level of detail is dependent on the nature of the problem, the potential solutions, and the sensitivity of the findings to the basic information.

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Problem Definition

The magnitude and frequency of flood hazard and the location, number and value of threatened properties are the basic information needs. The amount of data available to meet these information needs and the appropriate method to employ to develop additional data are site specific.

Plan Formulation

The technical information needed for plan formulation includes the existing with and without conditions flood hazard and flood damage. The hydrologic engineering contributions are the location and size of the measures, elevation-flow and flow-frequency relationships, and the determination of the operational integrity of proposals. Flood damage assessments produce the elevation-damage functions and expected annual damage.

Plan Evaluation/Selection

Technical information is needed for plan evaluation and to identify a feasible plan with federal interest. Analyses are required to develop approximate cost-benefit values for representative plans, to ensure that the project will be safe, and that the project will function appropriately. A specific plan need not be selected. A reasonable plan that is feasible and involves federal interest must be likely to result from detailed planning.

Information Completeness/Detail Target

The ideal for reconnaissance-phase technical studies is complete hydrologic engineering and inundation reduction benefit analyses for the existing without project conditions in the detail needed for the feasibility-phase study. Major changes in problem definition, benefits, identified flood hazard, and several other important issues are thus stabilized early in the project development process. This ideal may be achievable in some situations. However, the lack of available data, the complexity of the study area, and limited time will often dictate that a lesser detailed analyses be performed. The existing with project conditions are evaluated to the detail required to determine whether or not a feasible plan with federal interest exists. The analysis of future conditions will only be performed when it seriously impacts on the feasibility of a plan with federal interest.

Planning the Investigation

The hydrologic engineer, economist, and other technical staff will develop work plans for their respective technical studies. The plans form the basis for scheduling and funding the technical analyses. The plans will be subsequently expanded into more detailed and complete work plans for the feasibility-phase study. Coordination with other technical disciplines is essential during development of the work plans.

The basic elements of reconnaissance-phase hydrologic engineering and flood damage analyses work plans are shown on Table 1 and Table 2, respectively.

Essential elements of the work plans are to 1) define the objectives of the hydrologic engineering and flood damage analyses so that they support the overall planning study objectives; 2) define the geographic boundaries for the technical analyses; 3) document available information that may be used for the technical analyses; 4) outline analysis strategies to achieve the objectives; and 5) develop a study schedule and cost estimate.

Reconnaissance-Phase Study Strategy

The three interrelated activities proposed as a study strategy are: establishing a field presence in the study area, performing desk-top analysis, and performing full-scoped technical analyses using traditional tools with abbreviated data tailored to the detail defined by the study conditions.

Cost-shared studies require close coordination and interaction between Corps personnel and local sponsor staff. Coordination efforts will occur beginning early in the reconnaissance-phase, and continue on through to the implementation of the project.

Often overlooked is the need for Corps technical staff to meet early-on with local agency technical counterparts and others knowledgeable about the flood hazard potential of the study area. This permits gathering local information on features of physical structures and floodplain geometry, previous analyses, and observed event data. The information gathered from the field presence is essential for subsequent technical analyses.

Desk-top analysis refers to a concept of performing analysis relatively quickly and easily by an investigator using pencil and paper and hand held calculator (or perhaps simple commercially available Personal Computer packages). The concept is to distinguish it from the other end of the analysis spectrum that would involve use of highly sophisticated, specially developed computer models. The analysis may be for a limited part of the study involving a day or less, or more comprehensive requiring 1-2 weeks. Desk-top analysis are performed using available information and simplified or approximate analytical methods. Some type and level of desk-top analysis may be performed at any time during the study process, but should routinely be conducted after the field trip and prior to application of major computer programs.

Table 1

Reconnaissance-Phase Study
Technical Elements of Work Plan for
Hydrologic Engineering Analysis

I. Hydrologic Engineering Study Objectives

II. Definition of Study Area for Hydrologic Engineering Analysis

III. Description of Available Information

   A. Maps, correspondence, documents, and reports
   B. Observed flood information
   C. Previous study data and analysis results

IV. Definition of Existing Conditions Flood Hazard

   A. Historic floods documentation
   B. Hypothetical floods development
   C. Existing without conditions flow frequency, water surface profiles, etc.
   D. Existing with conditions flow frequency, water surface profiles,
   E. Appraisal of special technical issues: such as erosion/sedimentation, unsteady flow, water quality, future development etc.

V. Existing With Projects Conditions

   A. Appraisal of broad range of flood loss reduction measures.
   B. Documentation of flood hazard reduction performance at representative measures.

VI. Time, Cost, and Resources Required

Table 2

Reconnaissance-Phase Study
Technical Elements of Work Plan for
Flood Damage Analysis

I. Flood Damage Study Objectives

II. Definition of Study Area for Flood Damage Analysis

III. Description of Available Information

   A. Maps, correspondence, documents, and reports
   B. Damage inventories
   C. Previous study data and analysis results

IV. Delineation Damage Reach Boundaries

V. Definition of Existing Conditions Damage Potential

   A. Historic damage documentation
   B. Perform inventories
   C. Develop damage relationships
   D. Compute damage potential without proposals
   E. Compute damage potential with proposals
   F. Appraisal of special technical issues: such as future development, flood plain management, etc.

VI. Existing With Projects Conditions

   A. Appraisal of broad range of flood loss reduction measures.
   B. Documentation of flood damage reduction performance measures/plans.

VII. Time, Cost, and Resources Required

Traditional hydrologic engineering and flood damage analysis concepts and computer programs are applicable for reconnaissance-phase studies. The analysis may be more abbreviated and approximate than for later feasibility-phase investigations. How much more abbreviated and approximate will depend on the study setting, available data, and issues to addressed.

Field Presence and Local Coordination

Overview

The field presence normally involves a field inspection by Corps technical staff, review of local documents (gauge records, correspondence, local or other agency reports, operation manuals, newspapers articles, and photographs), interviews with local officials and residents, and meetings to discuss observed flood characteristics. Although the process involves more information gathering than analysis, it provides valuable insights and can lend credibility to the analysis methods and results.

Hydrologic Engineering Information

The types of information obtained from a field presence are defined herein and in Table 3.

1) Characteristics of observed events such as velocities, direction of flow, warning time and time to crest, and any problems with debris and sediment.

2) High water marks (HWM) obtained from interviews and documents for observed events.

3) Frequency of overtopping of landmarks such as roads, bridges, levees and walls, and other features.

4) Historic flood inundation boundaries sketched on aerial photographs based on information gathered from interviews and documents. The boundaries should be substantiated and agreed upon by knowledgeable local officials and residents.

5) Physical characteristics affecting the flow such as cross-sectional locations, Manning's n-value, and other features such as bridges and culverts. Simple cross-sectional coordinate data can also be obtained, or more detailed cross-sectional data acquired on a limited scale.

6) Inspection of erosion, aggregation and degradation, and identification of potential water quality issues.

7) Preliminary identification of type and location of potential flood loss reduction measures. Includes local inputs and any physical, regulatory, operations, or other constraints that might affect implementation of various types of measures.

Flood Damage Information

The type of information gathered during the field presence includes frequency of inundation, amount of structural and content damage, and information from post-flood damage surveys. Table 3 contains a summary of the items listed below.

1) The type, categories, and locations in the study area of damage associated with observed events.

2) Structure and content values and local information on existing stage-damage relationships. Identification of unique structures.

3) Estimates of threshold flooding frequency and elevations.

4) Estimation of infrastructure, public facility, commercial/industrial and other types of damage.

5) Damage survey data and other information from observed events which may be used to verify damage relationships and for calibration studies.

6) Future development proposals that might affect the feasibility of the alternative analyses.

Desk-Top Analysis

Overview

Desk-top analyses are used to gain preliminary insights into flood hazard problems and potential solutions. Available information includes the use of maps and charts and previously developed information from field reconnaissance and other studies. Simplified or approximate analytical methods include equations, graphs, and charts.

Hydrologic Engineering Analysis

The watershed boundaries are defined on USGS Quadrangle maps and aerial photographs. The length of the watercourse for the study area (or runoff area) is determined and the channel bottom profile plotted from the best information available. Either simple or 8-point stream cross-sectional data is obtained during the field reconnaissance or is available from previous studies.

Profiles of highwater marks of observed events are sketched. Normal depth calculations are performed using the Preliminary Analysis System for Water Surface Profile Computations (PAS) computer program (Hydrologic Engineering Center, 1988). Travel times are estimated from simplified equations, velocity estimates, and experience. The values are compared with observed event data and adjusted accordingly.

Flow-frequency estimates are determined for gauge locations of the study area. Existing without conditions flow-frequency estimates are made for ungauged areas of interest using applicable simplified equations, transfer of hydrologically and meteorological similar gauged relationships, or regression equations.

Profiles of the best estimates for the 10-, 4-, 1-, and .02-percent chance exceedance frequency events are sketched. The values are compared with the observed frequencies of overtopping of local landmarks. The rainfall frequency of each observed event is estimated and assumed (for desk-top assessments) to roughly correspond to the runoff frequency of the event. The observed event frequencies are thus compared with the estimated profile event frequencies. Adjustments are made as appropriate and the best estimates of the flow-frequency and frequency-profiles adopted for the desk-top level analysis.

Detailed survey requirements are determined using the PAS program. The program is used to define the distances upstream and downstream in addition to the study area required for detailed surveys. The required survey floodplain extent is determined and the most cost-effective survey method for the study is determined using the PAS program.

Flood Damage Analysis

The desk-top flood damage analysis uses the information gathered during the field presence - aerial photographs, topographic maps, and data from previous studies. The type, amount, and location of damage incurred during observed events is noted. Three or four key damage reaches are tentatively defined from the desk-top water surface profile estimates, likely project sites, and flood damage reaches defined in the economic studies. Observed flood and flood frequency inundation boundaries are sketched on the aerial photographs using information from the field presence, topographic maps, and the assistance of the hydrologic engineer. High-water-mark elevations and locations are noted on the aerial photographs.

General damage categories (commercial, residential, industrial, and other), or categories consistent with damage survey reports for observed events are defined. Stage-damage relationships for structure values are assigned from field inspection, previous studies, and Flood Insurance Administration relationships (Hydrologic Engineering Center 1976). Typical values or average structural values for each category are developed. Content values are assumed a percent of the structure value.

An order-of-magnitude estimate of the existing conditions expected annual damage by damage reach and damage category may be determined based on the flow-frequency, flow-elevation, and elevation-damage relationships. This value can be used to assist in determining early-on in the study the location and economic likelihood of a range of potential measures being feasible. Measures which obviously are not physically or economically feasible should be removed from further consideration. The reasons should be documented. The two or three measures most likely to be found feasible, should also be identified as appropriate for subsequent more refined study.

Analytical Methods Using Computer Programs

Overview

The application of traditional hydrologic engineering and flood damage analyses computer programs for existing with and without project conditions provides additional analyses capabilities not available with desk-top approaches. The applications may range from full-scoped to abbreviated detailed level of analyses, the latter the most common. A selected list of computer programs appropriate for reconnaissance-phase studies is contained in Table 4.

Hydrologic Engineering Tools

Hydrologic engineering computer programs are used to determine the flow-frequency and flow-elevation relationships for without and with plan conditions. The PAS program is a for-runner of programs designed specifically for use in early, preliminary analysis. A discussion of the computer program applications that follows is for a full-scoped analysis using an abbreviated data set such as might be obtained from the desk-top level assessments. These analyses would normally take less than a person-month each for the hydrologic engineering and flood damage studies.

Preliminary Analysis Systems for Water Surface Profile Computations (PAS) Computer Program. The PAS program is used early in the river hydraulic studies. The program uses several 8-coordinate point cross sections, flow, and Manning's n-value estimates to compute normal depth, and several other hydraulic parameters. A rating curve may be developed. The downstream distance for an alternative starting condition, and upstream distance affects of project head losses may be determined. The accuracy of computed water surface profile computations associated with various types of surveys (field, aerial spot elevations, and topographic maps) and confidence in Manning's n-value may be estimated. Cost comparisons of the various survey methods may be made using the PAS.

HEC-1 Flood Hydrograph Package. The HEC-1 Flood Hydrograph Package is used to develop with and without conditions hydrographs. It may thus be used to develop flow-frequency relationships using single event storm analyses. The analyses are performed using precipitation data, loss rates, unit hydrographs, and routing criteria.

Subbasins are delineated. Storm patterns for observed events are reviewed and totals and distributions estimated for the subbasins. Loss rates are estimated from regional relationships, previous study data, and field inspection information. Unit hydrograph parameters are estimated from regional relationships developed from previous regression analysis or adopted from experience. Runoff hydrographs are subsequently combined and routed using simple hydrologic methods. The events are compared as possible with gauged records and high-water marks and parameters adjusted appropriately.

The hypothetical frequency storms are analyzed in a similar manner using the same runoff parameters. The results are compared to flow-frequency relationships developed from the desk-top assessments and parameters adjusted as appropriately.

Simulations are performed to develop existing conditions peak flow frequency relationships, and then repeated for proposed flood loss reduction measures to develop with conditions flow-frequency relationships.

The detailed feasibility-phase analysis would generally follow the same approach. Subbasin delineations would be more refined. Storm patterns are analyzed in more detail. Loss rates and unit hydrograph parameters optimized, and comprehensive regional relationships developed. More advanced and accurate routings are made. Calibrations of hypothetical frequency events to gauged locations and adopted flow-frequency relationships are performed in detail (Hydrologic Engineering Center 1980).

An experienced HEC-1 user can develop a useful HEC-1 model using abbreviated data within a few days.

<u>HEC-2 Water Surface Profiles</u>. The HEC-2 Water Surface Profile computer program is used to compute with and without project conditions water surface profiles. Flow-elevation relationships, flood inundation boundary maps, and flow velocity estimates are major products of the analysis.

Full-scoped abbreviated analyses are conducted using data from previous studies, field reconnaissance, and data developed from desk-top analysis. The studies enhance the desk-top analyses while still being performed in a relatively short time frame. The abbreviated studies may include sensitivity analyses to establish the range of possible results and to identify the additional data requirements and need for more accurate methods.

Cross-sectional data are obtained from previous studies and available maps. Physical feature data such as bridges are supplemented as necessary by hand level surveys and cloth tape measurements during the field reconnaissance or approximated using externally computed head losses. Manning's n-values are estimated from field reconnaissance and aerial photographs. Flow values for observed and hypothetical frequency events are obtained from the desk-top analysis and abbreviated analysis results from HEC-1. Calibration of the profiles to observed high-water marks is limited but some adjustments can be made in an expeditious manner.

The detailed water surface profile analyses to be performed for feasibility-phase analysis are conducted using more extensive and accurate cross-sectional and bridge data. Survey methods include field surveys, aerial spot elevations, and higher accuracy topographic maps. Better definition of the flow values, Manning's n-values, and other parameters is provided for the detailed studies. Calibration of the profiles to observed high-water marks and frequency of overtopping of landmarks is an important aspect of the detailed analyses. Development of detailed flood inundation boundary for also is an important part of the analysis.

An experienced HEC-2 user can develop a useful HEC-2 model using abbreviated data within a few days.

Estimates of the accuracy of the computed water surface profiles may be made using the findings and procedures described in the Accuracy of Computed Water Surface Profiles (Hydrologic Engineering Center, 1986) research report or via application of the PAS computer program discussed in a previous paragraph.

HEC-5 Reservoir System Analysis. HEC-5 is used to simulate the operation of one or more reservoirs for flood control or conservation purposes. The simulation results are used to develop without and with reservoir storage proposals flow-frequency relationships. The reservoir or reservoir system is characterized by the topology of the river system and storage locations, hypothetical or historical flood inflows, reservoir physical characteristics, and reservoir operating rules. Each reservoir is operated for designated control points and thus releases are based on channel conveyance capacities, local inflows, status of storage in reservoir, and operating rules.

Abbreviated analysis for reconnaissance-phase studies use preliminary inflow data, approximate reservoir characteristics, and simple rule curves. A useful HEC-5 model may be developed from abbreviated data by an experienced user in a few days. Simulation analyses thereafter are simple to perform.

The HEC-5 model would progressively be refined for the feasibility phase analysis by developing more complete and accurate inflow data, refining the characterization of the physical features of the dam and reservoir, and refining operating rules to the increased specificity of plans under study.

Flood Damage/Benefit Analysis Tools

Flood damage analysis computer programs are used to manage structure/flood damage potential inventory data, develop aggregate elevation flood damage relationships, and coordinate the hydrologic, hydraulic, and flood damage relationships to enable computation of expected annual damage and benefits.

Structure Inventory for Damage Analysis (SID). The SID program manages structure inventory data and develops aggregate elevation damage relationships by damage category and damage reach. It enables storage of generalized damage potential function that can be applied to preliminary through detailed structure inventories. Structures may be grouped by blocks, composites of group of structures represented, and/or limited samples of the structure population can be specified. The program may also be used to develop event damage (for example hypothetical frequency events) that could subsequently be integrated by hand computations or simple spread sheet analysis to yield expected values. The output is generally used as input to the EAD program described below.

Inventory data for the program may be preliminary or very abbreviated as would result from field reconnaissance "windshield" surveys. The experienced user can develop useful results in a matter of days.

For feasibility-phase studies, the inventories are expanded and refined, damage potential functions and structure values refined, and accurate reference flood data for aggregation analysis developed and supplied.

Expected Annual Flood Damage Computations (EAD). The EAD program orchestrates damage potential, rating, and frequency relationships for without and with proposal conditions into a damage-frequency relationship. It then computes expected annual damage and inundation reduction benefits. Tabulations of without and with plan damage and benefits for one or more plans of improvement are produced. The evaluation relationships needed by the program may be preliminary or approximate, or highly accurate based on detailed surveys and analysis. The program is a highly useful screening tool for determining potential order-of-magnitude benefits for the full array of flood-loss reduction measures.

An experienced EAD user can develop a useful flood damage model using abbreviated data within a day or two.

Refinements for feasibility-phase analysis are generally accomplished through use of more complete and accurate input data developed from other analysis. Relationships for changing physical stream conditions and contributing watershed would also be specified.

Philosophy of Computer Program Usage for Reconnaissance-Phase Studies

Computer programs are inherently demanding of data and produce precise (and thus appear to be quite accurate) results. Their use in reconnaissance-phase analysis is none-the-less quite appropriate. There are some important issues to examine, however.

User's manuals and training courses devoted to these computer programs tend to emphasize a single application concept -- input of accurate data and exploitation of all options of the program. Training courses at HEC, for example emphasize the complete, detailed, careful application of its programs to complex and sophisticated problems. While this is a sound philosophy that tends to minimize misuse by novices, it does not encourage innovative, abbreviated application as is the need for the studies discussed here. To some degree, this is the result of computer programs, such as HEC's, being blamed for improper application and poor results (rather than holding the analyst responsible).

Another problem is characterization of the results. Output is to decimal precision, neatly organized in computer printed reports, and often presented in quality graphic format. This further lends to the sense of accuracy and stability of results.

How many times have the hydrologic engineer and/or economist been chastised for changing the results and thus "screwing up" the study? This recurring phenomena, perceived or real as the case may be, must be overcome or productive and useful application of computer programs for abbreviated analysis in reconnaissance-phase studies simply won't occur. The quality of information available for decisions will thus be less than it could be.

The elements of the solution that can encourage innovative use of these very capable tools are: 1) experienced users encouraged to use their judgment, 2) enlightened management that understands and expects (plans for) changes in information accuracy as studies progress, and 3) increased and expanded coordination and communications among participating technical specialists, study managers, and Corps/local sponsor management.

Concluding Comments

Technical studies performed for reconnaissance-phase studies pose a major dilemma for Corps hydrologic engineers and economists. Their training and experience have equipped them to perform studies using accepted, proven methods to the detail acceptable to Division, HQUSACE, and Board of Engineers for Rivers and Harbors reviewers. In the past reporting documentation was generally not required nor scrutinized before studies were completed. While some would debate the issue, there was a measure of consensus on what is an adequate hydrologic engineering, flood damage/benefit analysis for project authorization documentation.

Now no consensus exists -- only that 12 months are available and the determination that a "likely favorable Corps project" will either be surfaced or not. The complexity of the problems and solution, and available data do not interact with the allowable time. No consistent completeness or level of confidence in technical study results is possible. Also, no matter what is produced, everyone involved (Corps reviewers, the local sponsor, and the professional himself) know that better results are possible -- even desirable! We do need at least informally, to begin to attempt to form consensus on what is an acceptable level of risk of poor decisions based on the available data at the conclusion of the reconnaissance-phase studies. Will the Corps be comfortable with 1 in 4 favorable reconnaissance-phase findings that are later found to be wrong? One in 10? Is the Corps as concerned that unfavorable reconnaissance-phase findings might, upon further investigation, be found to be wrong? Would the same failure rate be acceptable? Probably not.

It is recognized that the Corps does not anticipate noticeable numbers of wrong conclusions from reconnaissance-phase study results. It is probably an unreasonable anticipation. Perhaps experience, if we have sufficient opportunity, will resolve these issues. In the meantime, a management attitude that encourages innovation in technical study methods application, and tolerance to abbreviated data usage of traditional analysis models will contribute to increasingly efficient and effective performance of reconnaissance-phase studies.

It is concluded that adaptation of existing traditional analysis methods is appropriate for reconnaissance phase studies. Increased emphasis should be placed on establishing a field presence and performing desk-top analysis. Use of major computer programs with abbreviated data can make a meaningful contribution to the quality and reliability of these studies if Corps managers and reviewers create an appropriate climate for the working-level technical professional.

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PLAN FORMULATION STRATEGY - KAWEAH CASE STUDY

by Mary Ada Squires[1]

Introduction

The Kaweah (pronounced Ca-wē-ah) River Basin Investigation serves as a prime example of how plan formulation strategy has changed as a result of new study cost-sharing requirements. These new cost-sharing requirements for feasibility studies have, of necessity, led the potential study sponsor into actively participating in project formulation strategy during the reconnaissance phase of study. It is to the sponsor's advantage to insure that study efforts during the cost-shared feasibility studies focus on locally supported project alternatives. On the following pages, I will provide you with a brief background of the Kaweah study area and discuss the dramatic new way in which project formulation is taking place as a result of active study sponsor participation.

Description of Study Area

Location. The Kaweah River Basin is located in the San Joaquin valley in the southern portion of the great Central Valley of California, about 220 miles south of Sacramento and San Francisco and about 160 miles north of Los Angeles. The primary focus of the study is in Tulare County, the city of Visalia, and the Tulare Lakebed area. The economy of the valley is related to intensive agricultural development that produces a wide variety of crops and livestock. The major urban center in the study area is Visalia with a population of about 63,000. The total flood plain population is 68,500 including about 57,000 persons living in Visalia.

Hydrologic Conditions. As shown in Figure 1, the basin begins on the western slope of the Sierra Nevada and flows are captured in Lake Kaweah, a 143,000 acre-foot gross pool storage reservoir formed by Terminus Dam - a dam constructed by the Corps in 1962. The Kaweah River reaches the flatter slopes of the San Joaquin valley floor about 2 miles below Terminus Dam. At this point a major tributary, Dry Creek, joins the Kaweah River from the north. One mile below the confluence of Dry Creek with the Kaweah River, at McKays Point, the river is divided into two channels by a dual weir system. The northern channel becomes known as the St. Johns River, which flows north of Visalia and eventually reaches the Tulare Lakebed area. The southern channel retains the name Kaweah River and flows westerly for only a few miles before breaking into numerous distributaries which flow through and to the south of Visalia and also eventually terminate in Tulare Lakebed.

The unique aspects of the Kaweah River Basin are that (1) it is located in the arid west where, typically, there is no significant rainfall between May and September and (2) the basin terminates at Tulare Lakebed, a

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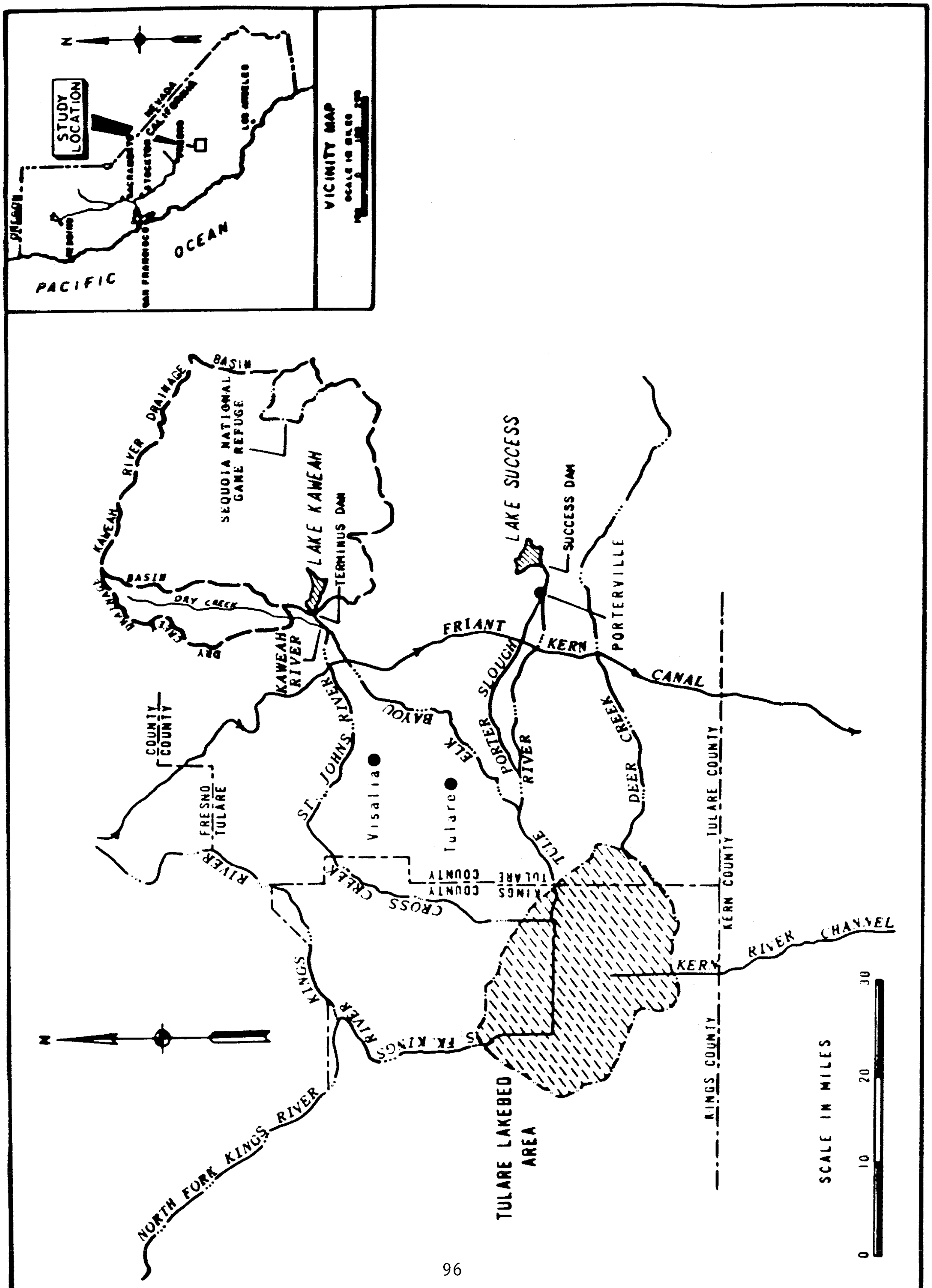


FIGURE 1 Kaweah River Basin Study Area

highly developed agricultural area, formerly a desert sink with no outlet to the sea. These conditions lead to water supply problems since there is no precipitation during the late spring and summer when growing crops need water. Also, Tulare Lakebed inherently has frequent flooding problems since it is not only the terminus of the Kaweah River but many other rivers as well.

Floodflows on the Kaweah River are of two types, winter rainfloods and spring snowmelt floods. The winter rainfloods, which occur from November through March, are caused by heavy rains and are characterized by sharp, high peaks of short duration and comparatively small volumes. The snowmelt floods occur during the period March through June and are characterized by small peaks and high volume.

The hydrologic conditions found in the Kaweah River Basin are ideal for combining flood control and irrigation water supply storage in a single reservoir. The existing Lake Kaweah is used for control of the high peak general rainfloods during the winter. In the spring, when the more predictable snowmelt runoff occurs, the runoff is stored in the reservoir for crop irrigation during the summer. In the fall, the reservoir is evacuated in preparation for high peak winter storms.

Problems and Opportunities. The major problem in the study area is the potential for severe urban flooding. Visalia and surrounding urban communities have only a 60-year level of protection from Terminus Dam and a 20-year level of protection from Dry Creek, which is the uncontrolled tributary of the Kaweah River just downstream of Terminus Dam. The perpetual need for a surface source of irrigation water supply and the dual storage capability of reservoirs in the area provide an opportunity for added water supply as well. And water-oriented sports such as boating and fishing have always had enthusiastic supporters from nearby communities and from tourists, who are predominantly from the Los Angeles area.

Preliminary Analysis

Plans Considered. Alternative measures were evaluated on the basis of conformance with planning objectives and constraints, probable hydrologic effectiveness in providing flood control, and potential local acceptance. Table 1 summarizes the measures that were examined and explains whether the measure was retained for further study.

Alternatives for Possible Further Study. Based on the study objectives of increasing flood protection and water supply, the measures with the most potential local support and technical feasibility involve increasing storage at the existing Lake Kaweah and/or controlling Dry Creek flows. These measures can be accomplished by (1) modifying the Terminus Dam spillway to allow additional storage, (2) constructing a detention basin on Dry Creek, (3) constructing a Dry Creek reservoir with a tunnel connection from Lake Kaweah, or (4) constructing a new reservoir at the confluence of Dry Creek and the Kaweah River, referred to as the Limekiln damsite.

Table 1

Plans Considered for Flood Control

Measure	Initially Chosen for Further Study	Remarks
No Action	Yes	Retained for comparative purposes
Nonstructural	No	Is not very effective for a developed area
Ground Water Recharge	No	Only incidental to other purposes
Levee Construction	No	Transfers damages to Tulare Lakebed
Increased Spreading Areas	No	Appropriate land unavailable
Diversion Canals	No	Adversely impacts local economy
Pumping into Friant-Kern Canal	No	Unreliable
Storage Upstream of Terminus Dam	No	Few benefits relative to costs
Dredging Lake Kaweah	No	Not cost effective
Storage on Other Kaweah Basin Streams	No	Flooding too localized to support costs involved
Enlarged Lake Kaweah	Yes	Reduces Kaweah River flows and is cost effective
Dry Creek Detention Basin	Yes	Controls Dry Creek flows and is cost effective
Dry Creek Reservoir with connection from Lake Kaweah	Yes	Controls Dry Creek and Kaweah River flows and is cost effective
Limekiln Reservoir	Yes	Controls Dry Creek and Kaweah River flows and is cost effective

Preliminary benefit and cost estimates developed for these measures indicate that they are economically feasible; therefore, any or all of these measures can be analyzed in more detail during the feasibility phase of the study. A more detailed description of these measures is provided below.

1) Enlargement of Lake Kaweah. The most cost effective method of increasing storage in Lake Kaweah would be through modification of the emergency spillway. The existing gross pool storage is 143,000 acre-feet. Additional storage would primarily be used for flood control with conservation storage provided when space is available. Increased capacities of 20,000 to 43,000 acre-feet (increased elevation of 10 to 21 feet) were analyzed for flood control and conservation storage. Any enlargements beyond 43,000 acre-feet would be too costly because of major road and bridge relocations. Our preliminary findings indicate that a 10-foot enlargement is not economically feasible. In addition, our studies indicate that considerable additional storage is required before any significant increased flood protection can be provided to downstream urban areas. For example, the 43,000 acre-foot enlargement would reduce 100-year flood damages in Visalia and nearby communities by one-half. This enlargement results in a 21-foot height increase to a gross pool elevation of 715 feet and a total storage capacity of 186,000 acre-feet. By comparison, a 30,000 acre-foot enlargement would reduce 100-year flood damages by one-fourth and a 20,000 acre-foot enlargement would reduce damages by only 2 percent. Enlarging Lake Kaweah would have no effect on the frequent flooding that occurs from Dry Creek flows. Through joint use of the flood control storage, additional conservation storage of up to 4,000 acre-feet a year could also be provided by enlarging Lake Kaweah.

A significant adverse impact of this measure involves the relocation of a number of residences and businesses located around the lake. All existing recreational facilities would be resited or replaced above the increased gross pool elevation. Hydropower production of the 17 megawatt plant which is currently being constructed at Terminus Dam would be reduced slightly as a result of this measure.

The preliminary cost estimate for potentially feasible enlargements of 15 feet to 21 feet ranges from $12 million to $22 million and includes the cost of in-kind replacement of existing recreational facilities which could be impacted as a result of higher gross pool elevations.

2) Dry Creek Detention Basin. A potential damsite was considered on Dry Creek about 2 miles upstream of the Kaweah River. Several small ungated detention basins, ranging in size from 19,000 to 33,000 acre-feet, were analyzed for flood control. This alternative would be effective in eliminating the relatively frequent flooding from Dry Creek, but would have little effect on the 100-year flood event, which primarily stems from Kaweah River flows. Conservation storage and/or major recreational facilities could be considered if the dam were gated. Flood damages to Tulare Lakebed would only be slightly reduced with this measure.

Preliminary cost estimates range from $20 million to $26 million depending on the size of the reservoir.

3) Dry Creek Reservoir with Connecting Tunnel. This measure involves a large Dry Creek Reservoir of about 95,000 acre-feet. The dam would be in the same location as the smaller detention basin. A connecting tunnel would allow water to be transferred from Lake Kaweah to Dry Creek Reservoir for flood control and water supply storage. This alternative would eliminate frequent Dry Creek flooding and reduce 100-year flood damages in the urban area by one-fourth. Up to 60,000 acre-feet of conservation storage could be provided.

The preliminary cost estimate for this alternative is $108 million.

4) Limekiln Reservoir. This 287,000 acre-foot storage site is located on the Kaweah River at the confluence of Dry Creek about one mile downstream from the existing dam. A gross pool elevation of 694 feet was selected, which is the same elevation as the existing gross pool at Lake Kaweah. This measure would essentially convert the existing Lake Kaweah into a large 430,000 acre-foot lake. The existing dam would be left in place. This measure would provide 130-year flood protection to the urban communities and substantially reduce flooding in Tulare Lakebed. An average annual increase in water supply from the reservoir is estimated at 27,000 acre-feet. With this measure, the new 17 megawatt powerplant that is being constructed this year at Terminus Dam would be inundated. A new powerplant could be constructed at Limekiln Dam. Major new recreational facilities could also be considered.

The preliminary cost estimate for this measure is $224 million.

Recreation. Additional new recreation facilities can be considered with any of these measures if a non-Federal recreation sponsor can be identified. The non-Federal sponsor must be willing to cost-share in the feasibility study and the construction cost of the recreation facilities and assume all operation and maintenance costs. At this time, there is no recreation sponsor. The cost estimate for an enlarged Lake Kaweah includes resiting of impacted existing public facilities only and does not reflect any additional facilities.

Impacts on Environmental Resources. Each of the alternative plans would inundate oak woodlands and riparian vegetation, thereby adversely affecting fish and wildlife habitats. The impacts of a detention basin on Dry Creek would be less severe because flooding would be short term and areas to be inundated currently have very little riparian vegetation due to past and present grazing. The impacts of Limekiln Reservoir would be most severe because there is a large amount of riparian vegetation at the confluence of Dry Creek with the Kaweah River.

Impacts to fish resources depend on the amount of stream habitat that is affected. The more miles of stream habitat that are lost, the greater the negative impact. The negative effects of losing stream habitat are offset by such benefits as increasing the storage in Lake Kaweah by modifying Terminus Dam, developing warmwater fisheries in new lakes, and enhancing stream habitat by increasing summer releases from either an enlarged Terminus Dam, Limekiln Reservoir, or Dry Creek Reservoir. Therefore, the impacts on fish resources would be both positive and negative.

The impacts to water quality would be beneficial. Enlarging Terminus Dam would increase the size of Lake Kaweah. If the depth of the lake increased, the water quality would improve. A detention basin on Dry Creek would trap sediment; therefore, the water quality in the stream would improve. If either Limekiln or Dry Creek Reservoir were constructed, there would be an increase of summer flows for irrigation releases due to the additional water supply storage. This would improve water quality in the channels below the reservoirs.

The identified impacts on air quality would be temporary or minor. Temporary impacts from dust resulting from construction activity would be minor if approved dust control measures were used. An increase in residential and recreation uses in the area would increase traffic, resulting in an adverse effect on air quality.

In terms of severity of adverse environmental impacts due to the loss of valuable riparian habitat, Limekiln Reservoir would result in the most adverse impact of the four measures considered, and enlarging existing Lake Kaweah would result in the least adverse environmental impacts.

Plan Formulation and Evaluation Strategy

Initial Formulation. About three-quarters of the way through the study, the benefit and cost data started coming together so that we could see which alternatives were potentially feasible. The four feasible measures are summarized in Table 2.

Formulation With the Study Management Team. This was the most demanding and dynamic part of the reconnaissance formulation process. Once local interests were informed that the four primary alternatives had the potential to meet the Corps economic requirements, they became very interested in the distinctions that could be made between these alternatives on the basis of project outputs and costs. Specifically, they took a hard look at (1) the level of flood protection provided, (2) cost per acre-foot for additional water supply, (3) affordability of construction costs and (4) differences in study costs. Attendees at the meeting (about a dozen representatives from irrigation districts and Tulare County) discussed these project distinctions in detail.

In terms of project outputs, local interests support flood protection and water supply. In considering flood protection, the consensus was that the urban areas should have at least 100-year level protection in order to be able to withdraw from the Flood Insurance Program. The local water district and county representatives felt it was important that any alternative selected should provide a significant level of flood protection in order to insure that there would be local urban support for the study and urban participation as a cost-sharing partner. Limekiln reservoir provided a 130-year level of flood protection. The large Dry Creek reservoir and tunnel provided about an 83-year flood protection and the other two alternatives, enlarging the existing Lake Kaweah and the Dry Creek Detention Basin, were not effective against large floods. From the standpoint of water supply, the consensus at the meeting was that the alternatives would provide water supply at an acceptable cost.

Table 2

Summary of Economically Feasible Measures

	Storage (Acre-Feet)	Project Purpose	Construction Cost ($ million)
Enlargement of Lake Kaweah	30,000 to 43,000 increased storage	Flood Control Conservation Storage	12-22
Dry Creek Detention Basin	19,000 to 33,000	Flood Control	20-26
Dry Creek Reservoir w/Connecting Tunnel	95,000	Flood Control Conservation Storage	108
Limekiln Reservoir	287,000	Flood Control Conservation Storage	224

In terms of cost, local interests considered both construction costs and study costs. Financial feasibility was considered from all angles by the representatives. The general consensus was that although Limekiln Reservoir

was an excellent idea, it was just too costly for them to be able to afford, and the significant environmental impacts might make it unacceptable to the general public. During these discussions they wanted to know what the cost allocation was, but the only data readily available was an estimate on the basis of benefit distribution. The actual cost allocation study would not be conducted until the feasibility phase of study. With a rough estimate of their non-Federal share in mind, they felt that they might be able to afford the large Dry Creek reservoir with connecting tunnel if the project could be developed so that a 100-year level of flood protection was provided. Study costs were also an area of concern since studying the large Dry Creek reservoir with tunnel option was twice as costly as just studying the enlargement of Lake Kaweah. The Lake Kaweah enlargement was the proposal that the Corps was originally requested to study. The Corps was also requested to provide a breakdown of the flood control benefits by political boundary between the city and the two counties in order to determine cost-sharing responsibilities of the potential study cost-sharing partners.

Following additional formulation, a Dry Creek project was developed that would provide a 100-year level of flood protection by combining a large Dry Creek reservoir and an enlarged connecting tunnel with a 21-foot enlargement of Lake Kaweah. In order to get an acceptable benefit-to-cost ratio, the added costs of a larger tunnel had to be offset by removing the gates from the Dry Creek reservoir outlet. The project first cost of this reformulated alternative was estimated at $125 million.

After this suitable alternative was formulated with an acceptable benefit-to-cost ratio, the lead sponsor, the Kaweah Delta Water Conservation District, initially tried to line up support from small communities who received urban flood control benefits, but that effort failed. The lead sponsor then tried to get a high level of monetary support from Visalia since the city receives about two-thirds of the potential project flood control benefits, but Visalia indicated that it was not convinced that it should participate at any level. After considerable coordination and negotiation, the lead sponsor was able to line up three additional sponsors, Tulare County, Kings County, and the city of Visalia, with the understanding that the four of them would share equally in the study costs and were making no commitment toward participation in construction costs. Now that a potential study with potential sponsors had been developed, our next step was to have a public meeting to get a political reading on the results of the reconnaissance study.

Formulation at Public Meeting. The four potentially feasible projects were discussed at the public meeting with an indication that the large Dry Creek Reservoir with connecting tunnel alternative was being reformulated to provide a 100-year level of protection and was receiving support from potential study sponsors. Based on the presentations at the meeting and comments provided later, public support and opposition were about equal. The general attitude of the opponents was that there was no flood problem and the project was only benefiting the large agricultural interests in the Tulare Lakebed area. If a new flood control project were to be constructed, however, there were advocates for additional reservoirs upstream of Lake Kaweah. None of these sites had been evaluated in any detail. The primary gist of the meeting, however, was an exchange of information with the public about the Corps findings and discussion about the future steps to be taken in the planning process. Following the public meeting, the potential study sponsor agreed to set into motion the budgetary process required to generate the local cash flow for the study.

Formulation During Higher Level Review. Although the Corps "preview of reconnaissance findings" conference held at our Division Office resulted in a number of issues related to interpretation of WRDA '86 operation and maintenance requirements, very few problems arose from a formulation standpoint. The meetings did, however, point out that the Limekiln alternative had to be carried forward into feasibility as the NED plan. It also pointed out why our NED plan is usually not financially feasible.

Let me give you an example. Limekiln costs $224 million. Since it is economically feasible,with a favorable benefit-to-cost ratio, it is bound to have large net benefits simply because of the magnitude of the dollar amount involved. In the case of Limekiln, the benefit-to-cost ratio is 1.4:1, and the net benefits are about $8 million. Now compare that with an inexpensive project like enlarging Lake Kaweah by 43,000 acre-feet. This alternative costs only $22 million. With a benefit-to-cost ratio of 1.5:1, the net benefits are less than $1 million. This cheaper alternative cannot compete with Limekiln. It would require a benefit-to-cost ratio of 4.3:1 in order for the proposal to enlarge Lake Kaweah to be competitive with the Limekiln alternative.

Formulation With Executive Committee. Now that details of the study have been developed with a group of people that have evolved into a study management team, and the formulation information has passed through a public meeting and higher level review in the Corps, there is still another formulation faction to contend with - the newly formed Executive Committee. By this time the feasibility cost-sharing agreement and accompanying scope of studies have been developed, negotiated, compromised, finalized, publicized, sanctioned by higher authority, and signed by the local sponsor and the District Engineer. And now the Executive Committee comes into play - the mayor of the city, the county supervisors and the director of the irrigation district. Now, we are no longer dealing with our technical counterparts, but with political figures who feel that they have suddenly been brought into a situation that has already been decided; i.e., the alternative to be studied will be a large Dry Creek Reservoir with connecting tunnel to provide 100-year flood protection and about 20,000 acre-feet of average annual increased water supply at a construction cost of $124 million. But the newly elected city mayor is not convinced that he has a flood problem. He would also like to see just about anything but dams being thoroughly studied during the feasibility phase of study. He is concerned about environmental impacts of the dam proposal and would also like to see environmental enhancement considered along the creek that runs through town.

The Corps and the study management team will attempt to analyze and quantify these additional proposals using available data and professional judgement without increasing the overall feasibility study cost. If some new proposal looks like it might warrant additional study, the added study costs will be estimated; and the multiple local sponsors will then need to decide who will be responsible for paying the additional study costs-all of them equally or the one requesting additional studies.

Another recent twist to formulation has surfaced in our initial executive committee meetings where consideration of possible additional project purposes is coming to the forefront. The proposed project is primarily flood control with irrigation water supply being accommodated when flood control storage is not required. It is becoming apparent, however, that the opportunities afforded by a two dam project with an interconnecting tunnel are plentiful. Additional project purposes for environmental enhancement, dedicated irrigation storage, recreation, and hydropower are being considered as possible elements to evaluate during feasibility studies.

Conclusions

Local Formulation Is Faster Than National Formulation. The major project formulation decisions are made by the locals during the reconnaissance phase of study as soon as the preliminary benefit-to-cost ratios are developed. The locals' financial commitment to study funding for feasibility is only made after they feel confident that there is an acceptable and implementable project being offered. The Corps does not have this type of strong financial commitment toward a project until the feasibility study phase has been completed and the project is authorized by Congress.

Regional and National Perception of Benefits is Different. Flood risk is a very difficult concept to convey to local interests. High flows and threatened flooding in recent years does not impress them - flooding is too easily seen as a small risk and forgotten. More visible annual benefits, water supply for instance and sometimes recreation, are more readily recognizable benefits and thus tend to be supported by the local communities.

Formulation Must Be Flexible. Based on the dynamics of formulation that will develop after the feasibility cost-sharing agreement has been signed, it is necessary to scope the project design studies so that features such as varying tunnel diameters, gates for outlet works, and smaller or larger dam sizes can be added or deleted as needed.

STUDY MANAGEMENT

BLUE RIVER BASIN CASE STUDY

Nanci Tester [1]

Overview

Geographical Region. The Blue River, a right bank tributary of the Missouri River, drains a predominantly urban area of 272 square miles. As indicated on Figure 1, Location and Vicinity, the basin is divided by the Kansas-Missouri state line, with 56 percent in Kansas and 44 percent in Missouri. The Blue River is formed by the confluence of Wolf and Coffee Creeks in Johnson County, Kansas. It flows northeasterly, entering Kansas City, Missouri at the state line, continuing to the Missouri River confluence at mile 358. It has an average annual discharge of 146 cubic feet per second (cfs). Brush Creek and Indian Creek are the principal tributaries. The reconnaissance study covers from 75th Street at the Blue River upstream and including the major tributaries of Indian Creek, Tomahawk Creek, Wolf Creek, Coffee Creek, and Mill Creek. The lower 12 miles of channel (below 63rd Street) are under going channel modification as a part of a previously authorized project.

Water Resource Problems. The flood problems on the Blue River and Indian Creek have been well documented over the past 27 years. A major flood in September 1961 caused almost $8 million in damages. The September 1977 flood which resulted from a 2-day storm centered over the Brush Creek basin cost 12 lives and over $66 million in damages, of which nearly 90 percent occurred in the Country Club Plaza district. Flood problems have plagued residents and businesses in the Overland Park, and Leawood, Kansas and Kansas City, Missouri portions of the study area since 1961. During the September 1961 flood, an approximately 40-year frequency event, a peak discharge of 41,000 cubic feet per second (cfs) was recorded at the Bannister Road gage (Blue River mile 23.16). This was the largest discharge ever observed on the Blue River. By comparison, a 100-year flood would have a peak discharge of 57,000 cfs, and a 500-year flood would have a discharge of 93,000 cfs. The largest flood of record on Indian Creek occurred on June 9, 1984. On June 8 and 9, 1984, the most severe storm of record occurred on the Indian Creek drainage basin, with rainfall amounts in excess of 8.0 inches. Additional floods in the study area occurred in 1944, 1958, and 1986.

[1] Biologist, CECW-PW, Washington, D.C.

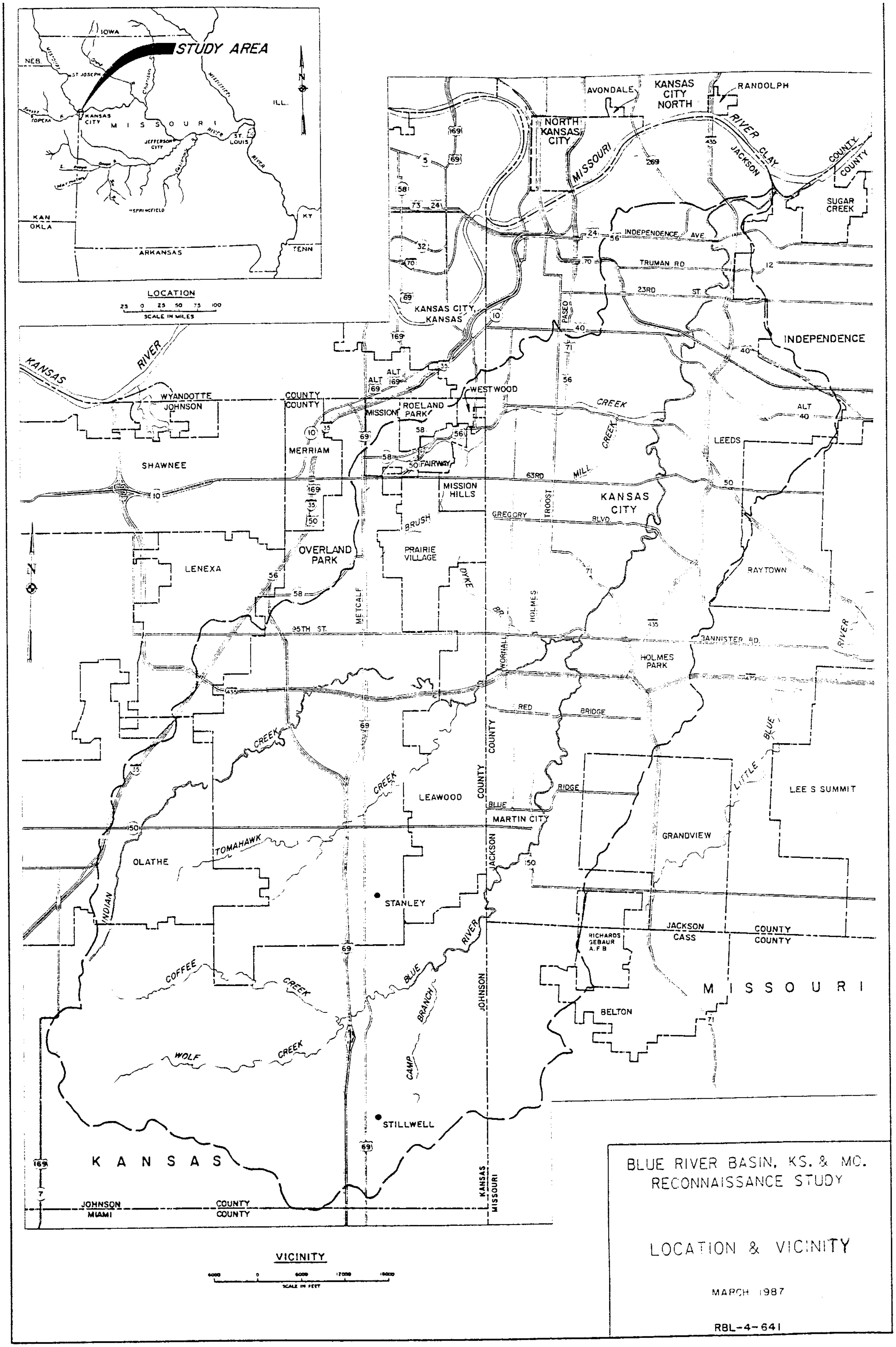


Figure 1 Location and Vicinity

Political Subdivisions. The study area jurisdiction includes 2 states, 3 counties and 7 cities. The three counties included in the study area are Johnson County, Kansas, and Cass and Jackson Counties in Missouri. The seven cities include Overland Park, Lenexa, Leawood, Prairie Village, and Olathe in Kansas, and Kansas City, and Belton in Missouri.

Reconnaissance Study Initiation. The reconnaissance study was initiated in January 1986, when $200,000 in funds were allocated to the Kansas City District, Corps of Engineers (Corps). Technical data were available from numerous sources, but mapping in the Kansas City, Missouri portion of the study area required updating. Aerial photography was flown in February 1986 and the mapping products were made available in June. The delay of this vital data attenuated plan formulation, and study completion. At the inception of the reconnaissance study, draft EC 1105-2-168 was being promulgated in the field. The requirements of that EC were instrumental in shaping the framework and outcome of the reconnaissance study. The cost sharing requirement for the feasibility study dictated that flood damage reduction solutions must be developed not only to be economically efficient, environmentally and politically acceptable, but must also be located in jurisdictions capable of financing the feasibility study. Additional reconnaissance study requirements of EC 1105-2-168 included a 12 month limitation of study, development of a cost sharing agreement for the feasibility phase of study, and Washington level reviews and certification.

Study Management Team Input

Previously, the degree of Non-Federal input at the reconnaissance level had been discretionary and informal; the new procedures formalized early Non-Federal involvement by establishing a Federal/Non-Federal Study Management Team (SMT).

The Study Management Team. All political jurisdictions within the study area were invited to participate on the SMT. The team was composed of two Corps of Engineers staffers, two representatives from the State of Kansas, and one representative each from the state of Missouri, Johnson County, Kansas, the Mid-America Regional Council, and the cities of Olathe, Overland Park, Prairie Village, Leawood, and Lenexa in Kansas and Kansas City, Missouri. The city team participants were generally City Engineers or Assistant City Engineers. State participants included departmental water resource specialists, familiar with the Corps role in water resource planning methodology.

1) While the overall level of interest in participating in the SMT was high, it was neither uniform nor consistent in the membership. Non-Federal SMT members from locations not having experienced recent flooding were peripherally involved in the SMT, being primarily interested in the outcome of the study and potential project impacts to their community or resources. Non-Federal SMT members having experienced recent flooding were more involved in the SMT process, but realistically other obligations and responsibilities limited their degree of involvement. The SMT membership represented different audiences in their jurisdictional authorities and the scope of public served. The city and county members were closer to the constituents and the political repercussions of flood devastation, while the State and Federal members had limited experience in the fundamental reactions to flood hazards and damages, approaching the study and potential solutions more problematically. Identifying agendas and determining common communication grounds were two of the early items processed in the SMT.

2) The SMT membership offered new insights in the scoping of problems, the development of potential solutions and the identification of impacts. In particular, the City representatives provided valuable assistance by coordinating with the public, soliciting contacts and providing detailed data to the Corps for the study effort. Their assistance in the reconnaissance study problem identification and inventory steps was critical to its accomplishment.

3) The City of Overland Park, KS had contracted with a private consultant group to conduct a flood control study in Overland Park, coinciding with the Corps reconnaissance study. The SMT coordination identified Corps/consultant methodology variances and technical data disparities that were addressed early and continued throughout the study period. While the dialogues and discussions with the consultant initially seemed cumbersome, their unconstrained and innovative approaches became assets to the Corps and much of their data were incorporated into the reconnaissance study. In particular, their public involvement activities, problem identification strategies and unconventional solutions required Corps staff to rethink traditional positions, and consider why not. The City staff coordinating between the Corps and the consultant exercised considerable diplomacy when caught in the middle of professional disagreements. The coordination experience with the City and their contractor had a signficantly positive impact on the reconnaissance study conclusions.

Reconnaissance Coordination Efforts

Inhouse Coordination. An inhouse team of senior staff was assembled from Hydrology/Hydraulics, Economics, Environmental Resources, Estimating and the Geo-technical branches immediately after study inception. The study manager developed a preliminary reconnaissance schedule and budget scenario for team input. Thereafter, team meetings were held to discuss data development, study assumptions, budgeting and scheduling progress. A team field trip was held during the plan formulation stage. SMT meeting minutes were coordinated with the inhouse team monthly. Technical staff coordinated with the SMT members on an as needed basis. The hydrology/hydraulic staff were particularly active in coordination with the Overland Park, Kansas staff and consultant.

Coordination with the SMT. A list of the 14 representatives participating in the SMT process is included at Table 1, Study Management Team Participants.

Table 1 Study Management Team Participants

Entity	Representative
Kansas Water Office	Tom Lowe
Kansas Division of Water Resources	Bill Funk
Missouri Department of Natural Resources	Bob Dunkeson
Johnson County, Kansas	Barry Hokanson
	Dave Peel
Overland Park, Kansas	Phil Piatt
Lenexa, Kansas	David Watkins
Leawood, Kansas	Dan Kemp
Olathe, Kansas	Steve Hansen
Prairie Village, Kansas	Jerald Robnett
Kansas City, Missouri	Mac Andrew
Mid-America Regional Council	Dave Garcia
Corps of Engineers	Dave Day
	Nanci Tester

The Corps called the first meeting to frame the Federal reconnaissance study procedures and provide copies of pertinent study regulations and the model cost sharing agreement. The SMT coordination mechanism was developed consensually. Monthly meetings were held with the Corps Study Manager facilitating the discussions, summarizing the meeting and distributing synopses to the SMT membership and inhouse technical staff. Informal meetings and conversations were held frequently among the membership. Data developed during the course of the study were shared equally among the membership.

Public Input. After the initial public workshop in February, a summary of the public interests was developed and sent to interested parties. Resource groups were apprised of the study progress periodically and specifically invited to attend and comment on a Corps presentation of potential plans in October 1986. Resource interests stated that the concept of the SMT was too narrow in that it limited membership to potential sponsors rather than to all interested parties. Although there was no apparent reconcilation on this matter, additional effort to inform the resource interests of the SMT process and involve them in the study conduct was promised. Two public meetings were held in January 1987 to transmit study findings and to solicit public comment. The potential Non-Federal Sponsors addressed the assemblage, supporting the study conclusions, and soliciting constituent input. Consistently, residents voiced frustration at the length of time required to study the problem and the perceived ambiguity on the part of the Federal partner to commit to implementing a solution.

Reconnaissance Study Results

The study conclusions and recommendations are provided below.

> "Conclusions. Flooding within the study area is most severe along Indian Creek in Overland Park, Leawood, and Kansas City, and along the Blue River from Prospect Avenue to 75th Street. Plans to reduce flooding in these areas appear to be economically feasible and environmentally acceptable.
>
> The levee plan for Mission Road at Leawood, Kansas appears to be technically and economically feasible, but has been eliminated from further consideration in the feasibility phase studies due to a lack of Federal Interest. Recent Administration policy interpretation requires Federal flood control studies to emphasize reducing flood damages for existing development. Since a large portion of benefits at the Mission Road location involve intensification of land use and projected development, it is concluded that Federal participation in that area is not warranted at this time.
>
> Overland Park and Kansas City are potential Non-Federal sponsors of a feasibility study. Both cities have the legal authority and the desire to sponsor a feasibility phase study.
>
> Recommendations. I recommend that feasibility phase studies be undertaken with Kansas City, Missouri and Overland Park, Kansas as identified in this report."

Scheduling and Budgeting Efforts for the Feasibility Phase

The Feasibility Cost Sharing Agreement (FCSA) and Appendix A, Scope of Studies (SOS) document the inhouse and the Non-Federal effort required to meet respective study goals. As a basis for negotiation with the potential Sponsor, the members of the inhouse team were requested to provide budget and schedule needs for their participation in the feasibility study. After the inhouse effort was delineated, the potential Sponsor was approached for input.

Inhouse coordination. Each organizational branch involved with the reconnaissance study and/or projected to be involved in the feasibility study was requested to provide work hours and scheduling needs to the Study Manager for compilation. After the initial draft input, a Scope of Studies (SOS) was developed and re-routed to the inhouse team members through the chain of command for their comment and/or revision.

1) Scheduling Labor. Several issues were raised in the scheduling of staff for the follow-on feasibility effort. Notably, assigning work priorities and maintaining continuity in the staff designation complicated the scheduling process. While cost shared feasibility studies ranked above most planning studies in priority, they generally compete unfavorably with military projects and civil works projects under construction. Additionally, the Blue River reconnaissance study had generated two separate feasibility studies that threatened to vie with each other for precious staff time. Micro-computer project management software was procured and Gantt charts were produced to portray the tasks, scheduling and organizational responsibilities.

2) Budgeting. The synthesis of the feasibility study budget was intense. Feasibility studies have always required accountability on the part of the teammember or their supervisor during its conduct, but developing a binding cost sharing agreement with a Non-Federal Sponsor paying for ones services rightfully generated consternation. After the initial schedule and staff members had been determined, the work rates were established. Current effective labor rates, technical indirect and overhead rates for each organizational element were determined. For simplification, branch average effective rates were typically used unless higher graded employees were the principal worker.

Negotiating with the Sponsors. After the inhouse estimate was firmed and the scope of Federal responsibility was determined, a draft Scope of Studies was proposed to each of the potential Sponsors. The Sponsors considered the proposal, adding tasks for which they would have responsibility and determining staff time required for coordination, public involvement, and administrative review.

Negotiations and justification for the SOS were premised on the government cost estimates developed for the product defined in the task. When negotiations and clarification of the tasks resulted in a mutually acceptable estimate, the SOS was finalized for review. The reviews were conducted by technical, legal and management staff by both Federal and Non-Federal partners and were then submitted for approval to the Executive Committee members. Sponsor review included presentations to the Public Works Committee of the City Council and the full Council. Authority to provide A Letter of Intent (LOI) was then granted by the City Council to the Mayor. Table 2, Feasibility Cost Sharing Agreement Coordination summarizes the major events occurring in the negotiations process with Overland Park, Kansas and Kansas City, Missouri.

Table 2 Feasibility Cost Sharing Agreements Coordination

JAN-FEB 1987	Discussed Feasibility Study tasks and estimates for work with staff. Developed draft Scope of Study (SOS) for three alternative plans.
JAN 20	Overland Park, KS & Leawood, KS Public Meeting held
JAN 22	Kansas City, MO Public Meeting held
JAN 26	Overland Park letter from Mayor Eilert expressed city support for study and interest in execution of FCSA.
JAN 30	KCD letter to Leawood, KS explaining Feasibility Study requirements.
FEB	Provided copies of draft EC 1105-2-168 (V5.02) & model FCSA to prospective nonFederal sponsors.
FEB 11	KCD letter from Public Works Dir Satterlee expressing interest in FCSA.
MAR 10	KCD forwarded draft Recon Report to MRD for review.
MAR 13	KCD and MRD field trip to study area.
MAR 23	MRD provided comments to draft Recon Report, recommended deletion of Leawood, KS element of study.
MAR 27	KCD informed Leawood City Administrator of lack of Federal Interest.
MAR 31	KCD met with Overland Park City Engineer, negotiated draft SOS.
APR 1	KCD revised Overland Park SOS, transmitted modifications to City Engineer.
APR 3	KCD letter to Leawood, KS explaining lack of Federal Interest.
APR 7	KCD met with Kansas City, MO & Dodson Development Corp to discuss KCMO plan and study cost sharing.
APR 14	KCD met with Kansas City Asst City Engineer to negotiate draft SOS.
APR 18	KCMO submitted suggested revisions to SOS.
APR 19	KCD transmitted comments to KCMO on suggested revisions.
APR 24	KCD met with KCMO Asst City Engineer to resolve differences.
MAY 4	KCD verified KCMO final SOS.
MAY 5	KCD verified Overland Park final SOS.
MAY 7	KCD met with county & KCMO to discuss without conditions.
MAY 8	KCD submitted letter to Overland Park Mayor, requesting letter of intent and providing draft FCSA, SOS and data on scheduling cash contributions.
MAY 11	KCD submitted letter to Kansas City Mayor requesting letter of intent and providing draft FCSA, SOS and data on scheduling cash contributions.
MAY 11	Overland Park city council met, passed resolution authorizing Mayor to provide the letter of intent.
MAY 11	Overland Park, KS provided letter of intent to support the Feasibility Study.
MAY 26	Kansas City, MO provided letter of intent to support the Feasibility Study.

Feasibility Study Initiation, Renegotiation and Processing

The Reconnaissance report, FCSA's and Letters of Intent were forwarded for certification in May 1987. Certification was received in September 1987. The Overland Park, Kansas Feasibility study was initiated November 2, 1987 with receipt of the Federal work allowance and the Sponsors check in the district office. A notice of study initiation was sent to all persons on the study mailing list and to area newspapers. In June 1988, plan reformulation and increases in the technical indirect rates necessitated amending the FCSA. Reformulation was required when technical and institutional constraints essentially obviated the plan developed in the reconnaissance study. Unforeseen complications surrounding A sanitary sewer alinement and interior drainage dictate a modified solution be sought.

Unfortunately, technical indirect and overhead rates are not as stable as the effective labor rates. After the cost sharing agreement was negotiated significant Federal indirect rate increases impacted the study costs. Reformulation accounted for the remainder of the increase and extension of the study period from 12 to 20 months. The renegotiation was accomplished by additional inhouse budget and schedule coordination and re-negotiation with Sponsor staff, and City Council. The Executive Committee approved the amendment, and the Federal and Non-Federal Sponsor provided additional funds.

Summary and Conclusions

Summary. The Blue River Basin Reconnaissance Study SMT experience was positive and an invigorating influence on the study management aspects of the reconnaissance study, largely due to the members professionalism and the esprit de corps generated by the team. However, the reconnaissance study process continues to be fraught with frustrating complications and debilitating inefficiencies. Retrospectively, after entering into the feasibility phase study with Overland Park, Kansas, having initiated a new feasibility phase study with the Kansas City, Missouri Blue River partner and having completed another reconnaissance study in the interim period, it is my impression that the following issues will continue to reduce the efficacy of the program.

1) Reconnaissance level plan development in a basin situation (or in any complicated study scenario) requires indepth data to ensure a good scope of study and cost estimate. If current baseline data is unavailable or if funding is inadequate, reconnaissance study findings will miss or incorrectly assess concerns, translating into difficult, unwieldy problems during the feasibility phase of study.

2) Defining in-house work priorities in a low budget environment is a frequent source of friction for the team-members, the first line supervisors and the study managers. The project management concept may, in part, alleviate ambiguity but the staff and budget limitations are likely to continue.

3) The Federal accounting system is archaic and unresponsive to study management needs. There is no downward reporting mechanism available in the system to check expenditures or track schedules. The utilization of micro-computers and the acquisition of study management software facilitate the study manager's ability to manually compile data but they do not disguise the fact that the study managers' data manipulation is a redundant function that would be better suited to a responsive system network. Study management could be better accomplished with forethought rather than hindsight.

Conclusion. The development of an open, trusting partnership with potential Sponsors and Sponsors is crucial to the success of the reconnaissance and feasibility studies. The Corps must be responsive to the Non-Federal partner and public needs, capitalizing on its technical prowess and reputation for developing and implementing sound solutions.

RECONNAISSANCE STUDY FOR OVERLAND PARK

by Phil D. Piatt, P.E.[1]

Introduction

First, I would like to thank the Corps of Engineers for the opportunity to appear at this meeting. Your efforts to bring together participants from several parts of the country representing a broad range of experience is a worthwhile undertaking. Of course, I hope your hearing of our experiences in Overland Park will have some beneficial results in your planning for future studies.

Overland Park is a rapidly growing suburb of Kansas City, Missouri. We are on the Kansas side of the state line near the southwest edge of the urbanized area. The first slide **(Slide 1)** shows the geographical relationship of Overland Park to the Kansas City metropolitan area. The city includes over fifty square miles of area, and is approximately sixty percent developed at the present time, Population exceeds 90,000 of Kansas City's metropolitan population of approximately 1,200,000 persons.

Overland Park has grown rapidly over the past few years. Office and commercial development, resulting in construction of quality homes and apartments have made Overland Park a community of well above average income, as well as high expectations for public services. A large portion of the recent development has been in the Indian Creek drainage basin, resulting in rapid rises in the creek in the higher frequency rainfall events.

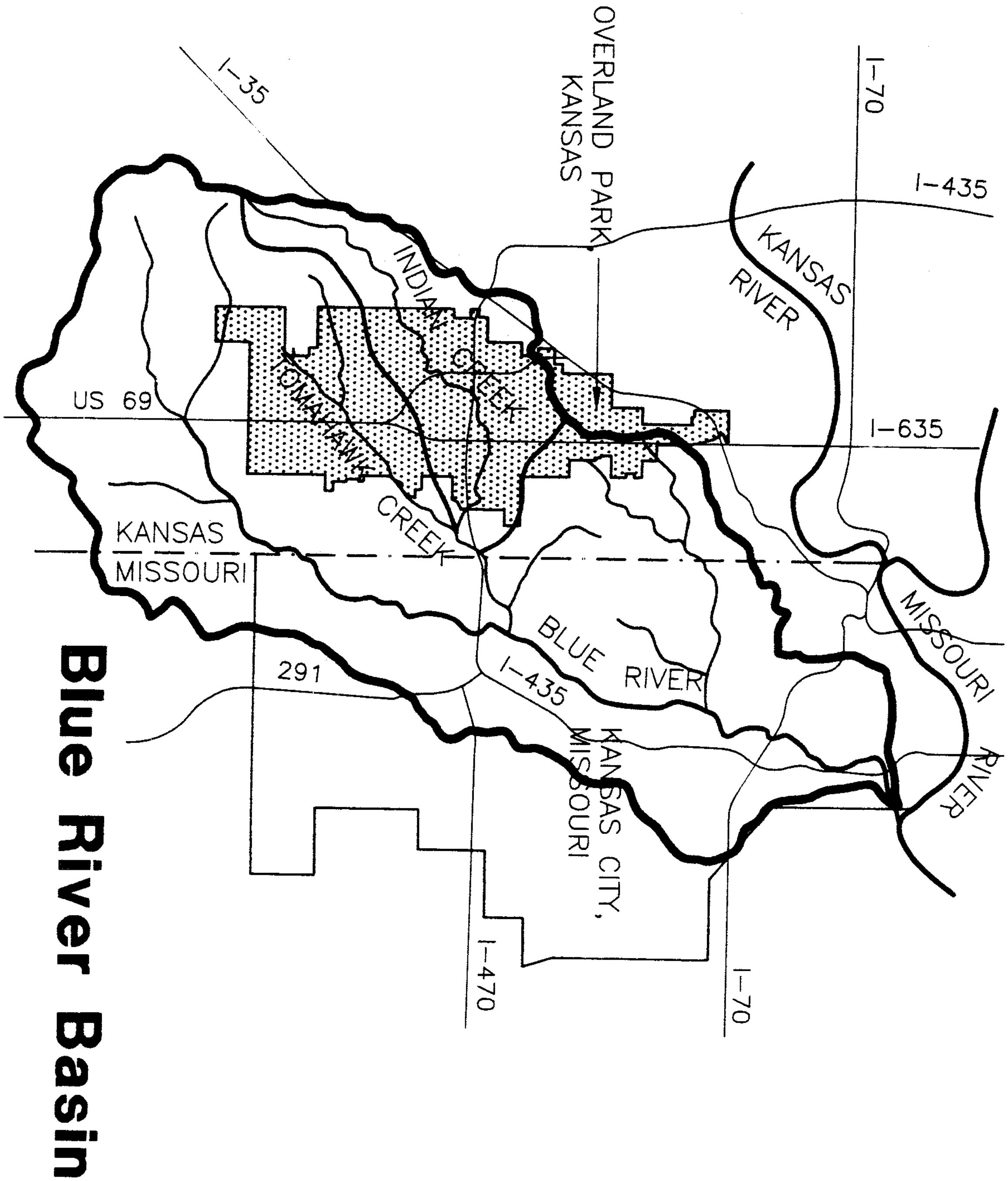
1984 Flood on Indian Creek

In June of 1984, a serious flood occurred on Indian Creek. The second slide **(Slide 2)** shows the location of Indian Creek through Overland Park. This basin is largely urbanized. The upstream, or southwest, portion of the watershed in Olathe is completely developed, as is the downstream portion located in the developed parts of Overland Park. The central portion of the watershed is not totally developed, but soon will be if current development trends continue.

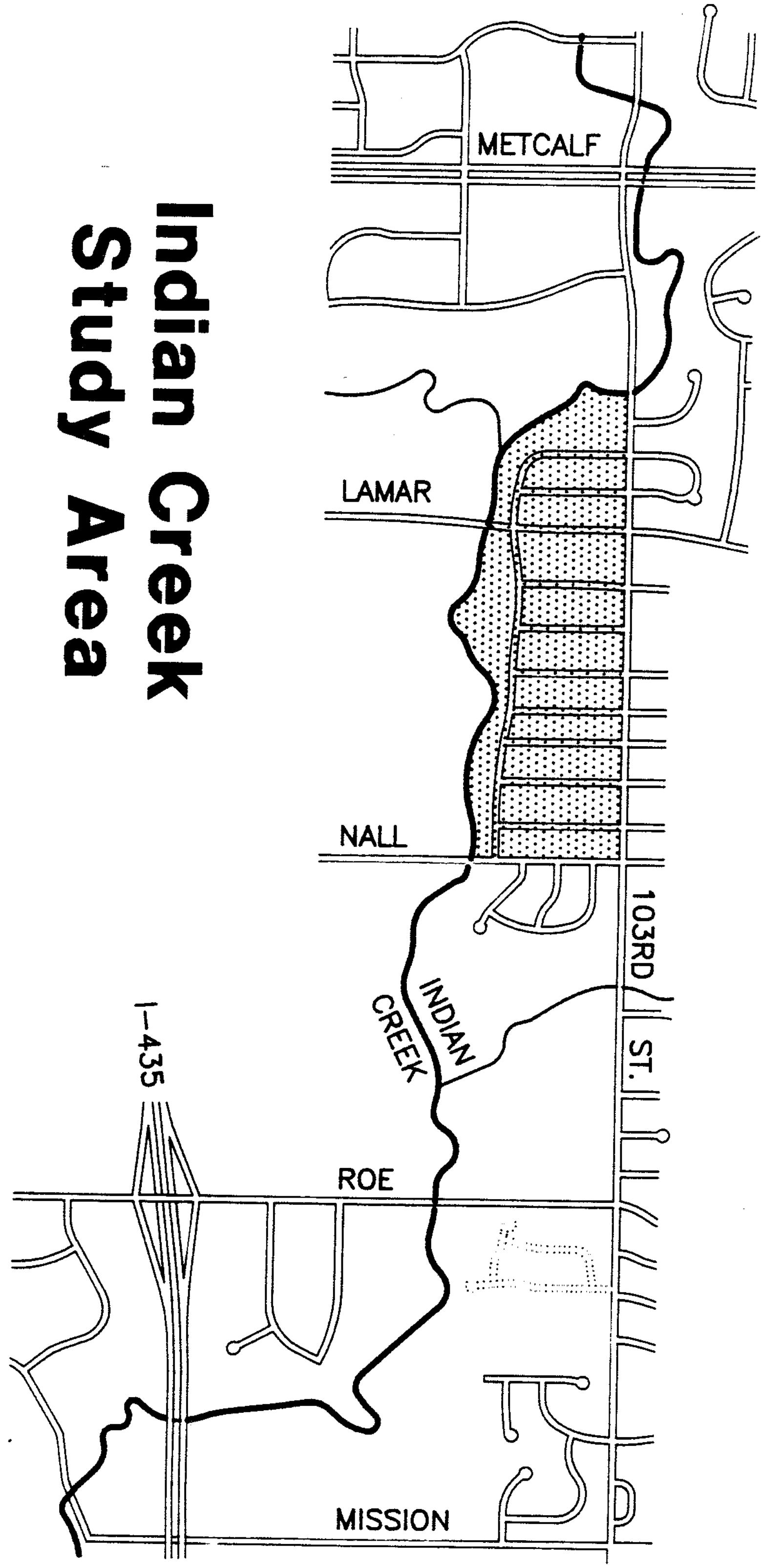
In the 1984 event rainfall typically was eight inches over most of the Indian Creek watershed. The rain fell within a twelve hour period, although the heaviest bursts, and nearly six and one-half inches of the total, occurred within approximately a five hour period. For the Kansas City area five and one-half inches of rain in five hours or seven inches in twelve hours would be a 100-year frequency event.

Flooding occurred along the entire length of Indian Creek. No homes or buildings were flooded in the newer areas of the city constructed since our flood plain ordinance was put into effect in the mid-1970's. However, some automobiles were damaged in parking lots, as a parking lot is an allowable use in a 100-year floodplain.

[1]City Engineer, Overland Park, Kansas.


Blue River Basin
OVERLAND PARK, KANSAS
I-35
I-70
I-435
KANSAS RIVER
INDIAN CREEK
TOMAHAWK CREEK
US 69
I-635
KANSAS
MISSOURI
BLUE RIVER
MISSOURI RIVER
291
I-435
KANSAS CITY, MISSOURI
I-470
I-70

Slide 1


Indian Creek
Study Area
METCALF
LAMAR
NALL
103RD ST.
INDIAN CREEK
I-435
ROE
MISSION

Slide 2

Slide 3

Slide 4

In the area just west of Metcalf Avenue, as shown in the third and fourth slides **(Slide 3 and 4)** street flooding occurred, as well as flooding of some apartment and condominium units constructed prior to our floodplain ordinance.

In the area east of Metcalf and west of Nall Avenue many homes were flooded in basements, garages, and living spaces. This is a portion of the Nall Hills subdivision which was platted and constructed in the early 1960's before flood plain regulations were put into effect. Flood damage was estimated by the Corps of Engineers in the Blue River Reconnaissance Study at $2,250,000.

East of Nall Avenue the major flooding occurred on park land except near the east city limit where flooding occurred in a commercial area. Damages were relatively small compared to Nall Hills, but future plans to correct flood damage problems should include flood protection and/or flood proofing in this area to prevent loss of property values. Again, damaged buildings were erected prior to our floodplain ordinance.

<u>1984 Flood Frequency.</u> At the engineering staff level, one of our engineering interests after the flood waters receded was establishing the frequency of the flood event. Therefore, high water elevations were taken along the creek. These high water marks were easily discernible from debris on fences, trees, and lawns, or stains on the sides of the buildings.

Just prior to this time the Corps had provided a preliminary flood study for the Federal Emergency Management Agency (FEMA) initiated at the city's request in September of 1978 because of rapid development in the Indian Creek watershed. The high water mark elevations plotted on these new flood profiles showed the flood to be about one foot above the 500-year flood in the more western areas of the city, down to generally halfway between the ten and fifty-year flood in Nall Hills. Obviously, these rather inconsistent results indicated something was wrong with the profiles. Subsequently, a mapping problem was discovered by the Corps, and since that time a new preliminary study has been furnished. The 1984 high water marks plotted on this latest preliminary study indicate much more consistent results.

<u>Floodplain Ordinance Enforcement.</u> In Overland Park we have tried to be conscientious in enforcing our flood plain ordinance. In the 1984 flood, the only damages that occurred were in areas of the city where the construction was done prior to adoption of the flood plain ordinance in 1977. To date, no flooding of homes or buildings built after 1977 has occurred that we know of. This indicates very accurate, or very conservative, flood calculations promulgated by FEMA, as well as serious enforcement of the flood plain ordinance by the city. However, since Nall Hills subdivision was constructed in the early 1960's portions of the subdivision are subject to flooding of homes in floods exceeding a ten-year flood. This is an example of the type of flood-prone development the National Flood Insurance Program is designed to prevent.

<u>Local Reaction.</u> After the flood had subsided and basic clean-up had been completed, concerned citizens and City Councilpersons discussed efforts to prevent a reoccurrence. The "Indian Creek Committee" was formed as a

citizens' group to provide liaison between city efforts to prevent flooding and other citizens in the Nall Hills area. This group met monthly at City Hall with a ward councilman from that ward and certain department and division heads from city staff. Discussions were wide ranging, including limiting further development in the watershed, keeping the channel clean of trash and fallen trees, a flood early warning system, further flood studies, and proposed construction of systems to reduce or eliminate flooding of homes.

All the foregoing remedies were pursued to the maximum extent possible -- except stopping development in the watershed. City forces have worked on several occasions removing fallen trees and trash from the creek. Though none of this work was considered to have a measurable effect on flood flows the City expended considerable effort to show good will. A flood early warning system was also installed in a cooperative effort with the U.S. Weather Service. The City furnished hardware and software, and the Weather Service agreed to monitor the data, enter forecasts into the system, and issue warnings as required. This system will give approximately a two hour flood warning based on Weather Service forecasts.

The HDR Study

The City entered into an agreement with HDR Infrastructure Consulting Engineers of Omaha, Nebraska, in early fall of 1985 to study flood flows on Indian Creek and to make recommendations on flood control methods. At the time HDR was hired we did not know that the Corps of Engineers would move ahead with its Blue River Reconnaissance Study, which included Indian Creek as a tributary of Blue River. The HDR study was completed in November of 1986. The Corps was only a few months behind, as it turned out, with their report being issued in May of 1987. HDR engineers worked cooperatively with the Kansas City Corps office and furnished and exchanged relevant data. Though it now appears that the HDR study was not needed, the City benefited by working very closely with the HDR engineers and sharing ideas. Some of the differences between the studies will be discussed a little later.

Blue River Reconnaissance Study

The Corps of Engineers began the Blue River Reconnaissance Study about January of 1986. The first meeting with potential non-federal sponsors was held in April of 1986. Since Indian Creek is included in the Blue River Watershed we were included as a non-federal sponsor along with several other cities within that watershed. The City Engineer was appointed to the Study Management Team. One city councilman representing the area of the city damaged by Indian Creek flooding was appointed to the Executive Committee.

Information Exchange. In my opinion the Corps did everything possible to keep the Study Management Team representatives informed of the scope of study and the progress that was being made. Nanci Tester was our study manager. She was very thorough in keeping the Study Management Team informed of every aspect of the study.

I feel the Corps' plan for this type of ongoing local involvement in the process was a very good one. No matter what question arose concerning the Reconnaissance Study I was able to provide answers to the Director of Public Works, City Manager, or interested City Council members. In addition, by having a City Council member on the Executive Committee there was direct access to the City's highest policy making body for the basic Agreement and other high level reports and discussions that were outside the engineering aspects of the study.

Status reports on the progress of the Reconnaissance Study were included as part of our monthly Study Management Team meetings including some discussion of each phase of the work. Those on the Study Management Team included not only local city engineers, such as myself, but also county, regional, and state water and environmental officials. In June of 1986, Nanci arranged a tour of the study area. For most of us, who had a limited knowledge of the flooding problems outside our jurisdictional boundaries the trip was very worthwhile in giving us all a much broader perspective.

The involvement of many local, regional, and state officials, the identification of opportunities as well as problems in the study area, the first-hand look at the entire area, and the full explanation of the Corps' work during every phase of the study reflected the Corps' commitment to providing a full and open exchange of information throughout the Reconnaissance Study. Assuming this type of full information exchange is the policy of the Corps in this type of study, you can be sure the policy was fully carried out by the Kansas City Corps of Engineers office in this case.

Concerns

Despite the many positive aspects of this study effort there were a few areas which have caused us some concerns. Some of these resulted from our unique situation wherein we had a private consultant doing exactly the same sort of study just a few months in advance of the Corps Reconnaissance Study.

Delays. The first of these concerns is the time that has elapsed between the flood in June of 1984 and today's date, with the issue still under study and no improvements either in place, under construction, or even in the final plans stage. This amount of elapsed time exceeds four years so far. Citizen concerns have been strongly expressed about the lack of responsiveness of the city. No one understands why it will take eventually five years, including four years of active study, before the Feasibility Study is completed and plans can be started.

Perhaps there is no real need for both a Reconnaissance Study and a Feasibility Study. Of course, one purpose of a Reconnaissance Study is to determine whether a project is worth further consideration based on its benefit/cost ratio. If it isn't, it is dropped from further consideration for a Feasibility Study. If the project appears feasible after a full Feasibility Study, presumably it would be eligible for planning for a project. In between each phase of this process is a period of time to work out the details and gain approval of an additional Agreement. In our case, this past year the elapsed time between the end of the Reconnaissance Study and the beginning of the Feasibility Study was approximately six months.

Perhaps one Agreement is all that is necessary. The Corps could study the project and if it appeared feasible, then start on construction plans. The Agreement could give the Corps authority to give notice of abandoning the work at any time the project could be deemed uneconomical or unfeasible in any way. The local sponsor could also have authority to give notice to the Corps that they no longer desire the project or did not wish to fund it any further. This would be a seamless, ongoing, virtually delay proof, goal oriented process, yet subject to controls on both sides.

In our case, the HDR study could have sufficed for a preliminary study to establish project cost. If final plans had been authorized at the completion of the study we would be well into construction at this time. However, because of differences with the Corps analysis, no further action was taken.

Benefit/Cost. Though this next issue has not been discussed at the City Council level to my knowledge, staff has debated over the favorable benefit/cost ratio aspect of federal requirements for these types of projects. We understand the need for some test of reasonableness on whether the federal government should commit funds. A favorable benefit/cost ratio does seem to be a reasonable test. The problem is that it is not always easy to calculate the costs, either in human terms or in terms of future costs. In the case of our Nall Hills area, repeated flooding would surely result in eventual loss of property values. The present calculations take actual "damages" into account, assuming the property regains its original value as soon as clean-up and repairs are complete. Unfortunately, we all really know the neighborhood will eventually become stigmatized or even permanently damaged causing a lowering of property values. In contrast to this approach, the Overland Park City Council is committed to solving these flooding problems in affected areas. This is a political response -- with no negative connotations of the term 'political' intended. It is a case of personal hardships in the here and now with obvious future ramifications - a political question of who gets what, where, when and how. Regardless of the degree of federal participation the City Council feels obligated to correct the problems.

Technical Differences - Computer Modeling. As far as technical differences between the HDR study and the Corps study I don't feel entirely qualified to discuss these differences in depth. There were significant differences, however. At the outset, to calibrate their model, HDR took a wealth of rainfall data from the 1984 event, plugged it into their model and adjusted the model until it matched the creek stages and timing along the entire length of Indian Creek using our shot elevations to check against the creek stages. The discharge, timing, and shape of the hydrograph, and creek stages at the Marty St. USGS gauging station just west of Metcalf were matched as well.

Using this model, the available rainfall data from a previous 1977 flood event was entered. Though surveyed flood elevations along the entire creek were not available from that flood, the model matched the creek stage and discharge and timing of the hydrograph at the Marty St. gauge.

With this degree of verification of the computer model HDR felt comfortable that their results would be of reasonable accuracy. HDR's evaluation of our 1984 flood event pegged it at approximately a 200-year flood. When the Corps pegged it at about a 70-year event it became obvious there were major differences between the two computer models. During subsequent discussions it was brought out that the Corps' model also matched the 1984 peak discharge fairly closely, but missed the time by nearly three hours, early. If true, this could help explain the difference in the perceived frequency of the 1984 flood event. If the Corps had the basin modeled to run off more quickly, the 1984 discharge would not appear to be as rare an event as the slower HDR model.

We were unable to take any position on this issue in the Engineering Division at the City of Overland Park because we don't really know which analysis was more correct. However, if HDR was correct then any design done for a flood protection project in Nall Hills by the Corps will be based on a flood that exceeds a 200-year event. Personally, I don't want to speculate on which analysis was more correct.

In order to have their study reflect conditions as they would exist in the future, HDR ran another synthetic condition anticipating full watershed development. The City's long range master development plan was used as the basis for future development. This type of "future" analysis would appear to be the correct method on which to base a flood control project. However, since FEMA recognizes only the present condition on flood studies, presumably the ample three feet of levee freeboard required by the Corps is supposed to account for future development.

The difference between HDR's "present" condition and their "future" condition was significant, and they recommended the design of the flood protection system be based on the "future" condition analysis. The recommendation of a so-called "future" condition with three feet of freeboard on the levee did seem somewhat excessive to us. However, this was nearly the equivalent of the Corps "present" condition -- whereby the larger freeboard would be justifiable. Personally, I believe a very careful or somewhat conservative analysis of the "future" condition with one foot of freeboard would be appropriate.

The HDR remedy called for a low meandering landform two and one-half to four and one-half feet in height along with channel modifications above the bottom five feet of the channel. According to their calculations the water level would be pulled down sufficiently by the enlarged channel section and decreased "n" values that their low levee, or landform, would be sufficient. The current analysis for the Feasibility Phase study being done by the Corps utilizes a much higher levee, and channel enlargements in some areas. The local Corps analysis does not yield the same results, apparently, as the HDR analysis. Again, I don't know who is correct. Of course, we are committed to use the Corps analysis. Our HDR study is shelved. On the other hand, we know the lower levees, or landforms, proposed by HDR provided an easier solution to the Nall Hills flooding problem -- if they are accurate.

Accuracy. We aren't sure what lesson could be learned from this. In working with HDR we felt we were working with experienced and competent engineers who were doing the best job they could in analyzing Indian Creek. We also know the Corps of Engineers probably has more experience with flood studies than anyone else in the world. Of course, each creek, even within a given region of the country, is different from all others, despite regional similarities. Analysis of a watershed requires time in the field to analyze "n" values, condition of banks and overbank areas, and geometry at bridges. We know that Indian Creek is far different from nearby, more rural, Tomahawk Creek, and both streams are greatly different from Brush Creek, farther to the north and east in an older part of the metropolitan area. For example, virtually all of the Brush Creek watershed is storm sewered, and portions of the channel are enclosed in culverts or are concrete lined. Much of Indian Creek is storm sewered, but most of its length is bordered by parks or a greenway. Parts of the watershed are undeveloped. None of the channel is lined with concrete or enclosed in culverts. We presume the Corps' models of these three streams reflects these great differences, but we have no knowledge of the Corps' model, or policy on such matters. Nor do we have any good reasons to believe Corps practices are any worse than HDR practices, but we know they are different.

One reason I am discussing this issue of accuracy is because of a problem with a FEMA engineering consultant doing a recent Flood Insurance Study on Tomahawk Creek. This consultant shall be nameless, but it is a well-known major consulting firm (not HDR). Part of their contract was to meet with the individual cities and discuss the results of their study. After a few minutes of discussion it became apparent they were far in error on the road crossings. They also stated they had never left the office to look at the creek to field check their assigned "n" values. In Overland Park it was necessary to re-run parts of the study to satisfy my office and to bring it more in line with good practice. I don't know about the other communities along other streams studied by the same consultant who could have erroneous flood studies.

Another reason for discussing the issue of accuracy is that a three foot error was discovered by the above nameless consultant (to their credit) in our original (1977) Flood Insurance Study on Tomahawk Creek. By following the provisions of that 1977 study, houses were being built three feet too low in a subdivision adjacent to Tomahawk Creek. Of course, FEMA took no responsibility for the error even though the original erroneous study and creek profiles were promulgated by FEMA. In order to correct the situation the Developer and the City worked cooperatively to make channel modifications and changes to plans for a soon-to-be-constructed bridge. We were given a very tight deadline to effect major floodplain changes based on extensive analysis of the hydrology and hydraulics of that reach of Tomahawk Creek. FEMA has taken no further action to implement their study despite the extremely tight deadline given the city and the developer in making a major flood analysis and completing construction on the creek channel changes. My point in this digression from the Blue River Reconnaissance and Feasibility Studies discussion is to point up the need for accuracy in making flood studies. In the last several years Overland Park has been involved in several major discrepancies relating to flood studies. For communities like ourselves, who are serious about floodplain management, a series of obvious mistakes or disagreements on floodplain studies is troublesome, expensive, and demoralizing. As time goes by, no doubt more and more consultants and governmental organizations will have the capability to perform these analyses. Even my own small engineering division has the expertise, equipment, and software to perform these studies. We don't have the manpower to sustain an extended effort in that field, but we have done some of our own studies. Hopefully, the prevailing standards for performing this work in the future, will relate more to technical excellence in evaluating each individual watershed, rather than relying on too much standardization where watersheds are obviously quite different.

Sanitary Sewers. I suppose I should mention one other problem with the Reconnaissance Study that did not become obvious until much later during the Feasibility Study. Though reconnaissance studies are supposed to be very preliminary in nature, adequate mainly for establishing approximate benefit/cost data, in our case a potentially very expensive item was overlooked. As all of us here who are engineers should know, major sanitary sewers often are located along creeks or rivers because of the need to provide gravity sewage flow to the sewage treatment plant. Also, we don't like to have major sanitary sewers located under levees, partly because of the superimposed load of the levee which may collapse the sewer, and partly because the sewer may provide a conduit through or under the levee, thereby compromising its ability to contain a flood. In our case, neither HDR nor the Corps of Engineers made any allowance for a major interceptor sewer following Indian Creek on its way through Nall Hills to the sewage treatment plant a couple of miles downstream. The expense of structurally lining the sewer or providing an arch encasement may result in an uneconomical project. Standard procedures for performing Reconnaissance Studies should include procedures for evaluating costs of utility relocations -- particularly sanitary sewers! If the Reconnaissance and Feasibility Reports could have somehow been condensed into one report the information would probably have been available and evaluated at a more convenient stage in the investigation.

Conclusion

Again, I would like to thank the Corps for your continued efforts in solving our flooding problems. Your openness in evaluating your procedures is commendable, and I am very appreciative of the opportunity to be a part of the dialogue. Despite some technical questions, I am confident we will complete our Indian Creek project to provide safe and economical flood protection for the Nall Hills neighborhood in Overland Park.

MANAGEMENT OF RECONNAISSANCE PHASE STUDIES

James F. Johnson

Introduction.

This paper will address the problems of managing a program that includes several reconnaissance phase studies, and the lessons learned from this experience. We have initiated eight reconnaissance studies under the two-phase planning approach since 1984, and we have completed seven. These have led to six cost-shared feasibility studies, one of which is sponsored by two states. In addition, we are scheduled to initiate an "appraisal" study this fiscal year and another reconnaissance study in FY 1989. All of these reconnaissance studies reflect high Administration priorities; they either have had, or we expect that they will lead to, cost-shared feasibility studies; and they should result in economically feasible projects. Based on our experience with a full range of cost-sharing partners; and economic, geographic, institutional, and other conditions, the system of cost-shared, two-phased planning is working. However, there are several obstacles that add to the difficulty in managing these studies.

Background.

Baltimore District has an active and growing civil works program that resulted from both serious regional water resource problems and strong initiatives taken by the District to explain its programs to state, regional, and local governments. Over the past several years, we have held numerous meetings with these government officials in an effort to thoroughly explain our programs, policies, procedures, and resources. In addition, we have developed a water resources assistance brochure that provides a detailed explanation of our program in "plain english," and we have incorporated that brochure into District responses to inquiries on water resource problems.

As anticipated, government officials have become much more familiar with our programs, how we can address their problems, as well as the hard "facts of life" on study and project cost-sharing. They have responded with interest and support for reconnaissance studies to address their water

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Chief, Planning Division, Baltimore District

resource problems, and have backed up this interest "with their wallets," by joining with the Corps in undertaking cost-shared feasibility studies. Our current partners include state water resource and transportation agencies, regional commissions, and local communities.

Baltimore Reconnaissance Studies.

Although this seminar is oriented toward reconnaissance phase flood control studies, the experience that we have gained from our other studies also is useful. I would like to explain our program in greater detail in order to put our experience in perspective. We currently have reconnaissance and feasibility studies underway in three broad water resource regions (Figure 1). Table 1 identifies the reconnaissance studies underway and recently completed, and displays graphically their pertinent characteristics.

TABLE 1
BALTIMORE DISTRICT RECONNAISSANCE STUDIES

Name	Type	Feas Cost	Sponsor	Contribution
Petersburg,WV	FC	$818,000	ICPRB	Cash,In-Kind
Moorefield,WV	FC	$953,000	ICPRB	Cash,In-Kind
South Branch,WV	FC	N/A	---	--
Lackawanna,PA	FC	$1,920,000	PA/Loc	Cash
Chesapeake Bay Shoreline	SP	$2,970,000	MD,VA	Cash,In-Kind
Chesapeake Bay Reallocation	MP	N/A	---	--
Gwynns Falls(205)	FC	$120,000	Balto	Cash
North Beach(103)	SP	$100,000	MD DoT	Cash

FC= Flood Control
SP= Shoreline Protection
MP= Multiple Purpose

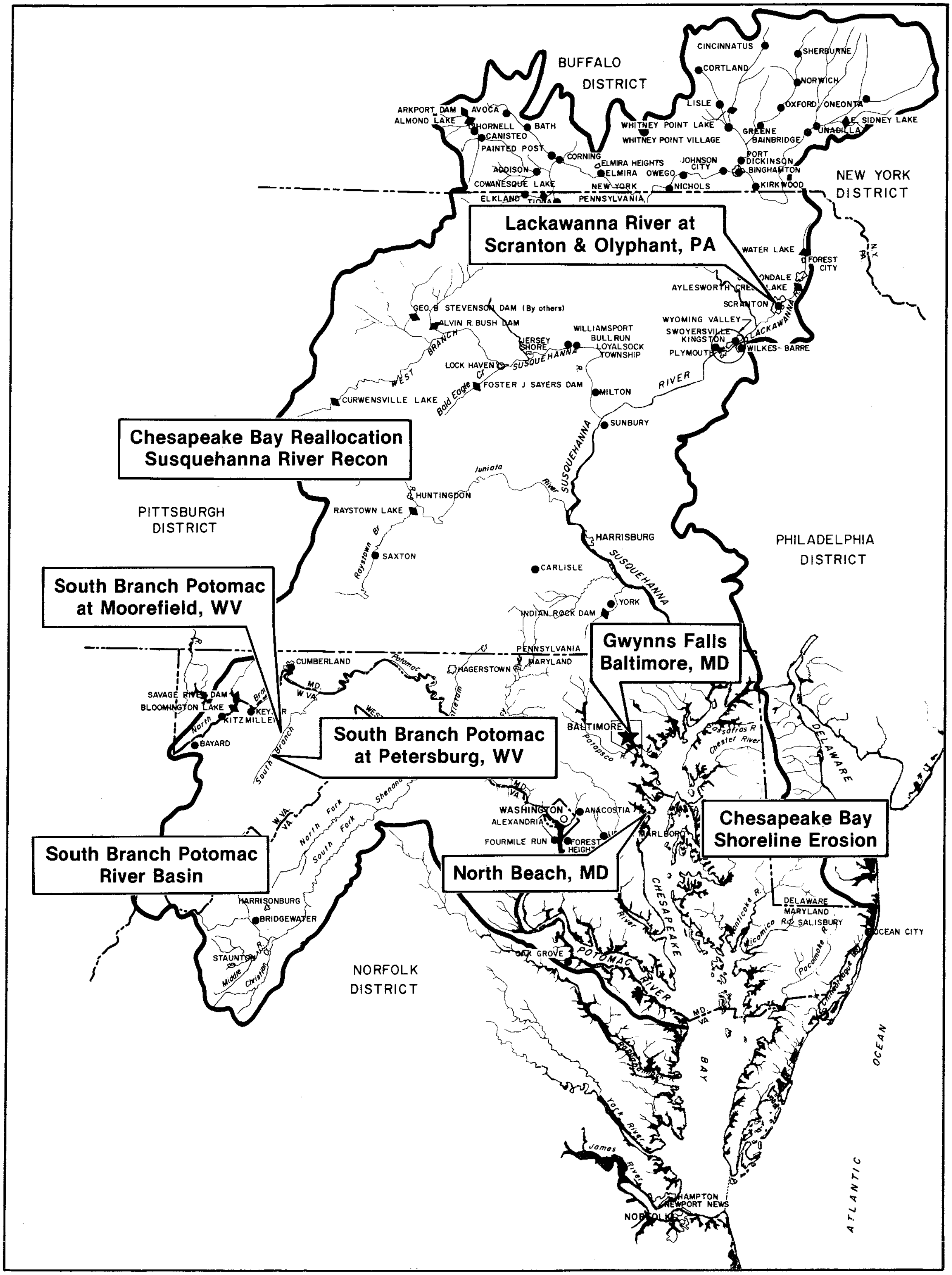

Figure 1. Reconnaissance and Feasibility Studies, Baltimore District, August 1988.

Upper Potomac River Basin. In November 1985, remnants of Tropical Storm Juan combined with a storm moving in from the West to bring heavy rainfall and severe flooding to the Upper Potomac River basin in West Virginia and Virginia. The basin was ravaged by a 400 year flood event, suffering some $360 million in damages. Funds were reprogrammed at HQUSACE to initiate reconnaissance studies for flood protection projects at Petersburg and Moorefield, West Virginia, and for flood control/multiple purpose reservoirs in the South Branch of the Potomac River.

The reconnaissance studies were initiated in September 1986 and completed in September 1987. The studies identified economically feasible levee projects in both communities, ranging in cost from $8 million to $13 million at Petersburg and from $9 million to $17 million at Moorefield, depending on the level of protection. Based on the reconnaissance study results, the District entered into an agreement with the Interstate Commission on the Potomac River Basin (ICPRB) to undertake cost-shared feasibility studies at Petersburg and Moorefield. The South Branch study found that reservoirs were not economically feasible, and recommended that a basin-wide flood warning system be investigated at a future date. The Petersburg and Moorefield feasibility studies were initiated in February 1988, with the non-Federal sponsors providing both contributed funds and in-kind services. The ICPRB has entered into separate agreements with the State of West Virginia and the two local communities. The study has received strong support from Senator Robert Byrd, Governor Arch Moore, ICPRB and the communities of Petersburg and Moorefield.

The community of Waynesboro, Virginia also was severely flooded during the storm of November 1985. Baltimore District conducted an initial appraisal shortly thereafter, and recommended a follow-on flood control reconnaissance study. We are scheduled to initiate this reconnaissance study in FY 1989.

Lackawanna River Basin. In September 1985, Hurricane Gloria moved up the Atlantic Coast, bringing substantial flooding to the Lackawanna River basin in the vicinity of Scranton, Pennsylvania. The region was declared a Federal disaster area, and in response to numerous requests from local governments, the District undertook several initial appraisals under the continuing authorities program. The area suffered moderate flooding again in March 1986. Subsequently, funds were added to the FY 1987 Appropriations Bill for the Corps to undertake a basin-wide flood control reconnaissance study.

The reconnaissance study was initiated in December 1986 and completed in June 1988. The study found that both levees and channelization were economically feasible at Scranton at a cost ranging from $2 million to $12 million depending on the type and level of protection, and that channelization was economically feasible at Olyphant at a cost of about $2 million. Based on the study results, Baltimore District entered into an agreement with the Commonwealth of Pennsylvania, the City of Scranton, and the Borough of Olyphant to undertake a cost-shared feasibility study at Scranton and Olyphant; with the non-Federal sponsors providing contributed funds and limited in-kind services for the effort. The study has received strong support from the Congressional delegation, especially from Congressman Joseph McDade, Governor Robert Casey, state legislators, and the communities of Scranton and Olyphant.

Chesapeake Bay.

Baltimore District completed a comprehensive report on Chesapeake Bay in 1984 calling for a number of follow-on reconnaissance studies to focus specifically on special problems. Two reconnaissance studies were subsequently funded.

1) Shoreline Erosion. In October 1984, the District initiated a reconnaissance study of shoreline erosion problems on Chesapeake Bay and completed the study in March 1986. The reconnaissance study identified extensive shoreline damage problems around the Bay, and fifteen sites were identified as potential Federal shoreline protection projects. Subsequent to completion of the reconnaissance study, the District coordinated extensively with HQUSACE and ASA(CW) to bring the scope of the proposed feasibility study in line with Administration priorities. As a result, the Baltimore and Norfolk Districts entered into agreements with the State of Maryland and the Commonwealth of Virginia to undertake a cost-shared feasibility study of shoreline protection along Chesapeake Bay in the two states. This study is currently underway using contributed funds and in-kind services from both Maryland and Virginia. The study has received strong support from the Congressional delegations and the state governments.

2) Storage Reallocation. In response to ongoing concerns over the impact of drought on the aquatic resources of Chesapeake Bay, the District initiated a "limited reconnaissance" drought management study in December 1985.

Based on the results of that study, the District reoriented the follow-on reconnaissance study to include other purposes, to limit the geographic area to the Susquehanna River basin, and to focus on the potential for reallocation of storage at basin reservoirs. The Chesapeake Bay Reallocation reconnaisance study was initiated in June 1987, and is scheduled for completion in October 1988. Potential site-specific feasibility studies have been discussed with Maryland, Pennsylvania, and New York; and the Susquehanna River Basin Commission.

In a related action, both the State of Maryland and the Potomac Electric Power Company have expressed interest in having the District investigate the potential reallocation of storage at Jennings Randolph Dam on the Potomac River for make-up water for a powerplant site at Dickerson, Maryland. The District is scheduled to initiate an appraisal study this fiscal year, which we expect will lead to a cost-shared feasibility study in FY 1990.

Continuing Authorities. The District also is currently conducting several reconnaissance studies under continuing authorities, two of which have recently led to cost-shared feasibility studies.

1) Gwynns Falls. A small flood control project is being evaluated under Section 205 for a portion of the Gwynns Falls located near downtown Baltimore. The commercial-industrial area was hit with damages of over $30 million from three floods between 1972 and 1984. A feasibility study was initiated in May 1988, and is being cost-shared with the City of Baltimore. Based on the reconnaissance study completed in August 1987, the most likely project is a levee system providing 220 year protection at a cost of about $1 million. The proposed levee would tie into an existing levee constructed by the city in 1987.

2) North Beach. A small shoreline protection project is being evaluated under Section 103 for a portion of Chesapeake Bay shoreline in North Beach, Maryland. An existing fifty-five year old bulkhead is failing, and wave damage is threatening a State highway and nearby homes. The reconnaissance study was completed in July 1986, and a follow-on feasibility study was initiated in July 1987. A stone revetment project is recommended in the draft detailed project report (DPR), at a cost just under $1 million. The Maryland State Highway Administration is cost-sharing the feasibility study and intends to be the non-Federal sponsor for project construction.

Managing Planning Division Resources.

Conduct of reconnaissance and feasibility studies requires careful management of financial and manpower resources, in order to assure timely study accomplishment. My comments focus on the program overview, and I would caution that our experience may be somewhat unique. The scenario is as follows. Although our planning staff resources have increased somewhat over the past few years, we are currently projected to utilize about 40 FTE's in FY 1988. Our planning program for FY 1988 will total about $9 million, which includes about $6.6 million in planning and engineering project investigations, and about $2.4 million in miscellaneous activities such as FPMS, Section 22, and other economic and environmental studies.

Work Schedules. Normally, the scheduling of work for reconnaissance studies would not present a problem. However, a series of unrelated events caused the planning program at Baltimore District to expand rapidly in a very short period of time. Because of strong Congressional and Administration interest, funds were reprogrammed at HQUSACE in FY 1986, to initiate reconnaissance studies at Petersburg and Moorefield, and the South Branch of the Potomac River, West Virginia. In addition, Congress added funds to the FY 1987 appropriations bill to initiate a reconnaissance study of the Lackawanna River basin, Pennsylvania. At about the same time, two major Chesapeake Bay studies were approved by HQUSACE to proceed. Initiation of these studies produced a programmatic surge beyond what we would normally have scheduled. As a result of this surge and our limited manpower, we have developed and relied heavily upon a computer-based workload-manpower management system. All workload is scheduled and prioritized; and all lower priority work has been stopped, dropped, or delayed. We believe that these reconnaissance and feasibility studies, along with our support to Engineering Division, are our highest priority. Our workload also will require intensive management and prioritization in FY 1990, after which the program is expected to stabilize.

Staffing. The reconnaissance studies were conducted by multi-disciplinary staffs, led by interdisciplinary study managers. Our study management responsibilities are assigned to two branches; one oriented more to specific project development and the other to comprehensive, basin-wide, and special studies. We have taken a number of management actions to offset our workload-manpower imbalance. These include the extensive use of open-end contracts to perform engineering, economic, and environmental work; developmental reassignments of division staff to study teams; and basically taking advantage of any program that can provide us with skilled technical or staff support. Over the past year, we have used about $1 million in services from our open-end contracts for activities that might otherwise be done in our planning division. I do not consider this an acceptable long-term solution, but rather one that is necessary to address these temporary imbalances.

Funding. Getting money for reconnaissance studies has obviously not been a problem. I believe that the accelerated receipt of funds is directly attributable to the study purposes, and the degree to which they reflect Administration priorities. Significant funding issues are more likely to surface in the feasibility phase than in the reconnaissance phase, because it is there that we face the difficult matter of undertaking new tasks, with new management partners, using unfamiliar resources, and accomplishing all of this under more stringent guidelines. In fact, the most difficult task in our reconnaissance studies may be to establish sound feasibility cost estimates and study schedules.

Lessons Learned.

Tenacity. Although we have several high priority flood control studies underway, we have not diminished our commitment to other mission areas. The size and diversity of our current program in part has resulted from our tenacity in not "letting go" of projects that both we and the local communities consider worthwhile. That tenacity is the strongest link between our flood control, shoreline protection, and reallocation studies.

Federal Interest. The ASA(CW) and HQUSACE have consistently stated that the projects investigated in reconnaissance and feasibility studies must be economically justified, and focus on project purposes that reflect Administration budget priorities. Aside from whether one agrees with these criteria, we are much more likely to be successful in initiating feasibility studies for such projects. Baltimore District saved time, money, and effort by focusing on projects that reflect the Administration's highest priorities, and that appear to have strong economic feasibility. Where necessary, we reoriented studies to more clearly reflect these priorities.

Focus Efforts. One thing becomes clear very early in the reconnaissance phase; there is too little time and money to perform all the tasks that various members of the study team and other district elements would like. It helps to remember that the bottom line in reconnaissance studies is to identify an economically feasible alternative that reflects the Federal interest, and to find a sponsor that will cost-share a feasibility study. It is easy to be distracted by other tasks that are "nice to do" but are not required.

Cost-Sharing Agreements. These agreements are very difficult to negotiate, even under the best of circumstances. Begin discussions for the feasibility study cost-sharing agreements early in the reconnaissance phase. Start the legal coordination early, and make sure the counsels get directly involved. Assure that in-kind services are thoroughly negotiated between the district's technical experts and the non-Federal sponsor on a task-by-task basis. These negotiations are more time-consuming and cost much more than one might expect.

Study Management. While always important, the roles of study manager and study team have become more complex and demanding in the current cost-sharing/two-phased planning environment. We must use top quality people as managers and key players, and support them with sufficient tools, systems, and other resources. Study management is now shared to a much greater extent with non-Federal sponsors. The potential for problems in communication, coordination, and organizational responsiveness is magnified, especially where substantial in-kind services are involved. Clearly, study management requires special talent, and we must take care not to lose that talent.

Documentation. All of the various pressures on study managers, including increased reporting requirements, will make good documentation even more critical. Documentation starts on Day 1, and involves the non-Federal sponsors as well as the Corps. This documentation should include an accurate accounting of Federal and non-Federal funds. In addition, there must be agreement between finance and accounting representatives of the non-Federal sponsor and the Corps on how funding will be monitored and what documentation will be prepared.

Concerns.

In addition to the aforementioned observations, I am also concerned about certain conflicting forces and how they affect the way in which we conduct our business.

Technical Accuracy. In both the reconnaissance and feasibility phases of our studies, there is an expectation that technical analyses and cost estimates should be highly accurate. These expectations come from non-Federal sponsors, and from higher command as well as from other elements in the District. Although more detail, stronger analyses, greater accuracy, and additional data are being proposed, these items carry a price tag both in time and money. We simply must do a better job of prioritizing what we want and need; this seminar is addressing that very issue. Increasingly, the Corps must come to grips with the problem, and reach agreement among the stovepipe elements in the districts, divisions and HQUSACE on acceptable levels of effort and detail in each technical area.

Study Costs. Obviously, if we increasingly have more technical requirements, how then are we going to reduce study costs? We are given firm guidance regarding the cost of these studies, and the relationship of costs between the reconnaissance and feasibility phases. However, we are moving through unfamiliar territory. It has been our experience so far that both phases are more expensive than we previously expected them to be. There are many unknowns, such as the cost of negotiating the FCSA and the cost of jointly managing these studies with the sponsors, such that our estimates are not nearly as firm as we would like them to be. When requirements such as 12 month reconnaissance schedules, increased reporting, increased accuracy of estimates (to name a few) are added, study costs also increase. Now that project cost estimates will be scrutinized over time, what technical expert would not want more detailed technical data? The resolution of appropriate levels of study cost and technical accuracy must go hand in hand. More detailed technical information should not be required without accepting the related increase in study costs.

Manpower Resources. One thing is certain; we are entering a new era of study management that is much more complex than ever before. We must conduct new analyses (e.g., financial feasibility); conduct all analyses more thoroughly in order to refine cost estimates; provide more detailed cost and schedule information throughout the study; operate with study sponsors in the more difficult arena of shared management and technical effort; and accomplish these studies within constricted schedules. In order to accomplish these difficult studies, we will need to combine our most capable staff along with effective use of contractors. Even this may not be enough. At Baltimore we have 8 open-ended contracts covering every technical skill area; and we use IPAs and Stay-In-School employees to accomplish more work with fewer FTEs. We still must face the reality that these complex studies need strong managers regardless of how much technical work is contracted. If cost-shared feasibility studies are expected to yield sound products, they must have top quality professional staff. Adequate manpower resources are absolutely essential to carrying out this mission.

Summary.

In summary, Baltimore District has undertaken several reconnaissance studies that have led successfully to cost-shared feasibility studies. For that we are pleased. On the other hand, having conducted several of these studies concurrently with limited staff resources has alerted us to inherent difficulties and potential risks. There must be a recognition from the top of the organization to the bottom that adequate resources as well as sound management principles are essential to successful reconnaissance and feasibility studies, and ultimately to project construction.

RECONNAISSANCE PHASE STUDIES - A DIVISION PERSPECTIVE

by D. E. Gene Lawhun, P.E.[1]

Introduction

As time passes, changes are inevitable. All Corps of Engineers (CE) people are acutely aware of radical changes which have occurred in programs involving water resources development over the past two decades. The most notable changes came with enactment of the Water Resources Development Act of 1986 (WRDA 86),(Public Law 99-662, November 17, 1986). Much has been said and written regarding the impact of WRDA 86 on our programs and methods of doing business. Today I will discuss changes prior to and within WRDA 86 which have affected funding, review, and approval of the Reconnaissance Phase of preauthorization studies. I will briefly review the past and present requirements for reconnaissance studies. I will provide a Division level perspective of the reconnaissance phase process, from initial funding through certification. I will share a recent case history of a reconnaissance study in LMVD. I will conclude by summarizing and offering some recommendations which I think are necessary to assure the continued success of our planning process and fulfilling our responsibilities to the non-Federal sponsor, the Administration, and the Congress.

Reconnaissance and Feasibility Phase Funding, Review and Approval 1970 to 1980

General. Between 1970 and 1980 there were several changes which impacted conduct and cost of Planning efforts. Among the most prominent were the regulations established to implement requirements of the National Environmental Policy Act (Title 1, Public Law 91-190, 1 January 1970) and the adoption of the Water Resources Council's Principles and Standards for Water and Related Land Resources Planning (Level C; Final Rule, 38 FR 24778-24862, 10 Sep 73). Needless to say these actions caused radical changes in the Corps' water resources program, particularly Planning. The impact of the changed requirements of NEPA and P&S are summarized as follows. Ongoing activities were suspended; the additional data requirements were defined and additional information collected; alternatives were reformulated and reevaluated; and additional documentation was written into reports. In most cases considerably more information was developed, much of which did not prove useful in the decision making process. Final recommendations submitted to the Congress were not improved. However, the additional work always caused extensive delays in completing study reports and large increases in study cost. While the Congress and the Administration generally accepted the increased estimates of cost for the additional work, additional funds appropriated did not offset the ever increasing cost of doing business. Limited funds and manpower, combined with increased work, did not allow timely completion of reconnaissance and feasibility study efforts. As we

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continued to string out the cost and time for ongoing work, we could not incorporate a healthy mix of urgently needed and authorized new start reconnaissance and feasibility studies with our limited resources. From a National perspective, the landslide of rules and regulations during the 1970's resulted in a wide variation in report content and format. A series of regulations entitled Planning Process: Multiobjective Planning Framework, referenced in ER 1105-2-200, were issued in 1978 in an attempt to standardize the planning process and report preparation. Although desperately needed, these regulations in many instances resulted in yet more delays and reworking of ongoing reconnaissance and feasibility study efforts. The regulation defined a three phase planning process: Stage 1, Reconnaissance Study; Stage 2, Development of Intermediate Plans; and Stage 3, Development of Detailed Plans and Plan Selection. Each stage involved four tasks, including Problem Identification, Formulation of Alternatives, Impact Assessment, and Evaluation. The concept was to identify needs and the full range of alternatives in the reconnaissance stage and zero in on final plan selection as additional detailed information was developed in subsequent stages. Each stage always included the option of evaluating additional alternatives as necessary.

The multiobjective planning regulations in the 1970's and the budget process permitted and even encouraged field offices to seek funding for authorized studies to conduct the reconnaissance and feasibility studies for a wide range of water and related land resource problems. Problems to be addressed included: Hydropower; Flood Control; Irrigation; Navigation; Shore and Beach Erosion; Hurricane Protection; Recreation; Municipal and Industrial Water Supply; Fish and Wildlife Enhancement; and Water Quality Control.

Funding of Reconnaissance and Feasibility Studies 1970 to 1980

Each year the Administration submits to the Congress a proposed budget which recommends funding of Corps activities on a line item, project by project basis, including reconnaissance and feasibility studies. In the appropriation process, the Congress may add or delete funding for individual projects in final appropriations. Since the early or mid-1970's, the requirements for compiling and documenting the annual Administration budget have been promulgated to the Field in draft Engineer Circulars (EC's). During the 1970's the Budget EC and other regulations provided broad guidance concerning National policies, funding eligibility, and selection criteria for budgeting for individual projects. Division and District Engineers had great freedom and near full authority and responsibility for developing their annual budget within the broad guidelines. Washington level review and approval was not nearly as rigid as currently exists. In regard to the budget process from the Division and District Engineers perspective, I refer to this time period as the "Good Old Days". Each year the budget process and EC's have become more complex. The funding "ceilings" for reconnaissance and feasibility studies have leveled out or been reduced. Several factors have contributed to this trend. One of the major factors is the effort of the current Administration and Congress to reduce the Federal deficit. The budget EC defines several main programs through which Congress authorizes funds for the Corps. The program entitled "General Investigations" covers a broad category of Planning Division and Engineering Division activities including funding for authorized reconnaissance and feasibility studies, Preconstruction Engineering and Design (PED), which is Design Memorandum type work, and some Advance Engineering and Design (AE&D) efforts.

Review and Approval of Reconnaissance Reports, 1970 to 1980

During the 1970's, the Division Engineer's staff was responsible for the technical review of Reconnaissance reports. Division Engineers had authority to approve all reconnaissance reports except those for Urban Studies. In a few instances, HQUSACE would notify the Division Engineer in advance that approval of a specific reconnaissance report would be reserved for HQUSACE.

Reconnaissance and Feasibility Phase Funding, Review and Approval, 1980 to Present

General. The 1980's have seen radical changes instituted in water and related land resource development programs. The early years of this time period saw many dynamic changes to the Planning process. One of the early changes in the 1980's resulted from CE's Regulation Reform Action Program (RRAP) which consolidated over 100 planning regulations into one Planning Guidance Notebook consisting of six regulations. (DAEN-CWP developed a series of ER's; ER 1105-2-10, -20, -30, -40, -50, -60, and associated EP's 1105-2-15, -35, -45, and -55, dated 5 February 1982.) The Planning Guidance Notebook initially abolished the three phase study process and did not require the preparation of reconnaissance reports. Some Divisions, including LMVD, maintained the concept of an initial reconnaissance effort as a Division level management function, but no reconnaissance report was required by HQUSACE.

In 1983 the Administration abolished the P&S and replaced them with the U. S. Water Resources Council, Economic and Environmental Principles and Guidelines for Water and Related Land Resources and Implementation Studies, hereinafter referred to as P&G. The P&G established that the National Economic Development plan would be identified and normally recommended as the selected plan. The Planning Guidance Notebook was updated in 1985 and defined the Two Phase Planning process as outlined in the P&G. So once again HQUSACE required reconnaissance studies, but delegated authority for approval to the Division Commander. The Planning Guidance Notebook required that most reconnaissance report efforts would be completed in 12 months with no reconnaissance report to exceed 18 months. Concurrently, the Administration initiated the concept of funding the reconnaissance phase 100 percent Federal cost with the feasibility phase cost shared 50/50 with the local sponsor. These requirements were enacted into law by WRDA 86. The purpose of the reconnaissance study as currently defined is to determine whether there is at least one alternative which is economically justified, and meets current criteria for Federal interest. The reconnaissance study provides a basis for negotiation of a cost sharing agreement for the feasibility phase with local sponsor. The schedule and cost of feasibility studies are defined in the reconnaissance report.

Funding of Recon and Feasibility Studies 1980 to Present

As concerns over Federal deficits increased in the 1980's, more restrictive eligibility and selection criteria were developed to determine whether projects or studies would be included in the budget submitted to the Congress. The Administration initially defined high priority projects as those which provide commercial navigation, flood damage reduction, and the addition of hydropower to authorized or completed projects. For the FY 89 budget high priority outputs were limited to commercial navigation, flood damage reduction, and hurricane and storm damage reduction. Division Commanders are assigned a target funding level and submit a recommended program within that level. The recommended program consists of a prioritized listing of studies developed using the eligibility and selection criteria established in the budget EC. In review of budget proposals, HQUSACE and ASA(CW) often incorporate additional screening criteria. This often eliminates studies and projects which the Division has recommended within assigned funding target levels.

During the 1980's, the HQUSACE assigned targets for the "General Investigations" program generally showed a slight increase each year except for the FY 89 Mississippi River and Tributaries funds. WRDA 86 authorized numerous projects for preconstruction engineering and design and planning and engineering. Funds for these efforts are appropriated as a part of the General Investigations program. Funding for Preconstruction Engineering and Design (PED) design memorandum work and some Advanced Engineering and Design are also programmed in the General Investigations category. The budget guidelines for FY 89 and 90 require that reconnaissance phase studies are to be included in the target for the General Investigations program. As a result, new start reconnaissance studies must compete for funds with the other authorized projects and programs within the General Investigations target. This makes it very difficult to maintain a viable program of new start reconnaissance efforts. For Fiscal Year 89, seven new start reconnaissance studies were recommended within the LMVD General Investigations target. HQUSACE, after applying additional screening criteria, supported only three of those recommended new starts. In my opinion, we must develop consistent criteria and a process which will allow funding for a healthy new start reconnaissance study program.

Review and Approval of Recon Phase, 1980 to Present

The process for review and approval of Reconnaissance Reports and studies has also radically changed during the 1980's. Until near the end of 1985, the Division Engineer maintained responsibility for the review and approval of reconnaissance reports. He could request an Issue Resolution Conference if necessary, including a request for BERH staff participation. However, initiatives to control spending and ensure that studies meet Federal criteria, the approval process was modified. HQUSACE established requirements for reconnaissance report "Certification". This certification was to occur after the Division Engineer had approved the reconnaissance report. Certification was to assure that the report and its recommendation to continue into the feasibility phase is in accordance with ASA(CW) policies and budget priorities. EC 1105-2-168, dated 11 Sep 87, entitled, Procedures for Two-Phase Planning, gave the details of this "certification" process. This process included the requirement for a mandatory Issue Resolution Conference (IRC) conducted prior to Division approval of the reconnaissance report. CECW-P, EC 1105-2-188, dated 30 Jun 88, entitled, Project Review and Approval Procedures, appears to supersede EC 1105-2-168. This EC provides for concurrent review of reconnaissance and feasibility reports by BERH, HQUSACE, and ASA(CW). The certification process is much the same except the mandatory IRC is to be conducted concurrent with Division review. In instances where there is a clear Federal interest in a justified project, reconnaissance reports can be certified during the IRC contingent upon HQUSACE approval of the IRC Memorandum For Record. Where there are significant policy questions, HQUSACE may provide ASA(CW) opportunity to provide project specific guidelines prior to certification. The EC provides a specific schedule for each step in the certification process which is designed to eliminate delays in obtaining certification.

Case Study - Mermentau, Vermilion, and Calcasieu Rivers and Bayou Teche, Louisiana - Upper Bayou Teche, Louisiana Interim

I am aware that this seminar is focused on reconnaissance phase studies for flood damage reduction, however, I have chosen to present a case study of a project which includes substantial benefits for agricultural water supply. This particular case will illustrate some of the communications gaps which can develop between the various offices of the Corps and local sponsoring organizations in the reconnaissance study approval and certification process.

Location of Study area and Description of Existing Project and Problems Investigated

The Upper Bayou Teche area is located in south central Louisiana, about 80 miles west of New Orleans. Figure 1 provides a map of the study area and includes portions of Iberia, Lafayette, St. Landry, St. Martin, St. Mary, and Vermilion Parishes, Louisiana.

The existing Teche-Vermilion Basins Water Supply project, completed in 1982, was designed to restore historical low flows in Bayou Courtableau, which were cut off by construction of our Atchafalaya River MR&T project, and to provide additional fresh water needed in the Teche and Vermilion systems by pumping from the Atchafalaya River. The Teche-Vermilion Fresh Water District is responsible for operation of the pumping station and allocation of the available flow between the Teche and Vermilion. Area residents have indicated a need for a greater volume of freshwater for rice and crayfish farming. There are also needs associated with salinity intrusion and flood damages to agricultural lands and associated developments in the Bayou Courtableau area.

Reconnaissance Phase Study Actions including Certification

During 1983, the local sponsor for the Upper Bayou Teche, the Teche-Vermilion Fresh Water District, requested the New Orleans District to conduct a study to address the above stated problems. On 8 July 1983, the New Orleans District requested approval to conduct the study under authority of an ongoing study in that area (the Mermentau, Vermilion, and Calcasieu Rivers and Bayou Teche, LA). On 9 August 1983, the Division office approved the request. The Division included the study as a new start reconnaissance study in the 1985 budget submission. HQUSACE eliminated the study from the budget due to the limited funds available for the new start reconnaissance studies and other studies having higher priority outputs. The FOA and higher authority began to receive Congressional inquiries concerning the study. The Congressional and local interests were advised that funds were not available to initiate the study. They were also informed that the study, if conducted, would be in two phases, a reconnaissance phase funded 100% Federally, and a feasibility phase to be cost shared 50/50 between the Federal government and the local sponsor. They were further advised that the reconnaissance phase would require about 12 months to complete and cost about $110,000. Because of its desire to have the studies initiated, the non-Federal sponsor offered to contribute the $110,000 required for the reconnaissance phase study. This was prior to enactment of WRDA 86, which legislated study cost sharing, but was during the time that local sponsors were required by administrative policy to "contribute" funds for feasibility phase studies.

To our surprise we learned that even though we could, and in fact did, accept contributed funds from non-Federal sponsor to cost share feasibility phase study efforts by Administrative decision, we needed Congressional approval to accept "contributed funds" from the non-Federal sponsor to conduct this reconnaissance study. At that time, the New Orleans District was already accepting funds from non-Federal sponsors on three cost shared feasibility studies. The Subcommittee on Energy and Water Development of the Committee on Appropriations of the United States House of Representatives and Senate in February 1985 and March 1985, respectively, provided approval for the Corps to accept the funds. HQUSACE guidance stipulated that the non-Federal sponsor should be advised that acceptance of the funds was to complete the reconnaissance phase and did not commit the Corps to undertake the feasibility study. Furthermore, if the feasibility study was undertaken, the local sponsor would not necessarily obtain reimbursement or credit for the contributed funds. On 13 May 1985, the New Orleans District received the funds from the local sponsor and initiated the reconnaissance study. The New Orleans District completed its reconnaissance study during April 1986 and determined that several alternatives were justified based on agricultural water supply benefits. A section of EC 1105-2-149, dated 28 June 1985, subject: Single-Purpose Water Supply Studies, is quoted as follows, "the Corps of Engineers will not use General Investigation funds to conduct single-purpose water supply studies, unless specifically agreed to by Congress and the Administration." Based on this and knowing that agricultural water supply is not a high priority output, we expected that ASA(CW) would not support continuation of the study into the feasibility phase. The non-Federal sponsor was informed of the policies. As a result, numerous Congressional inquiries followed.

Problems Associated with Upper Bayou Teche Reconnaissance Report Approval and Certification

Some of the correspondence generated as a result of the reconnaissance study results and the confusion over policies are summarized below. In my opinion, this study demonstrated very dramatically what can happen if you don't have articulated, broad National policies communicated in written guidance to the field.

In response to a letter dated 22 April 1986, the New Orleans District Engineer provided the following information to Senator Johnston on 10 June 1986.

a. Economic justification for the three alternatives which appeared justified were based on agricultural water supply benefits;

b. Single purpose water supply projects are not in the Federal interest;

c. General Investigation funds may not be used to conduct single purpose water supply studies unless specifically agreed to by Congress and the Administration; and

d. That the District Engineer had requested meeting with his higher authority to discuss possibility of continuing study.

On 30 May 1986, Congressman John Breaux wrote ASA(CW) Robert K. Dawson questioning why the study was terminated and expressed his desire that studies proceed as soon as possible.

In a letter dated 2 July 1986, ASA(CW) Dawson wrote the following statement in a letter to Congressman Breaux:

> "We have recently received clarification concerning single purpose water supply projects from the Office of Management and Budget. It has been a long-standing policy that the Federal Government not build single purpose municipal and industrial water supply projects. Agricultural water supply, on the other hand, is water stored or diverted to benefit crop production. The Corps informs me that, since the preliminary alternatives identified in the Upper Bayou Teche study provide agricultural water supply, there appears to be sufficient reason to proceed into the feasibility phase.
>
> I certainly appreciate your interest in this study and the Teche-Vermilion Freshwater District's cooperation with the Corps in working together on this study. I am confident that we can develop an approach to address these water resource problems."

Congressman John Breaux also wrote to the New Orleans District Engineer on 30 May 1986 questioning why the study had been stopped and stating his desire that the study proceed into Phase Two.

In his response on 26 June 1986, the New Orleans District Engineer included the following points in his response to Congressman John Breaux.

a. Economic justification for the three alternatives which appeared justified were based on agricultural water supply benefits.

b. Advised that an advance copy of the preliminary draft reconnaissance report was furnished to Teche-Vermilion Fresh Water District in April 1986. The report included recommendations to proceed into the second stage. Cautioned that results were preliminary until report was approved by Division and New Orleans District internal review was not complete. Requested a letter of interest from non-Federal sponsor, Teche-Vermilion Fresh Water District, indicating its willingness to financially participate in the second stage.

c. Advised that after consulting with the Division, it was determined that the New Orleans District was in error in recommending continuation of the study in the draft report. EC 1105-2-149 influenced this decision and stated in part that General Investigation funds may not be used to conduct single purpose water supply studies unless specifically agreed to by Congress and the Administration.

d. Advised that HQUSACE had informed the Division office that new guidance concerning water supply studies had just been issued by OMB. This new guidance may impact the decision to continue the Upper Bayou Teche study. Expected decision by mid July 1986. Advised he would be informed as soon as any additional information was available.

On 11 July 1986, Congressman John Breaux wrote ASA(CW) Robert K. Dawson questioning when the non-Federal sponsor could expect the Corps to initiate Phase II of the Upper Bayou Teche study (Feasibility phase).

ASA(CW) Dawson wrote Congressman Breaux on 28 July 1986 and stated:

> "The Corps of Engineers informs me that efforts to complete the reconnaissance phase are continuing and preparations for the feasibility phase are underway. The Corps expects to finalize a study cost sharing agreement with the Teche-Vermilion Freshwater District in the near future and could begin to work on the Feasibility Phase in early September."

The New Orleans District Engineer wrote to Congressman Breaux on 21 July 1986 providing additional information in response to Mr. Breaux's letter dated 30 May 1986. That letter stated:

> "This letter is in response to your request of May 30, 1986, for information on the status of the Upper Bayou Teche study. Clarification concerning Corps of Engineers involvement in single purpose water supply projects has been received from the Office of Management and Budget. Agricultural water supply studies, such as the Upper Bayou Teche study, may be pursued by the Federal government. Municipal and industrial water supply projects remain outside of the Corps' area of involvement, however.
>
> The New Orleans District plans to submit the reconnaissance report on Upper Bayou Teche to the Lower Mississippi Valley Division this month for review, recommending continuation of the study. The feasibility phase is scheduled to begin in September 1986. The Teche-Vermilion Fresh Water District has been advised of this decision."

On 22 July 1986, the New Orleans District Engineer forwarded the Reconnaissance Report to the Division for approval.

In view of ASA(CW) Dawson's statement that the Feasibility Phase is expected to begin in September 1986, we reached agreement with HQUSACE to finalize the Reconnaissance Phase in accordance with EC 1105-2-162. That EC established that the Division Engineer could approve reconnaissance reports and "ready to be executed" (draft) feasibility cost sharing agreements (FCSA), and could determine the need for IRC's. Accordingly, on 28 August 1986, the Division Engineer approved the Reconnaissance Report for entering into the feasibility phase of the study. On 3 October 1986, the District Engineer and local sponsor signed the FCSA.

During the mid-part of October 1986, the Division received DAEN-CWB/CWP letter, 22 Sep 86, subject: Execution of Cost Sharing Agreements for Feasibility Phase Studies. This letter referenced that the ASA(CW) has indicated that there will continue to be a review of projects by the Administration at each major point in the annual budget process and advised that with cost shared feasibility studies there would be a Washington level "certification" of reconnaissance reports prior to further funding. The letter provided other information and paragraph 6 is quoted as follows:

"In the interim, you should seek HQUSACE "certification" before approving the reconnaissance report or executing the cost sharing agreement for the feasibility phase of the study. "Certification" should be sought by submitting a copy of the reconnaissance report and draft cost sharing agreement to HQUSACE, ATTN: DAEN-CWP."

Since ASA(CW) had informed Congressmen that the study would continue, and we had already approved the reconnaissance report and executed the FCSA, we were of the opinion that certification would not be required. Furthermore, Congress, in the Committees' reports on the Fiscal Year 1986 Appropriations bill, directed that the $110,000 contribution be credited toward the non-Federal share of the feasibility study and also directed that an additional $120,000 be available to initiate the feasibility phase of the study. However, apparently by decision of the HQUSACE Program Development Office and Planning Division personnel, the funds were not to be released until the reconnaissance report was "certified".

On 13 January 1987, the Division Engineer forwarded a letter to Commander USACE (DAEN-CWZ-A), providing copies of the approved reconnaissance report and executed final FCSA requesting "certification" to expedite allocation of FY 87 funds. On 14 April 1987, three months later, the HQUSACE "certified" the reconnaissance report and advised that funding would be made by separate correspondence. There was one last bit of interesting guidance, quoted as follows:

"Please ensure that all parties understand that we would consider the outputs of the project to be agricultural water supply. Such outputs are not a high budget priority and would not be supported for project construction purposes."

The local sponsor no doubt believes that its project is progressing through the study phase only because of the political pressure brought to bear. It is also led to believe that it will have to use the political process to move into construction when that time comes.

In my opinion, the misunderstandings which resulted in this instance could have been avoided if clear and consistent policy had been established with field offices delegated appropriate authority and responsibility to carry out those policies. Such misunderstandings and breakdowns in communications provide clear signals to the Congress and local sponsors that District and Division Commanders do not have sufficient guidelines and authority to make decisions concerning project development. These situations create in Congressman and local sponsors a greater tendency to deal only with the Washington level echelons of the Corps.

We have had other experiences with other reconnaissance reports. A reconnaissance report for a navigation project was forwarded to HQUSACE for certification. It was certified in less than two months without the mandatory Issue Resolution Conference. A reconnaissance report for the Reelfoot Lake, Tennessee, study was submitted to HQUSACE on 13 November 1986. An Issue Resolution Conference was held on 6 April 1988. Additional information was submitted to HQUSACE on 1 July 1988, but no decision on certification has been made as of this time. The certification process appears to be dependent on case by case determinations, and to some extent, on individual personalities and attitudes of reviewers.

Summary

In summary, the past two decades have brought numerous changes regarding our involvement in water and related land resources development. These changes have spanned all aspects of our program, with major changes occurring in the planning process including the reconnaissance phase of studies. As I have tried to communicate in this paper, not all the changes have represented an improvement in our program execution or improvement in our final products. If we are to maintain credibility in our new partnership relationship with the non-Federal sponsors, we must implement many changes in quick order. Some of the most notable and important changes must come from OMB, ASA(CW), and HQUSACE. Therefore, I offer the following recommendations for change.

Recommendations

1) Change for change's sake is not good business. Changes will continue to take place, but we must learn to apply new policies and make legislative change applicable only where it is clearly necessary. Corps projects take a long time to complete. Making changes retroactive to ongoing projects only extends that time, often with no real change in final project configuration. Generally, we should "grandfather" ongoing projects and studies. That is, complete the ongoing work using the same policies under which they were initiated. Application of new policy in the middle of project development causes duplication of effort, added expense and time, and most often does not significantly affect final project development.

2) Through all levels of our organization, we must guard against incorporation of useless data in our planning and engineering studies, reports, and technical design documents. The measure of the data's usefulness should be determined by whether or not that data allows us to recommend a better solution to our problem in a more cost effective manner. Applying a new rule or including additional information simply because of a "requirement", when it is obvious that decisions have already been made, or the additional work will not affect the decision, is a waste of time and resources.

3) The budget process for all of our programs must be streamlined and made more efficient. More and more, we see the budget process becoming the vehicle for decisions to implement or not implement projects. As originally conceived, the budget process was intended to fund projects and programs, not formulate those programs. Going through the planning and authorization process and then having to reevaluate and rejustify every project for every annual budget preparation adds a tremendous amount of work. The additional work increases cost. Hopefully, some of the budget efficiencies envisioned in Initiative '88 will improve the funding process. Hopefully the budget guidance can be developed and made consistent, avoiding the year to year need for a revised process and a revised budget EC every year.

4) Consistent National policies for water and related land resources development must be developed and communicated to the field. Implementation, management, and approval for the majority of the intermediate planning and engineering report documents should be delegated to the FOA Commanders. For many years the strength of the Corps has been recognized by the authority delegated to Division and District Commanders. Real customer care can be realized only if those who deal directly with the customer can speak and negotiate for the organization. We need to eliminate and avoid confusion which inevitably comes when we say the Division or District Commanders can "approve" and action, but make that approval meaningless by requiring "certification" by higher authorities. Such play on words no doubt destroys credibility of the Corps, and forces local sponsors to deal directly with the higher echelons of the Corps.

Conclusion

The reconnaissance study program is the current foundation for the entire future Civil Works program of the Corps of Engineers. The Corps must maintain a healthy reconnaissance program if it is to remain as a viable organization. The reconnaissance study is the first step in meeting water resources needs for the future. The Corps must be immediately responsive to requests to initiate reconnaissance studies. We must be very careful in applying policies which will not allow the Corps to be responsive. A separate funding target should be provided for reconnaissance studies so that they are not required to compete for funds with projects in the PED and AE&D stages, which are now all a part of the combined General Investigations budget. We need to give particular concern to the approval or certification process when reconnaissance studies are completed so that we can move quickly and efficiently into the feasibility phase for those projects which meet policy and legislative requirements, and are responsive to the needs of the people of the United States.

LEVEL OF DETAIL FOR RECONNAISSANCE STUDIES

GEORGE A. SAULS, P.E. 1/

The development of a fully coordinated Plan of Action early in the study process is crucial to a timely and efficient study execution. When study initiation, funding levels and scheduling are developed without sufficient coordination among the planning and technical elements, inefficiencies are introduced. The result is an unproductive use of time and effort in redefining the previously uncoordinated tasks, schedules and funding after the study has been initiated.

The single most important act that can insure the success of a study is to initiate coordination with all elements at the time of problem identification. The use of a Standing Project Development Group consisting of senior personnel for preliminary project assessment is one means of accomplishing this.

Establishment of a study team comprised of experienced staff should be the first order of business for each Reconnaissance Study. This team can then start the process of developing a coordinated Plan of Action and identifying funding requirements.

A Plan of Action developed in this manner brings broad based experiences to the study effort and can significantly enhances the quality of the Reconnaissance Study effort. A study team of this make-up also ensures commensurate levels of detail among the various elements, thus producing a balanced study. The team can also identify critical items requiring early initiation to insure timely completion (eg. surveys). The uncoordinated use of "standard" study tasks, schedules, and funding distributions to be applied to Reconnaissance Studies is a sure-fire way to introduce unnecessary waste into a time and funding constrained study process. With hydrologic and hydraulic analyses of existing conditions usually scheduled as one of the first study tasks, time spent on "finalizing" a premature, uncoordinated Plan of Action can jeopordize the timely completion of the Hydrologic and Hydraulic Analysis. Since these studies have short time frames, unnecessary delays must be avoided.

The development of a balanced total study effort with commensurate levels of detail for each technical element impacts on some specific hydrologic and hydraulic items, while others are fairly constant from study to study. As with all technical

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elements, use of experienced staff for Reconnaissance Studies is considered essential. Utilization of experienced staff increases reliability and confidence in conclusions reached based on limited analyses. Given the level of detail, funding and time constraints, use of Reconnaissance Studies for developmental assignments for less experienced staff members is not advised.

Although all studies differ, some common characteristics in hydrologic and hydraulic efforts for Reconnaissance Studies exist. It is essential that a Reconnaissance Study produce a good representation of existing conditions. The hydrology, hydraulics and economic data should be of sufficient quality to assure that the expected annual damages (EAD) computed in the Reconnaisance Study do not significantly change in subsequent study efforts. The Reconnaissance Study estimate of EAD is <u>the</u> key in evaluating potential solutions. By assuming low O&M costs, the EAD can be used to estimate the construction cost of a justifiable project for various reaches and levels of protection. This proves invaluable in screening alternatives. Adequate consideration of non-structural solutions such as flood warning should be included in the Reconnaissance Study.

Historic data must be researched for model verification, both hydraulic and economic. Ideally, hydrology should be finalized in a Reconnaissance Study. Hydraulic models may be have to be constrained by lack of sufficient funds and data. Previous hydraulic studies such as Flood Insurance Studies can provide a good basis for project evaluation and allow for a more detailed study which increases reliability.

Examples of other study items that may require limited analyses are evaluations of project impacts on hydrology, coincident conditions, sedimentation assessments, and analyses for interior drainage. The impacts of these conditions can be assessed by making conservative assumptions and employing sensitivity analyses. Sensitivity analyses (hydrologic, hydraulic, and economic) provide a relatively quick and inexpensive means of assessing potential project impacts and thus increase confidence and reliability of results.

Development of good existing conditions models, sensitivity analysis and good engineering judgement applied by experienced staff can produce a recommendation for a project in a Reconnaissance Study that can be refined in subsequent studies without requiring reformulation. With current local cost-sharing requirements for subsequent studies, a quality product must be developed in the Reconnaissance level in order to provide a high level of certainty that a justifiable project will result from Feasibility Studies.

Successful completion of Reconnaissance Phase Studies requires a coordinated effort from all technical elements using experienced staff to perform a balanced study. Continuous coordination with management must be maintained to avoid surprises and allow for mid-course corrections. Periodic briefings of senior staff provides independent assessment of progress and insures an acceptable product at study conclusion. Clear documentation of assumptions, sensitivity analyses and decision logic are also essential for review and approvals.

Since the conclusions and methods of analyses employed in the Reconnaissance Phase form the basis for formulating Feasibility Phase study efforts, the impacts of a well prepared Reconnaissance Study can carry over into subsequent studies. With Feasibility Studies requiring local cost sharing and increased participation from the sponsor, a firm foundation established by a Reconnaisance Study can streamline Feasibility Study efforts and thus enhanace the reputation of the Corps of Engineers.

LEVEL OF DETAIL
FOR RECONNAISSANCE STUDIES

EDWARD W. SIZEMORE, P.E. [1]

Missouri River Division (MRD) Guidance

In February 1986, the Planning Division of the MRD published guidance concerning the level of detail needed for the Continuing Authorities Program. The guidance pertaining to Initial Appraisals and Reconnaissance Studies for engineering analyses are shown on the attached table.

1987 Workshop Consensus

Last year's workshop concluded the following:

1) The level of detail is in fact established by the 12 month time frame set to conduct the reconnaissance study.

2) The level of detail should be established by the study manager through negotiations with team members after they all have the opportunity to conduct a field reconnaissance and review of available data.

3) The level of detail does not necessarily need to be consistent among the disciplines.

4) When possible, final existing conditions hydrology/hydraulics should be developed.

Discussion

MRD Guidance. Technical studies are conducted during reconnaissance phase for two reasons:

1) To determine if feasibility phase studies are warranted; and

2) To scope and estimate the costs of the technical studies proposed to be conducted during the feasibility phase.

Therefore, a level of detail must be determined for three cases:

1) The reconnaissance phase studies to determine if feasibility phase studies are warranted;

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2) The feasibility phase studies that will be required to make and to support the recommendations of the Feasibility Report; and

3) The reconnaissance phase studies necessary to scope and estimate the costs of the required feasibility phase studies.

For the case of determining if initiating the feasibility phase is warranted, the guidance provided by the Missouri River Division appears to be adequate. Time and costs for this case can be based on the scope shown in the attached table. However, the second and third cases require more discussion. It's actually a two step process to scope and estimate the cost of conducting the detailed technical studies required to support the decision to recommend (or not recommended) a Federal construction project. The feasibility phase studies will serve as the foundation for the plan formulation leading to the recommended project and the baseline estimated construction cost. Therefore, final hydrology and hydraulic design are required as well as all the supporting data collection, mapping, etc. which will be necessary to complete them. The scoping and preparing the cost estimate to perform these detailed engineering studies are among the most important products of the reconnaissance phase, after the decision has been made that the feasibility phase studies are warranted. In conclusion, the task to be completed in the reconnaissance phase of scoping and preparing a cost estimate for the feasibility phase studies must not be overlooked. The time and resources to accomplish this task must be included in the initial scoping and resource allocating for the reconnaissance phase.

1987 Workshop Consensus. The level of detail can be limited by the time available, but proper allocation of the resources and involvement of the right people are more critical than the time allocated. If you have enough money and experienced people on the job, the reconnaissance phase studies, at an appropriate level of detail, can be accomplished within a 12 month time frame. All team members should initially conduct a field reconnaissance , preferably at the same time, and review data available in their field of expertise. Next, the interdisciplinary study team should try to reach a consensus on the scope of work, level of detail, division of responsibilities, and allocation of study resources (dollars). The team project manager should be responsible to see that an understanding of the appropriate level of detail is reached and that the level of detail is not greater than the quality of the data. For example, detailed economics should not be based on rough hydraulics. To meet the objectives of the reconnaissance phase studies, completion of final hydrology/hydraulics is not necessary, however what is, are good estimates of the scope and cost to complete them in the feasibility phase.

MRD PLANNING GUIDANCE ON LEVEL OF DETAIL

Initial Appraisal

Hydrology and Hydraulics

Use existing data (previous flood control, flood insurance studies, etc) for initial discharge frequency determination, water surface profiles rating curves, and stage/elevation/ frequency relationships. Based perliminary hydraulic analysis on existing data, generalized procedures, standard sections and configurations. Engineering judgment and experience should be in the initial appraisal of the most promising potential viable solution.

Interior Flood Control Analysis

This stage is to insure that the costs for interior flood control facilities are considered.

Interior flood control analysis should be based on available data using simplified formulas. Costs of gravity drains and pumping facilities should be determined using conservative assumptions and estimates.

Geotechnical

Use available data, i.e. borings from nearby projects, agriculture soil maps geological maps, aerial photography, drilled wells,etc. Make judgment as to geotechnical feasibility of project.

Reconnaissance Study

Use available hydrologic and hydraulic information to extent possible, supplemented and refined by limited field data and office analysis, in assessing alternatives and selecting the most likely implementable plan. Any significant hydraulic problems associated with any of the alternative assessment and plan selection process. The HEC-2 model, should be included but developed only to the accuracy required for each individual study. Limit effort on alternatives which are clearly not feasible.

General relationship curve of pumping station capacities versus cost and coincidental frequency factors derived from past designs can be used in sizing and costing pumping stations.

Supplement above information with on-site observations that could include flight auger drilling, shallow test pits, hand auger borings, hand penetrometer tests and visual classification of soil and rock outcrops. Do preliminary geotechnical design, as necessary, to insure validity and cost effectiveness of project.

Initial Appraisal

Surveying and Mapping

Use only available surveying and mapping information, except for decision documents. Supplement available Surveying and Mapping only as necessary for final design in decision documents.

Designing and Estimating

Initial design and cost estimates are based upon professional judgment experience, field observations and limited office analysis. General relationships cost curves can be utilized. If initial appraisal is to be decision document, designing and estimating should be commensurate with the scope of project. Use standardized designs to extent possible. Develop preliminary cost estimates of a potential solution.

Reconnaissance Study

Surveying and Mapping

Use available surveying and mapping information to fullest extent possible in assessing the problem, alternatives, and plan selection. Limit any supplemental surveying and mapping to only the essential in deciding on selected plan.

Designing and Estimating

Use available information to extent possible, supplemented by limited field data and office analysis, to assess alternatives and select plan. General relationship cost curves can be utilized. Develop preliminary cost estimates of alternatives and selected plan.

VIEWS ON LEVEL OF ECONOMIC DETAIL FOR RECONS

PAUL D. SOYKE (1)

The level of detail for reconnaissance level studies obviously varies considerably. This variance depends on the magnitude of the study and the amount of information available. However, it also depends on the sensitivity of the data to the results. This is best determined by the formation of an experienced study team who can visit the study site, review the available information and then make some informed judgments.

For most economic analyses, the use of an accurate hand level is generally satisfactory. One with at least two power magnification is preferred. By using street corner or manhole elevations, which are often available, accuracy can be well within 0.5 feet. Only where the analysis is sensitive to profile differences of less than 0.5 feet is the use of rod and level necessary. It should go without saying that data should be collected by reaches to determine where the critical damages occur.

In large flood plains, homogeneous areas can be sampled to gain efficiencies. It is, however, important that major industrial and commercial firms be interviewed. Damage can vary substantially depending on the type of operation, the amount of inventory, and similar elements.

The experience of the analyst can reduce the work effort by identifying areas that may be critical to the study. The work can then be concentrated in those areas rather than spending an inordinate amount of time on areas that would have little chance of qualifying for a Federal project. This experience should be supplemented by interviewing people familiar with the flood problem to verify or supplement what the analyst's opinion is.

The hydraulic data is a key element to the economic analysis. It is therefore important that it be as accurate as possible. If it is not possible to accurate within the constraints of the study, then the analyst needs to know how sensitive the result is to the data.

Much of the risk can be removed from the hydraulic and economic analysis by having good information on historic flood damage. Districts should keep good records, not only during major events, but also of intermediate flooding since

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those can be critical in calculating annual damages. The Corps should be more willing to fund the collection of this type of data.

The selection of a good study team is probably the most important element in a study. Although the most experienced staff can not always be on the team, there needs to be a concentrated effort to assure that the team has enough experienced members to allow them to make good judgments. These judgments primarily relate to determining what parts of the study require the most effort, where the sensitive issues will be, and what areas are most likely to result in a Federal interest.

One final consideration in the efficient use of study resources is and try to assure that data only needs to be collected once. In most cases, this is the single most costly element of a study. It is important to use any data collected or developed during the reconnaissance phase in the feasibility phase.

ENVIRONMENTAL CONSIDERATIONS IN RECONNAISSANCE STUDIES

Glendon L. Coffee[1/]

Passage of the Environmental Policy Act (NEPA) in 1969 ushered the Corps into an era of increased environmental awareness and sensitivity. Subsequent legislation adopted in the 1970's such as the Clean Water, Endangered Species, and Archaeological and Historical Preservation Acts; issuance of Executive Orders addressing flood plain and wetlands issues; and the development of the Principals and Standards added greater importance to the provisions of existing laws, such as the Fish and Wildlife Coordination Act, and further reinforced the need to include environmental considerations in the Corps' planning process.

The Corps did not always adapt easily to these new environmental requirements. In the early years, the absence of appropriate environmental considerations in the plan formulation process contributed, in part, to law suits, stalled projects, returned reports, and missed study milestones. On many occasions a plan was developed on principally economic and engineering factors, with environmental issues receiving perfunctory attention in order to comply with planning guidance. Under this approach, plan formulation steps could be repeated several times as "new" factors were identified, requiring further evaluation. These redundant activities often resulted in extended study schedules and increased costs. The costs were absorbed by the Federal Government, with the major penalty paid by local interests being delays in the ultimate implementation of feasible projects. Despite the early problems encountered with incorporation of environmental considerations into the planning process, these requirements have now become a integral feature of our activities in the planning area. In fact, among Federal agencies the Corps has often been recognized for our efforts to respond to the requirements of the NEPA. However, a major issue in this regard remains, as it does with the engineering and economic topics, in determining the appropriate level of detail in which to pursue investigation of specific environmental concerns and the associated costs of these efforts.

The cost-sharing policies of the current Administration and the requirements of the Water Resources Development Act of 1986 have forced the Corps to become more accountable for the total study process and the costs incurred. No longer do we have the luxury to unilaterally request additional funds from higher authority to address unanticipated study efforts or to seek approval for missed study milestones. Now, cost-sharing not only provides us with a non-Federal funding source, but also a partner to which we also must be accountable. Meeting the "accountability" challenge in the environmental area of the study process brings with it new

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tasks and an increased emphasis on existing requirements: (1) education of the local sponsor, (2) appropriate levels of detail, (3) greater attention to description of future study needs and costs for Feasibility Phase efforts; and (4) increased need for "team work" to get a quality job done within schedule and budget.

In the past, environmental study activities have often been viewed by local interests as an esoteric aspect of the overall plan formulation process that was left to the Corps staff to perform, while they concentrated their attention on the benefit-to-cost ratio of the alternatives and what would be their financial responsibilities to implement these plans. If local interests are to become full partners in the study process, they must be made to understand that they are not just obtaining our engineering expertise in the cost sharing agreement, but also all the requirements of our planning process which have been developed over time to assure formulation of the "best" overall solution to address the problem at hand. Hence, the local sponsor must become familiar with the requirements which we face in all areas, and we should expect that they would want to be since we will be spending their dollars. While some sponsors may be quite knowledgeable, we will often work with less sophisticated entities who could care less about the National concern over the loss of bottomland hardwoods, the shrinking habitat of an obscure plant, or the need to preserve aspects of our cultural heritage. With cost-sharing we are now faced with the enhanced task of communicating to local interests the numerous Federal environmental requirements which we must satisfy in formulating plans and in gaining their support and cooperation in addressing these requirements. As a result, it is important that our early discussions with the local sponsor in the Reconnaissance Phase devote time to explaining how applicable environmental statutes and regulations could effect the scope of formulated plans and the type, magnitude, and cost of studies in which they will be expected to share during the Feasibility Phase. The need for education of the local sponsor will not be restricted to just the environmental requirements which govern the planning process, but will also involve other areas of the process (i.e. NED plan formulation, etc.).

The need for this early education of the local cost-sharing sponsor is important to achieving one of the purposes of the Reconnaissance Phase which is to identify the issues which will influence the plan formulation process and the acceptability of any recommended solutions to the sponsor. From an environmental perspective, examples of the issues which could affect the acceptability of potential solutions to the local sponsor include necessary environmental studies, cultural resource investigations, environmental design considerations, fish and wildlife mitigation requirements, future maintenance requirements, etc.

While our major efforts in the Reconnaissance Phase will of necessity concentrate on economic and engineering considerations (to determine the potential for feasible solutions and the presence of a Federal interest), we must also give balanced thought to environmental factors as well. Since environmental studies can, in certain situations, play a major role in the Feasibility Phase and their results possibly have a significant bearing on the eventual benefit-to-cost ratio of the recommended solution, it is imperative that attention be devoted to pertinent environmental topics at the appropriate level of detail. These efforts should include a description of significant fish and wildlife resources of concern for "without" project conditions; an evaluation of the impacts of the alternatives considered for "with" project conditions; identification of potential fish and wildlife mitigation needs; cultural resource investigation needs; future environmental studies that may be needed in the Feasibility Phase; early consultation with appropriate State and Federal agencies; and identification of the type of environmental documents required for formal reporting of the final study results.

After a determination of the potential feasibility of a plan and the Federal interest in that plan has been made in the Reconnaissance Phase, the environmental study team members should be requested to evaluate the alternatives considered and the other environmental factors that may prove to be of importance in future studies. The timing of involvement of the environmental team members' activities in the Reconnaissance Phase should be determined on a study-by-study basis, depending upon the environmental resources involved and the type of solutions considered. However, the environmental activities should be initiated early enough and at the appropriate level of detail to prevent "overkill" in addressing a particular environmental concern or the possibility that a potentially significant environmental issue would be entirely overlooked at this stage in the planning process. The environmental team members' activities are important to assure that the negotiated Feasibility Phase study cost estimate includes all of the cost-shared study funds and schedule needed to complete the study. An incomplete budget and schedule could result in major problems and serve as a source of embarrassment if the Feasibility Cost Sharing Agreement (FCSA) had to be renegotiated. These problems should be prevented in large part by the progressive involvement, at an increasing level of detail, of environmental staff and outside agencies as the Reconnaissance Phase evolves.

Consultation with environmental agencies is important in the conduct of Reconnaissance Studies, not only to become aware of significant issues and concerns which must be addressed, but also in developing an adequate estimate of Feasibility Phase study costs. One obvious example involves the Fish and Wildlife Service. We are required by law to transfer funds to the Service to cover the costs of their coordination efforts. While the Corps provides the transfer funds in the Reconnaissance Phase, these costs will be shared with the local sponsors in the Feasibility Phase. For a particular study the amount of transfer funds negotiated can be significant. Therefore, it is important that we develop the socpe of anticipated Feasibility Phase fish and wildlife studies and their costs in consultation with the Service. Without such consultation we cannot reasonably expect the Service to live within the costs included in the FCSA if they had no involvement in developing this estimate. Failure to consult with the Service in developing the Scope of Studies could result in the need to renegotiate the FCSA with the local sponsor if the Fish and Wildlife Service's actual coordination costs exceed the cost increase ceiling specified in the FCSA. Similar examples of problems due to the lack of sufficient agency consultation in the Reconnaissance Phase could occur with endangered and threatened species coordination activities, cultural resource concerns, water quality issues, etc.

While the study manager is pivotal to the successful conduct of the Reconnaissance Phase study, it is important that the environmental team members exercise initiative in addressing the various environmental issues that will contribute to the success of the study efforts at this stage of the study. For example, if the potential need to mitigate for anticipated adverse impacts could materially influence the benefit-to-cost ratio of marginally feasible projects, the environmental team members must determine, at an appropriate level of detail, whether mitigation is warranted. This information will be of value in determining whether the study should proceed into the Feasibility Phase. The same applies for cultural resource considerations, endangered species concerns, etc. In other words, the environmental team members must know their job and aggressively undertake it with a sense of purpose, being responsible for coordinating their activities with Federal and State agencies interested in the study and conscientiously striving to meet established schedules within study estimates. The study manager is counting on all team members to perform their respective duties.

The above thoughts and needs on planning requirements are not new. Instead, they reflect "common sense" and the way we have normally approached study management and plan formulation all along. The difference now is that under cost-sharing more is at stake, both from a local financial perspective and the Corps' reputation as an effective and efficient organization. As Corps employees we are all stewards of that reputation. Just as the local sponsor is now a partner in the total study process, the environmental team members' role as participants in the study has also increased in significance.

ROADBLOCKS TO A FEASIBILITY STUDY

By Mary Ada Squires[1]

Introduction

Based on my personal experience with newly cost-shared reconnaissance studies, I have noticed several critical areas of conflict between the old way of doing business and the new way of achieving "customer care". My basic observation is that the Corps traditional objective of a reconnaissance study is in conflict with the needs of our new study sponsors. As a result of this conflict, it may be difficult to receive sponsor support for a feasibility study.

Corps Objective of a Reconnaissance Study

Basically the Corps objective of a reconnaissance study is to determine if there is a potential for a feasible project; i.e., a viable project with a positive NED benefit-to-cost ratio. With this goal in mind, a very short 1-year time frame is allocated to conduct the study.

In my mind, this short time frame is established because 1) most flood control projects, nationwide, are small in scope, 2) the intent of the reconnaissance study is simply to determine if there is a potential for further Federal involvement, 3) a 1-year study is a convenient time frame from a budgetary standpoint, and 4) this abbreviated study effort assures that there is not enough time allowed for detailed studies that should be cost-shared.

Potential Conflicts With the Corps Objectives

Need to Develop Good Definition of Flooding Problems. In order to provide a good assessment of the flooding problems and to properly identify alternative flood control solutions to these problems, it is imperative that the hydrology and flood plain delineation be of high quality with only a small likelihood of significant change. With a good hydrologic foundation, benefits and costs can be estimated to an acceptably accurate degree by quantifying the major, readily identifiable components of the benefit and cost calculations. With this kind of analysis the problems and potential solutions can be identified. However, for any study that is complex and/or large in scope, a 1-year time frame does not allow enough time to adequately develop the hydrologic data to the degree of accuracy necessary to make a decision on the potential for an implementable project.

Need to Allow Opportunity for Appropriate Formulation. It is important during the reconnaissance study to determine the effectiveness of solving the flooding problem with the potentially feasible measures that have been identified. It is equally important to identify the specific locations and magnitudes of these measures in order to determine possible adverse impacts and assess the potential for the measure to be acceptable from an

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environmental, social, and financial standpoint. This type of formulation is very difficult to accomplish within the required 1-year time frame unless the study is simple or small in scale.

Potential Conflicts With Sponsor Objectives

The Sponsor views the results of the reconnaissance analysis as a decision document for financial involvement in study cost-sharing as well as construction cost-sharing. What the Sponsor needs is a document that enables him to assess his regional benefits, which are evaluated from the local perception of costs vs. revenues. On the basis of the Corps preliminary reconnaissance study, the Sponsor either decides that the submitted formulation is unsuitable because the Federal benefit-to-cost ratio or regional cost-revenue return appear to be too close to unity to risk financial involvement or he is willing to risk study cost-sharing with the anticipation that the study will lead to a constructed project. The preliminary nature of a quick reconnaissance study in a complex or large basin does not provide the quality of data necessary to make this type of final "go" or "no-go" commitment. Consequently, the risk is great that the inaccurate results will lead to the wrong conclusions and good projects may be discarded while poor projects may be carried on through feasibility studies.

Ways to Resolve Potential Conflicts

I believe that the reconnaissance study should provide the basis for determining a narrow range of acceptable alternatives that have been assessed to a fairly high degree of accuracy, say 90%. This will provide the credibility required of the Corps when seeking financial commitment from non-Federal sources. This type of fairly high quality reconnaissance analysis would also safeguard future Federal investments in a study and assure that the initial Federal reconnaissance study investment was wisely spent. A highly productive initial decision document could be accomplished in one of two ways.

1) Allow an additional 6 to 9 months of study to adequately assess a large and/or complex basin or

2) Forget the reconnaissance study. Instead, conduct a feasibility study cost-shared with 25% in-kind services from the local sponsor. Then, if there is a potential for a favorable project from the Federal and local perspective, proceed to Congressional authorization and a 50-50 cost shared Preconstruction Engineering and Design Analysis. This would expedite the planning process and provide an efficient and effective construction decision.

PLAN FORMULATION, RECONNAISSANCE PHASE - A TECHNIQUE TO AUGMENT THE IDENTIFICATION OF POTENTIALLY VIABLE PLANS

by Robert D. Brown[1]

Purpose

All disciplines working the planning process are aware of the challenges -- too little time, too little information, too much work, and too high of a public expectation for favorable findings. This paper deals only with one, information for effective plan formulation. It presents a technique for augmenting the task of identifying viable alternative plans.

Case History

A case history for a recently completed formulation study for local flood protection within the Tulsa District is discussed which resulted in the need for and the value of the technique. The study was the Caney River Basin, Oklahoma. A map of the basin is shown at Figure 1. Funded in May 1987, and completed in May 1988, it posed all the challenges -- emotional public interest, intense political interest, and technical complexity. The intense public interest resulted from the great flood of the fall 1986. Bartlesville, Oklahoma, a community within the basin, experienced record flood damages of over $65 million. Congress included funding in the appropriations for Fiscal Year 1988 to complete the reconnaissance phase planning effort.

Formulation

The study team was formed early, interacted effectively, and completed the planning process in an exceptional manner. During review of the early findings, the technique was developed for effectively identifying solutions to the flood problem that may have otherwise gone undetected.

During the final month prior to the study completion, the study team and functional managers reviewed typical data from early project formulation. That data included stage-frequency curves, stage-damage relationships, cost estimates, benefit estimates, and the resulting economics for various plans. Each of the plans identified and concurred in by the local sponsor

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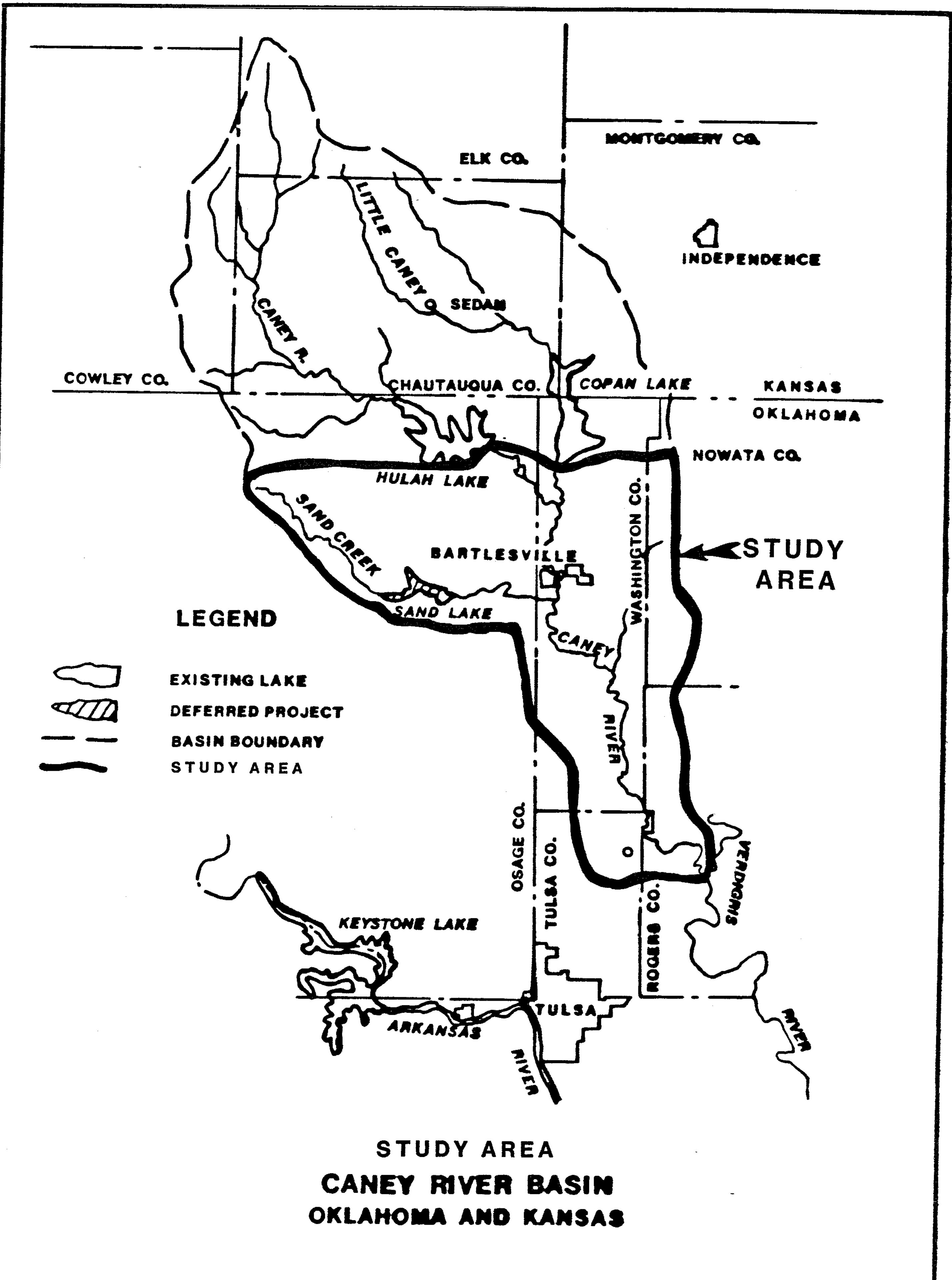

PANEL 2

Figure 1 Study Area

included "macro" level solutions to eliminate or reduce the flood threat to Bartlesville. Each of the large scale plans afforded protection to the entire city or a large segment thereof. One of the plans, a levee plan to provide protection up to the 250-year flood event, is shown at Figure 2. None of the "macro" plans were determined to be economically viable. As a result of the initial review, it became apparent that "micro" plans offering substantial flood protection to only highly developed portions of the city might be worthy of further consideration and would stand alone as a project. Within the remaining days of the study effort, a damage intensity-frequency map was developed to augment the identification of the "micro" plans.

Damage Intensity-Frequency Map Technique

The map was multi-colored to ease the identification of small scale plans to protect only high damage areas. Figure 3 shows the map developed for that purpose. Study reaches were delineated and the damage intensity-frequency zones for natural conditions were displayed over the city map by different colors. As illustrated by the 0-10 year damage intensity-frequency zone, high damage areas are displayed by the darker shade of the color depicting that damage zone. Lighter shading of the color within the zone depicts areas of lesser damages. The value of damages within each colored zone is also shown.

With the major damage zones highlighted by the damage intensity-frequency map, the study team readily identified "micro" plans for those areas that may have not been identified in the absence of such information. Figure 4 shows a "micro" plan developed during the end of the planning process. Several "micro" plans studied warranted further consideration. Benefit-to-cost ratios of all "micro" plans ranged from 0.1:1 to 3:1. From this technique, local interests were afforded a better product from the planning processs without a substantial expenditure of additional funds and time to provide that information.

Lessons Learned

1. Early formulation data should be available for initial review before two-thirds of the study schedule for completion of the draft report has elapsed. If early plans are found to not be viable, the remaining time is exceedingly valuable to search for any remaining viable option for Federal participation.

2. Although the pressing timetable challenges all planning teams to complete the formulation of only those plans identified

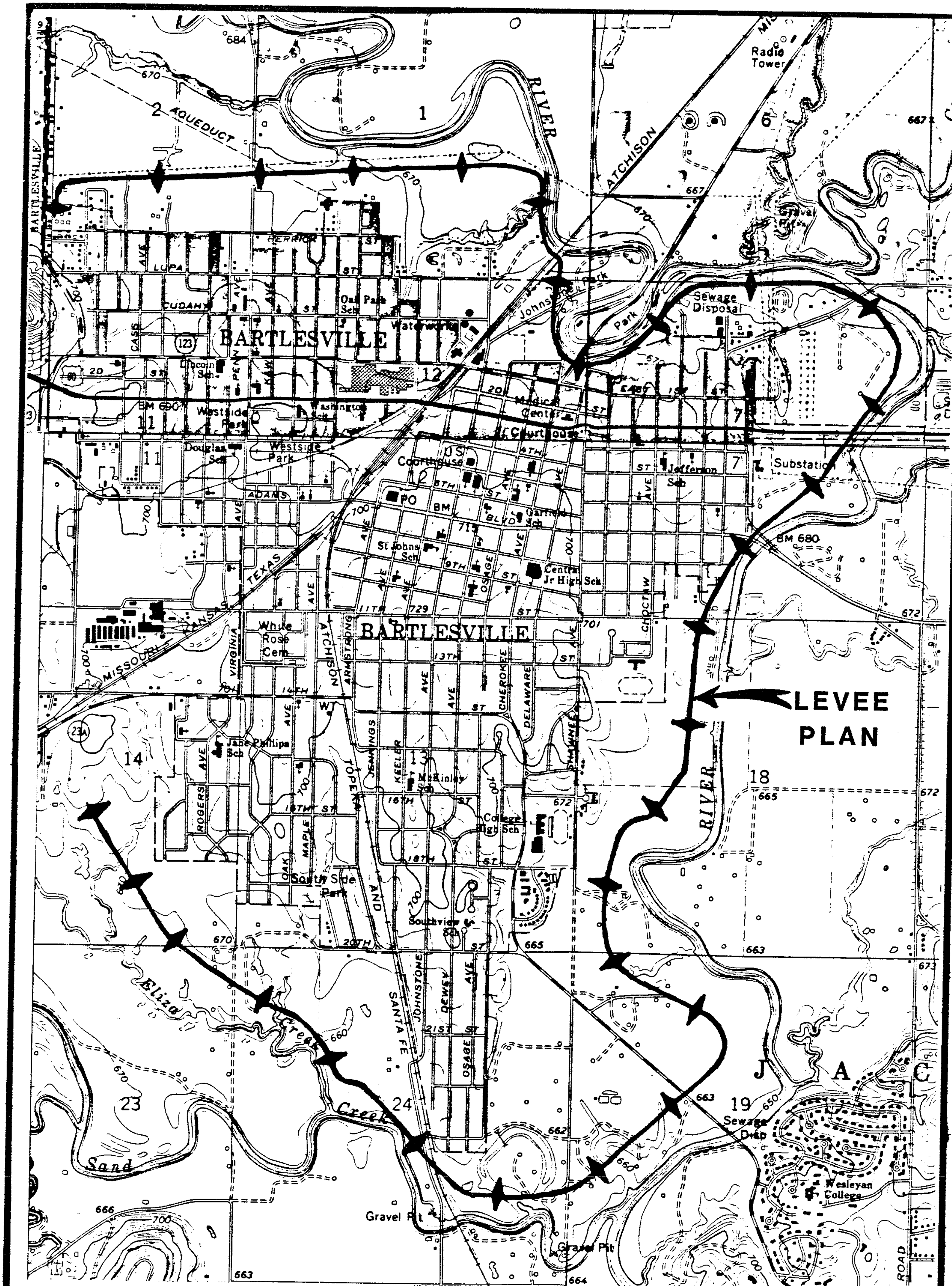

Figure 2 250-Year Levee Plan

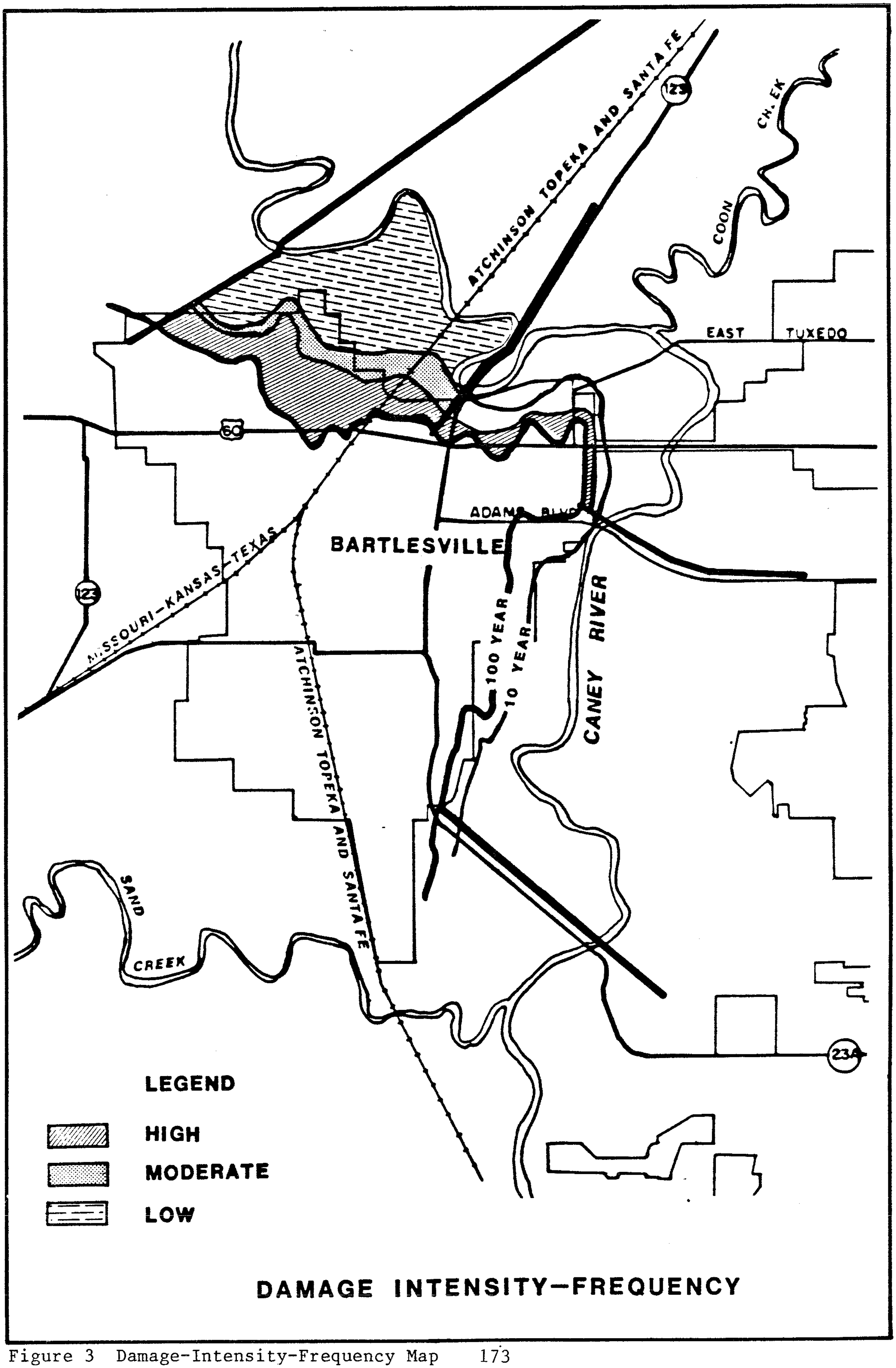

Figure 3 Damage-Intensity-Frequency Map

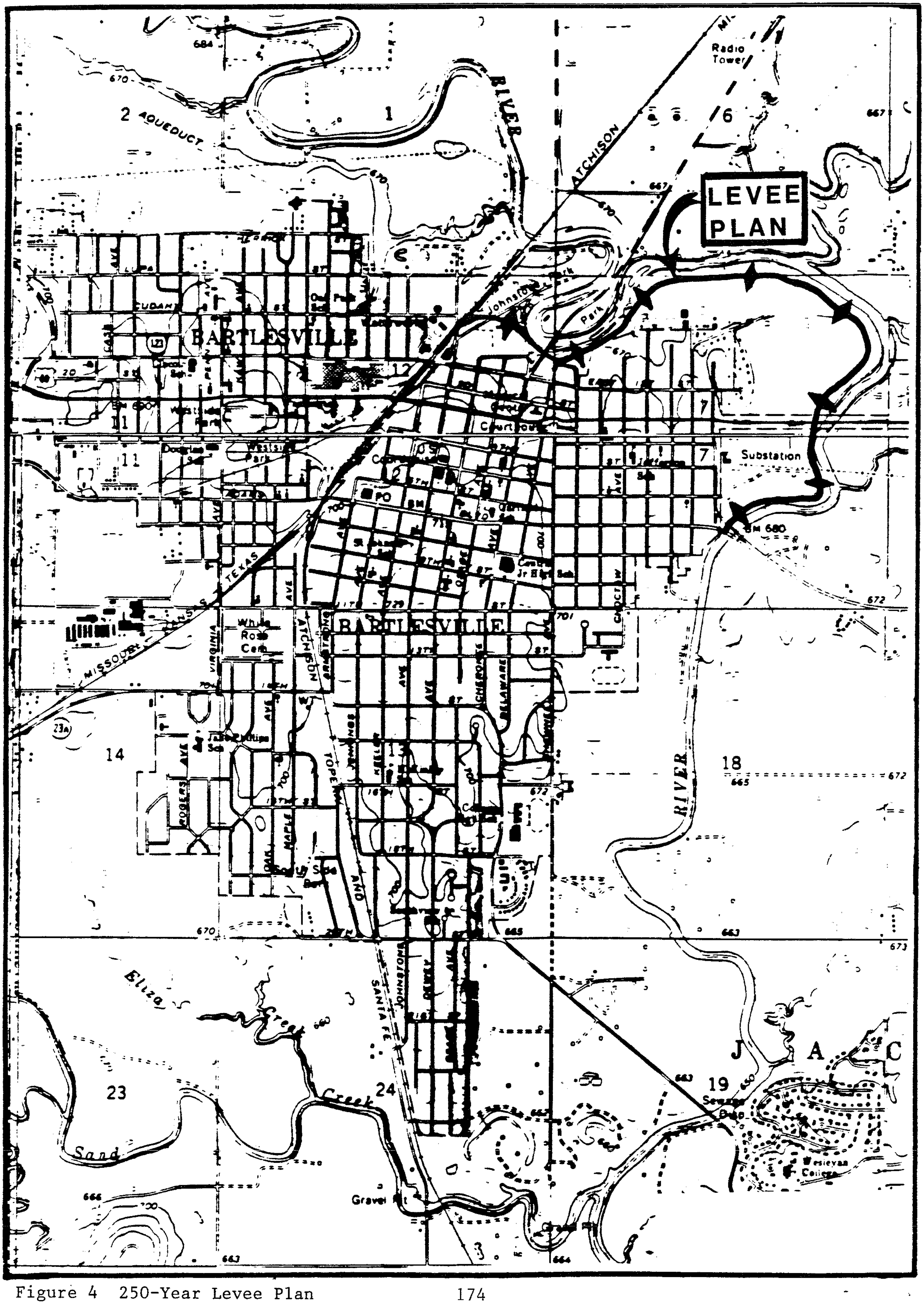

Figure 4 250-Year Levee Plan

early in the study, "micro" level plans may be viable and can be quickly detected with graphic information such as the damage intensity-frequency map developed from the early analyses.

3. Cost and benefit data developed for large scale plans can be disaggregated to promptly complete preliminary estimates for the smaller segments of those plans.

4. "Macro" and "micro" solutions to urban flood problems should be formulated if all practicable plans are to be identified in search of a viable reconnaissance-level plan for U.S. Army Corps of Engineers participation.

NOTE: The efforts of Mrs. Lisa Lawson, Regional Economist; Mr. Marc Masnor, Civil Engineer; Mr. Curtis Gawf, Civil Engineering Technician; and Mrs. Penni Fritz, Secretary; Planning Division, are gratefully acknowledged.

Synopsis by Panelist Phillip Frank Dunn on policy review and approval of reconnaissance studies for flood damage reduction.

I-88 Impacts.

(1) Concept of "field reporting officers" is fading because of vertical integration of management and review.

(2) Reporting requirements of I-88 for reconnaissance studies will increase Office of Assistant Secretary of Army involvement.

(3) District planning staff can be isolated from local sponsors by independent project managers.

(4) Independent project management is going to be very expensive. It is conceivable that more than 25 percent of the reconnaissance study cost will be diverted to activities of the independent project manager.

5. The "roll over" of management from the planning manager to the IPM may have hidden cost and time requirements. An independent project manager must be fully integrated into the study process prior to initiating negotiation with executive committee.

Reconnaissance Study Experience.

(1) It is still an open question as to whether a reconnaissance study provides sufficient information to provide a firm decision on the probability of favorable output from a feasibility study. Experience to date indicates that the best guess of an experience planners provides as good of a prediction on the outcome of feasibility study as does the information developed in the reconnaissance study.

(2) The reconnaissance studies to date have not greatly reduced the probability of proceeding with non-productive studies. Spending two years on a reconnaissance study for a three-year study is not warranted. It appears that reconnaissance study funds and time could be better used in preparing the feasibility study.

(3) Experience is showing that very little of the information generate for the reconnnaissance report is useful in feasibility studies.

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SUBJECT: Reconnaissance Phase Studies Seminar

1. Performance of reconnaissance phase investigations for flood loss reduction feasibility studies is an important step in the project development process. Policy and legislation establish the purpose of these studies and the general manner in which they are to be conducted. We are accumulating experience that is helpful in defining the specific details that are essential to successful studies. To accelerate capturing and disseminating our collective experience, a seminar was convened this past August that addressed issues relevant to the performance and management of these studies.

2. Key study management and technical issues associated with the conduct of reconnaissance phase studies were addressed. Objectives of the seminar were: 1) identify approaches for study conduct; 2) discuss scope and reliability requirements for technical analysis; and 3) determine specific guidance and assistance needs for district offices. Participants included representatives from HQUSACE, district and division offices, the Hydrologic Engineering Center, (HEC) and a local sponsor. Chiefs of planning from two divisions and a district also attended. Participants prepared papers and discussion summaries which are reproduced in the enclosed seminar proceedings. Additional copies of the proceedings may be obtained from HEC.

3. The proceedings are intended to increase the usefulness of existing guidance by providing insights from the experiences of study managers and study participants. Presently, we have no plans to develop additional guidance concerning the development and level of detail of a reconnaissance report. There was, however, a consensus of the seminar participants of what tasks should be accomplished in an "ideal" reconnaissance phase study. A summary of the key items of that consensus is attached. I must emphasize that these guidelines are for your information and use where applicable. We recognize that individual characteristics of each study area will dictate the conduct and level of detail for that specific reconnaissance study.

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CECW-PD
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4. I encourage you and your staff to read the seminar proceedings and reflect on the issues raised and discussed. I welcome your comments on the seminar proceedings and summary guidelines.

FOR THE DIRECTOR:

Encl

Dan M. Mauldin
DAN M. MAULDIN
Chief, Planning Division
Directorate of Civil Works

Enclosure: Seminar Proceedings
Attachment: Summary Guidance

Planning Division, HQUSACE
October 15, 1988

Guidelines for "Ideal"
Flood Control Reconnaissance Phase Study

The reconnaissance phase study develops and documents the information for a decision to proceed with feasibility phase investigations. It also forms the basis for negotiating the feasibility study cost sharing agreement (FSCA). The objectives of the study are to:

a) identify the flood problem;

b) determine whether it is likely that upon further study a feasible solution to the problem will result;

c) determine whether there is federal interest in the likely solution;

d) identify a local cost-sharing sponsor, and;

e) should the findings be positive, determine the scope of and define the tasks for completing the feasibility phase investigations.

The ideal reconnaissance phase study should:

1. Ideally, it is desirable to develop the complete hydrologic engineering and flood damage analysis for the existing without project condition in the detail needed for a feasibility phase study. Early, accurate and complete specification of the existing without project condition is the essential ingredient of the reconnaissance phase of a study. The reason is that problem definition, flood damages, flood hazards, and several other important items would be known early in the project development process, facilitating negotiations with the non-federal sponsor, and plan formulation and evaluation. While the degree of detail for all study aspects is important, project feasibility is highly sensitive to hydrologic and economic analysis. There can be a great difference in results from the use of general rather than specific hydrology. This ideal will be possible in some situations. However, the lack of available data, the complexity of the study area, and limited time may dictate that a less detailed analysis be performed.

2. Formulate a range of alternatives that would be reasonable to implement and represent different kinds of solutions to the problem. These alternatives should be formulated in sufficient detail to provide a basis for accurately estimating the cost of the feasibility phase studies. In addition to achieving the objectives listed above, the intent of formulating different kinds of alternatives is to ensure that a range of solution options is considered and that the alternatives are reasonable and implementable. Those found to be attractive will form the basis for the detailed Scope of Study that will be prepared and negotiated with the local sponsor. Studying variations of a single alternative or plan is not necessary or desirable. Identification of the NED plan will occur during the feasibility phase studies.

3. Screen the range of alternatives to a few meaningful and reasonable choices. The screening process enables elimination of obviously inferior alternatives that will not be considered in subsequent feasibility phase studies. The screening may be performed using judgment and application of approximate benefit/cost analysis.

4. Perform a first-cut benefit-cost analysis for the alternatives that have reasonable likelihood of warranting more detailed study during the feasibility phase. The benefit analysis will be based on the existing without project hydrologic engineering and flood damage information as discussed in paragraph 1. above. The existing with project conditions are evaluated to the detail required to determine whether a feasible plan with federal interest will likely result from further study. Cost analysis for the screened alternatives will conform to guidelines contained in other regulations.

5. Prepare detailed SOS to complete the feasibility phase studies for the alternatives remaining after screening and first-cut benefit-cost analysis. The SOS will be detailed to the specific task level. This should be similar in scope and form to the detail that would comprise a scope of work for a procurement action for the investigation.